Escalating Deteriorating Patients' Care in the Emergency Department: Characteristics and Safety Culture

Submitted by

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Abstract

Title: Escalating Deteriorating Patients' Care in the Emergency Department: Characteristics and Safety Culture

Background: Physiological deterioration in patients is often indicated by clinical features such as abnormal vital signs and declining conscious state. Rapid Response Systems (RRS) have evolved to help recognise and stabilise patients experiencing clinical instability in general acute medical and surgical wards. More recently, there has been an increasing uptake of emergency department (ED) specific responses to patient deterioration. The prevalence of deterioration and the effectiveness of ward based RRS are well documented in the 'Failure to Rescue' (FTR) literature. However, the characteristics affecting FTR in ED specific RRS are largely unknown.

Aim: The aims of the research were to describe the relationships between dynamic ED characteristics (workload, skillmix and casemix), organisational culture (safety climate) and the care of the deteriorating ED patient.

Methods: The study method was a mixed methods explanatory sequential design comprising a safety climate survey, retrospective medical record review and semi-structured staff interviews designed to explore the escalation of care practices of ED doctors and nurses.

Results: As a measure of the magnitude of the risk to ED patient safety, fourteen-day period prevalence of ED patients exhibiting first episode signs of physiological deterioration was 10.8% and the FTR rate of patients requiring escalation was 47.3%. Failure to rescue was not significantly impacted by fluctuations in workload, staffing levels/skillmix or ED patient casemix.

Failure to rescue deteriorating ED patients was significantly impacted by the experience and expertise of the person documenting signs of deterioration, the ED area in which the patient is being cared for, and the patient's vital sign which indicated physiological deterioration. Failure to rescue was also influenced by i) the safety culture within the ED, ii) staff self-confidence and confidence in others, iii) communication and team interaction, iv) the interpretation and implementation of care based on the health services and national performance indicators, and v) the education which is provided to support ED staff efforts to recognise and manage deteriorating patients.

Conclusion: This study provides key recommendations for emergency practice and research priorities to improve recognition and management of deteriorating ED patients. Firstly, there is a need for site specific cultural evaluation and change. There are also valuable insights to be learned from the intrinsic strengths and behaviours, characteristic of the ED team's expertise and experience. It is also recommended that current educational strategies are modified to incorporate regular interprofessional in situ simulation based on patient ED specific deterioration scenarios. This should include expert evaluation and feedback about the team's technical and non-technical performance. Finally, there is a need to investigate an ED specific approach to recognising and responding to patient deterioration. This should include an evaluation of, and recommendations for the roles and responsibilities of ED response teams, and an ED specific track and trigger system befitting the diversity and complexity of emergency care.

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signature:

Print Name: Clifford Connell

Date: April 6, 2019

Publications during enrolment

Connell, C. J., Endacott, R., Jackman, J. A., Kiprillis, N. R., Sparkes, L. M., & Cooper, S. J. (2016). The effectiveness of education in the recognition and management of deteriorating patients: A systematic review. Nurse Education Today, 44, 133-145. doi:10.1016/j.nedt.2016.06.001

Thesis including published works declaration

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes one original paper published in peer reviewed journals. The core theme of the thesis is to describe the relationships between dynamic emergency department characteristics (workload, skillmix and casemix), organisational culture (safety climate) and the care of the deteriorating ED patient. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the student, working within the Monash Nursing and Midwifery under the supervision of Professor Ruth Endacott (Monash University) and Professor Simon Cooper (Federation University).

The inclusion of co-authors reflects the fact that the work came from active collaboration between researchers and acknowledges input into team-based research.

In the case of Chapter Two my contribution to the work involved the following:

Thesis Chapter	Publication Title	Status	Nature and % of student contribution	Co-author name(s) Nature and % of Co-author's contribution*	Co-author(s), Monash student Y/N*
2	The effectiveness of education in the recognition and management of deteriorating patients: A systematic review.	Published	79%. Concept and collecting/analysing data and writing first draft	1) Endacott, R. input into manuscript 5% 2) Jackman, J. Data analysis 2% 3) Kiprillis, N. R. Data analysis 2% 4) Sparkes, L. M. Data analysis 2% 5) Simon Cooper, Data analysis, input into manuscript 10%	No No No No No

I have not renumbered sections of published papers in order to generate a consistent presentation within the thesis.

Student signature: **Date:** April 6, 2019

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the student's and co-authors' contributions to this work. In instances where I am not the responsible author, I have consulted with the responsible author to agree on the respective contributions of the authors.

Main Supervisor signature: **Date:** April 6, 2019

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There is no way to appropriately express the extent of the gratitude I feel towards my wife Emma and two sons, James and Thomas. The support that Emma has provided throughout this journey has known no bounds. Her love and understanding, infinite patience, depth of wisdom and genuine belief in me has made possible what had once seemed impossible. I have no doubt that James and Tom have been challenged by the time and effort I have invested in this project, but there have been very few indications that this has been the case. Rather, the support and understanding that these remarkable young men have shown is far greater than I could ever have wished.

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I would also like to thank the wonderfully supportive people at the study site who created such a frictionless experience while I was collecting data. Finally, I am immensely grateful to the participants who so generously gave their time and insights to making this study possible.

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List of Abbreviations

ATS	Australian Triage Scale
AWTTS	Aggregated Weighted Track and Trigger Systems
CCOT	Critical Care Outreach Teams
CIC	Consultant in charge (of shift) (pleural – CICs)
CNS	Clinical Nurse Specialist
ED	Emergency Department
EDMAC	Emergency Department Mandatory Alert Criteria
EMR	Electronic Medical Record
ES	Early Signs of physiological deterioration
EWS	Early Warning Score
FTR	Failure to Rescue
GCS	Glasgow Coma Scale
GLMM	Generalised Linear Mixed Model
GYP	Graduate Year Program
HR	Heart Rate
HREC	Human Research Ethics Committee
ICPS	International Classification for Patient Safety
ICU	Intensive Care Unit
LES	Liverpool Equivalent Sign
LS	Late Signs of physiological deterioration
MET	Medical Emergency Team
MEWS	Modified Early Warning Score
MMR	Mixed Methods Research
MPTTS	Multiparameter Track and Trigger System
MRR	Medical Record Review
NEAT	National Emergency Access Target
NEWS	National Early Warning Score
NIC	Nurse in charge (of shift) (pleural – NICs)
ORC	Observation and Response Charts
PART	Pre-Arrest Response Teams
PICF	Participant information and Consent Form
RR	Respiratory Rate
RRS	Rapid Response System
RRT	Rapid Response Team
SAE	Severe Adverse Event
SAQ	Safety Attitudes Questionnaire
SBP	Systolic Blood Pressure
SCS	Sudden Cardiac Arrest
SCS	Safety Climate Survey
SSA	Site-Specific Assessment
SpO2	Peripheral Oxygen Saturation
SPTTS	Single Parameter Track and Trigger System
SSU	Short Stay Unit
TSP	Transition to Specialty Practice
TTS	Track and Trigger System
UK	United Kingdom
USA	United States of America
VICTOR	Victorian Children's Tool for Observation and Response

Glossary

Registered Nurse

A Registered Nurse is a person registered by the Australian Health Practitioner Regulation Agency and the Nursing and Midwifery Board of Australia. The Nursing and Midwifery Board of Australia describe the role of a registered nurse as follows:

> "*Registered nurse (RN) practice is person-centred and evidence-based with preventative, curative, formative, supportive, restorative and palliative elements. RNs work in therapeutic and professional relationships with individuals, as well as with families, groups and communities. These people may be healthy and with a range of abilities, or have health issues related to physical or mental illness and/or health challenges. These challenges may be posed by physical, psychiatric, developmental and/or intellectual disabilities*." (NMBA, 2016)

Emergency Clinical Nurse Educator

An Emergency Clinical Nurse Educator is a registered nurse with critical care and educational expertise which is specific to emergency department nursing care.

Clinical Nurse Specialist

A Clinical Nurse Specialist is a registered nurse with postgraduate university qualifications in emergency critical care who has completed a minimum of twelve months emergency nursing experience following their postgraduate qualification and do not require supervision to act as in-charge of an emergency department. The role is awarded following a successful application process and an interview which includes assessments of professional and clinical expertise.

Healthcare Service

A healthcare service is an Australian organisation which provides primary, secondary or tertiary health care to the public.

Emergency Consultant Physician (Fellow of the Australian College of Emergency Medicine)

An Emergency Consultant Physician is a medical doctor registered by the Australian Health Practitioner Regulation Agency who has successfully completed a programmatically designed five-year (min.) specialist training course in emergency medical care. Upon completion of their training, physicians are eligible to apply for fellowship to the college.

Australian Triage Scale

The Australian Triage Scale is a system for categorising the urgency with which a patient presenting for care to an Australian emergency department needs to be seen. The scale comprises five categories from 1 to 5, category 1 being an immediately life-threatening condition that requires immediate assessment and treatment by a doctor, and category 5 being a chronic or minor condition where assessment and treatment can wait for up to two hours.

Chapter 1. Introduction and Background

1.1. Introduction

The delivery of safe and effective quality healthcare is a complex and challenging global obligation. Safe and effective quality healthcare is measured largely by the frequency and degree of harm we cause our patients, the consistency with which we deliver appropriate care, and how well we learn from our mistakes to create a strong patient safety culture (Winters, Pronovost, Miller, & Hunt, 2011). Unfortunately, there are significant gaps between the recommended and standards for care and the care that can be delivered. One area of safety and quality that has received much attention in recent decades is the recognition and management of patients whose condition deteriorates whilst in hospital.

The landmark SOCCER study demonstrated that there is a high prevalence of documented derangement in physiological variables (vital signs) found in patients on acute medical and surgical hospital wards (Harrison, Jacques, Kilborn, & McLaws, 2005; Harrison, Jacques, McLaws, & Kilborn, 2006; Jacques, Harrison, McLaws, & Kilborn, 2006). These early and progressive late physiological signs of deterioration are associated with serious adverse events (SAEs) such as cardiac arrest, severe respiratory problems and unexpected transfer to a critical care areas and death, (Jacques et al., 2006). There is also overwhelming evidence that survival to discharge from in-hospital cardiac arrest is poor (16-24%) (Benjamin et al., 2017; Ebell & Afonso, 2011; Larkin, Copes, Nathanson, & Kaye, 2010; Nolan et al., 2014). Clinical signs, including abnormal vital signs, often indicate physiological deterioration in the hours prior to cardiac arrest (Buist, Bernard, Nguyen, Moore, & Anderson, 2004; DeVita et al., 2010; Franklin & Mathew, 1994; Harrison et al., 2005; Hillman et al., 2002; Jacques et al., 2006; Kause et al., 2004; McQuillan et al., 1998; Sax & Charlson, 1987) and up to 8 hours prior to intensive care admission (Hillman et al., 2002; McQuillan et al., 1998; Winters et al., 2007).

Rapid Response Systems (RSS) have evolved to provide systemic support for frontline healthcare workers to provide a safer environment for the deteriorating hospital in-patient (Herod, Frost, Parr, Hillman, & Aneman, 2014). The uptake of these same systems in the emergency department (ED) has not been as proliferative (Considine, Lucas, & Wunderlich, 2012), and while ED specific RSS are beginning to gain traction, the efficacy of these modified systems is not yet clear.

This research sought to describe the prevalence of physiological deterioration in the ED and answer the question: Are organisational climate and structure associated with the recognition and management of patient deterioration by health care professionals in an emergency department? The question was addressed in a two phase, explanatory mixed methods design. It is expected that the results and conclusions of the research will provide evidence to inform policy design, clinical governance and practice development related to patient safety in the emergency department.

This chapter provides the background to the study, as well as the aims, objectives, scope and significance of the research. Section 1.3 describes the conceptual and theoretical frameworks used to frame the discussion of patient safety throughout the thesis.

1.2. Background

1.2.1. Quality Healthcare and Patient Safety

There is evidence that up to 58% of the care provided to patients in the last 15 years has not been in keeping with evidence-based or consensus-based guidelines (Hunt et al., 2012; Mangione-Smith et al., 2007; McGlynn et al., 2003; Runciman et al., 2012). The quality of safe and effective healthcare is often measured by the prevalence of serious adverse events (SAE). Unintended serious adverse events, in healthcare, are injuries, complications or self-reported concerns by a patient resulting in prolonged hospital stay, transfer to a higher acuity area (e.g. intensive care unit), disability or death considered to be caused by medical management rather than the patient's underlying pathophysiology (Harrison et al., 2005). Based on studies from the USA, Canada, United Kingdom, Australia and New Zealand, one in ten hospital in-patients will suffer an SAE. Of the patients who suffer an in-hospital SAE, 19.1% will sustain a temporary disability, 7.0% a permanent disability and 7.4% will die (de Vries, Ramrattan, Smorenburg, Gouma, & Boermeester, 2008). Approximately 50% of all SAEs are considered to be preventable (Baker, Norton, Flintoft, Blais, & et al., 2004; de Vries et al., 2008; Zegers et al., 2009) and 4.1% of preventable SAEs have contributed to in-hospital patient deaths (Zegers et al., 2009). Chen and colleagues have described how the implementation of RRS has an inverse relationship with the incidence of SAEs (Chen, Bellomo, Flabouris, Hillman, & Finfer, 2009). That is, an increase in the proportion of early emergency team calls reduces SAEs in hospital patients.

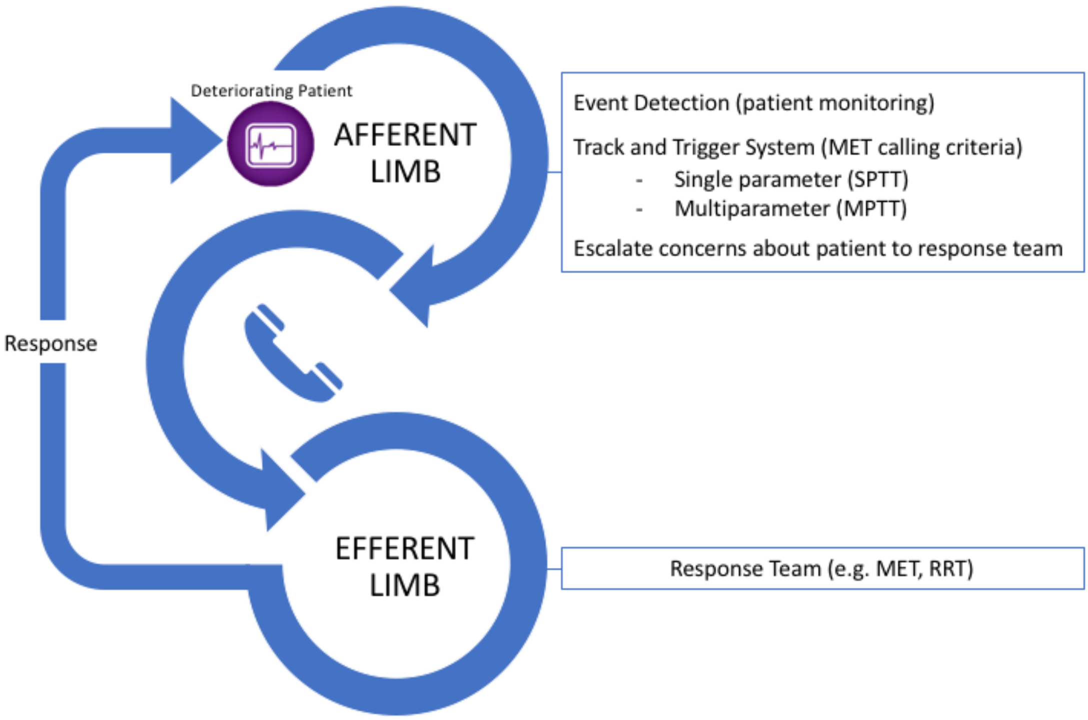
1.2.2. Rapid Response Systems

Survival to discharge from in-hospital cardiac arrest is poor (16-20%) (Benjamin et al., 2017; Ebell & Afonso, 2011; Larkin et al., 2010; Nolan et al., 2014; Peberdy et al., 2003; Sandroni, Nolan, Cavallaro, & Antonelli, 2007). Clinical features, including abnormal vital signs, often indicate patient deterioration in the hours prior to cardiac arrest (Buist et al., 2004; DeVita et al., 2010; Franklin & Mathew, 1994; Harrison et al., 2005; Hillman et al., 2002; Jacques et al., 2006; Kause et al., 2004; McQuillan et al., 1998; Sax & Charlson, 1987). These same indicators also precede serious adverse events and unscheduled intensive care unit (ICU) admissions (Hillman et al., 2002; McQuillan et al., 1998; Winters et al., 2007) with up to 60% of patients who require unscheduled ICU admission exhibiting documented life threatening observations in the eight hours preceding admission (Hillman et al., 2002).

For more than two decades RRS have evolved to assist health care workers in their attempts to recognise, stabilise and prevent patient clinical deterioration and SAEs (Winters & DeVita, 2011). Rapid response systems have become conventional safety strategies used in most Australian, British and North American hospitals (Winters & DeVita, 2017). And while the implementation of these systems has been adapted to various health care settings and specialty areas (e.g. obstetrics), they continue to rely on an established structure and feature set (Maharaj, Raffaele, & Wendon, 2015).

Rapid response systems comprise of clinical policies, procedures and tools that equip frontline health care workers with a coordinated hospital wide process for responding to patients with signs of physiological deterioration. The systems are made up of two essential structural components, or limbs, which provide an overt set of guiding principles, communication processes, team roles and responsibilities for rescuing deteriorating patients – the afferent limb and the efferent limb (see figure 1.1). In the afferent limb, ward doctors and nurses are provided with a set of physiological criteria and directives for reporting and escalating the care of patients with abnormal vital signs to a clinician or team of clinicians who can provide advanced care and expert consultation (Soar et al., 2015). At a minimum, the criteria for escalating care often include assessment findings of the patient's pulse rate, respiratory rate, systolic blood pressure, oxygen saturation, conscious state or concern about the patient (Kellett, 2017). However calling criteria may also include other patient data such as decline in urine output, arterial blood gas data, haematology and biochemistry data, pain, seizure activity and concern for the patient reported by health care workers or patient family (Green et al., 2018; Harrison et al., 2005; Kipnis et al., 2016; Mitchell et al., 2010; Moon, Cosgrove, Lea, Fairs, & Cressey, 2011; Smith, Prytherch, Schmidt, Featherstone, & Higgins, 2008). When used by ward doctors and nurses, these criteria and directives form the tracking and triggering component of the RRS structure and are commonly referred to as the afferent limb of an RRS (Devita, Bellomo, Hillman, Kellum, Rotondi, Teres, Auerbach, Chen, Duncan, Kenward, et al., 2006). The responding clinician/s, to whom the patient's care has been escalated, form the efferent limb of the RSS and are commonly referred to as Rapid Response Teams (RRT) (Cretikos et al., 2006). These teams have varying membership dependent upon the health services' resources and availability of specialty care units such as Intensive Care Units (ICUs).

Figure 1.1 Rapid Response System Structure



Rapid Response Systems are complex large-scale safety strategies which require a hospital, or health service, wide cultural commitment to rescuing deteriorating patients. This commitment includes the provision of a robust organisational framework, governance process and mechanism for evaluation and improvement (Edelson & Bellomo, 2011). Since their inception in the early 1990s, RRS have been the subject of rigorous research to examine the effectiveness of their structure, afferent and efferent limbs, alerting criteria and their benefits to the safety of deteriorating patients (Maharaj et al., 2015). There are, however, many facets of these patient safety systems that require further research if we are to remain confident in our resolve to ensure the provision of a high quality, evidence-based safety net for patients in physiological decline.

1.2.3. Track and Trigger Systems

The afferent arm of an RRS requires a set of tools and processes that support frontline doctors and nurses to monitor (track) their patients' condition for signs of clinical instability and agreed physiological parameters which triggers the activation of the systems escalation and response process. These 'track and trigger' systems (TTS) comprise of two parts, the event detection component and the process for escalating care (see figure 1.1). First described in the late 1990s, early warning scores (EWS) based on an aggregate weighted scoring of patient vital signs provided a valuable numeric tool which supported clinicians in their decision to call for help (Morgan, Williams, & Wright, 1997). Early warning systems have since been the subject of research designed to evaluate the feasibility of using them in clinical practice (Alam et al., 2014), and their sensitivity to detect clinical instability, as well as their capacity to predict cardiac arrest, unanticipated ICU admission and death (Smith, Prytherch, Meredith, Schmidt, & Featherstone, 2013). There are two main types of track and trigger systems; multiparameter track and trigger systems (MPTTS) using aggregated scores from different physiological data, and single parameter track and trigger system (SPTTS) which rely on upon a single point of data (i.e. a single deleterious vital sign) as their triggering value (e.g. medical emergency team (MET) calling criteria (Buist et al., 2004)).

Aggregated weighted track and trigger systems (AWTTS) are the most common MPTTS and are based on the earlier work by Morgan et al., and while both AWTTs and SPTTs generally align with principles of 'tracking' (monitoring the patient's condition) and 'triggering' (identifying the point at which the patient's condition requires intervention), uptake of both types of TTS (see figure 1.1) is varied across the world. For example, the National Early Warning Score (NEWS) is an AWTT which has powerful predictive value for discriminating cardiac arrest, unanticipated ICU admission or death within 24-hours of reaching a physiological score that indicates the patient is deteriorating and is recommended for use across the UK. Smith et al. found the NEWS had greater discriminatory value for these SAE than 33 other AWTTS identified in clinical practice use at the time of their study. Despite their ability to predict the likelihood of SAE, manual pen and paper based AWTTs such as NEWS require some minor calculations which can be prone to user error up to 29% of the time (Prytherch et al., 2006). However, electronic track and trigger systems using aggregated scores from different databases (e.g. vital signs and biochemistry results) can automatically generate a triggering early warning score without the need for any manual calculations (Green et al., 2018; Kipnis et al., 2016).

On the other hand, RRS using single parameter MET calling criteria are used in many Australian, Canadian and European countries (Smith et al., 2008) and may be easier to use in clinical practice while also less prone to error than manual AWTTs (Prytherch et al., 2006). However, the sensitivity and specificity of SPTTS varies widely and these outcomes are often not published (Smith et al., 2008). Single parameter track and trigger systems, such as MET calling criteria have also been shown to have up to a 15% higher triggering rate (Jarvis et al., 2015b). An outcome which can appear to be positive but is also associated with increased workload for ward staff and members of the response team (Herod et al., 2014). Like their aggregated weighted counterparts, electronic SPTTS are gaining traction in the acute healthcare setting as hospitals move towards recording patient data in electronic medical records (Capan, Wu, Campbell, Mascioli, & Jackson, 2017; Sefton et al., 2017).

1.2.4. Rapid Response Teams

The afferent limb of an RRS must trigger a system response from a predefined expert response doctor, nurse or team to provide the specialised support and treatment of the patient with evidence of clinical deterioration (Bellomo, DeVita, & Hillman, 2011). These teams have various names including, but not limited to, Medical Emergency Teams (MET), Rapid Response Teams (RRT), Critical Care Outreach Teams (CCOT) or Pre-Arrest Response Teams (PART) (Winters & DeVita, 2017). While MET and RRT are often used interchangeably, the personnel and composition of response teams varies widely (DeVita, Bellomo, Hillman, Kellum, Rotondi, Teres, Auerbach, Chen, Duncan, & Kenward, 2006; Maharaj et al., 2015). The name MET generally refer to physician led teams which, at minimum, usually include an intensivist and nurse/s, whereas RRT can also refer to a response team which is led by a nurse (Lyons, Edelson, & Churpek, 2018; Maharaj et al., 2015).

In part, the personnel who make up an RRT depend upon the intensive care resources available, hospital size and location, as well as the area within a hospital that the response is implemented (e.g. emergency departments). For example, ED specific teams for responding to patient deterioration in Australia commonly comprise of staff from within the ED team, such as the nurse and consultant ED physician (Considine et al., 2012). In this thesis, the terms RRT and MET are used interchangeably to describe the efferent limb of the RRS.

1.2.5. Implementation of a Rapid Response System

The success of an RRS to provide a robust 'safety net' for deteriorating patients is reliant upon the quality of its implementation. Though simple in concept, there are several human, cultural, environmental and structural system factors which have been identified as having an impact on the effective implementation of these complex systems. These factors can affect both the afferent and efferent limbs of the RRS, the strengths and weaknesses of which are equally as influential as each other. Put simply, a highly efficient RRT is powerless to provide care to patients experiencing physiological deterioration if they are not made aware of the crisis by the doctors and nurses caring for the patient. In an attempt to highlight importance of each part of these systems, prominent RRS researchers have advocated for a conceptual model that can be used as a standard approach to recognising and managing deteriorating patients.

Much like the 'chain of survival' theoretical conceptualisation of the principles required for effective resuscitation, an additional conceptual model for preventing the sudden cardiac arrest, unplanned ICU admission and death has been suggested (Smith, 2010). The 'chain of prevention' is a straightforward tool that describes the key elements required to effectively implement hospital strategies for recognising and managing patient deterioration. Smith also suggests that the model may be used by researchers to help identify the importance of each component part of RRS, as well as serving as a clear illustration of the systems which are easily understood by healthcare workers, patients, their families and friends alike (see figure 1.2).

Figure 1.2 The Chain of Prevention

The model consists of five elements essential to a successful RRS and is graphically represented by five rings. Each element (ring) is equal in importance, and much like the analogy used by its predecessor, the chain is described as being as only strong as its weakest link. The five parts of the chain of prevention include education, monitoring, recognition, call for help and response.

Furthermore, the success of RRS is as reliant upon the process as it is the people using it. Doctors, nurses, midwives and allied health care professionals that rely completely upon experience and clinical judgment without the tools, procedures and processes are unable to ensure that appropriate and effective clinical choices are made (Weed, 1997).

A significant and complex challenge facing the afferent arm of the RRS is the appropriate and timely escalation of physiologically unstable patients to the RRT early enough to avoid SAEs without overburdening an already under-resourced system (DeVita et al., 2010).

However, when both arms of RRS have demonstrated efficacy in supporting frontline healthcare workers to recognise and manage deteriorating patients (Maharaj et al., 2015; Odell, Victor, & Oliver, 2009; Ranji, Auerbach, Hurd, O'Rourke, & Shojania, 2007; Winters et al., 2007) when they are supported by a:

- sustainable evaluation process (Edelson & Bellomo, 2011; Sharek et al., 2007; Stolldorf, 2008),
- governance framework committed to system and cultural change (Bellomo et al., 2011; DeVita, 2004) and,
- comprehensive evidence-based educational program (Jacques et al., 2006).

The utility and role of education to support doctors and nurses in their attempts to recognise and respond to patient deterioration is systematically reviewed and discussed in detail in chapter two of this thesis.

1.2.6. Failure to Rescue

Often used as a measure of a health service's quality of care, failure to rescue (FTR) originally referred to adverse patient events and mortality which has been caused by failure to recognise, escalate and appropriately manage surgical complications (Silber, Williams, Krakauer, & Schwartz, 1992). Despite recommendations to the contrary by original authors (Silber et al., 2007), the term has since become a broader idiom which is not restricted to events that are a result of surgical complications. Rather, failure to rescue is now commonly used to describe failure to recognise, escalate and appropriately manage all patients in crisis which leads to a preventable adverse event or death. A recent systematic review identified as many as nine different definition of FTR (Johnston et al., 2015). In this thesis, FTR describes any patient with documented deleterious vital signs who does not have their care appropriately escalated according to an agreed triggering threshold.

Prevalence of Failure to Rescue

The prevalence of patients with early and progressive signs of physiological deterioration is high (Harrison et al., 2005; Harrison et al., 2006; Investigators, 2005; Jacques et al., 2006; Kause et al., 2004). In their retrospective cross-sectional survey of 3160 patient records across 5 Australian hospitals, Harrison et al. (2005) found that 54.7% admissions had at least one recording of early signs (ES) of physiological deterioration, 16.0% had late signs (LS) and 6.4% had reached the local organisations agreed MET alert criteria (Liverpool Equivalent Sign (LES)).

In their international prospective, observational study (*ACADEMIA*) Kause et al. (2004) identified 638 patients who suffered an SAE across 90 hospitals in the UK (69), Australia (19) and New Zealand (2). Sixty percent of the patients had one or more documented LS of deterioration prior to the SAE (168 prior to deaths, 112 prior to cardiac arrests and 103 prior to unanticipated ICU admissions). Importantly, there was no documentation of a medical officer being informed of physiological deterioration in 10-13.5% of the patient records in the 24 hours prior to the SAE. Failures to rescue deteriorating patients, such as those identified in the ACADEMIA study, remain the focus of research to explain their cause.

Table 1.1 Early and Late Signs of physiological deterioration. Adapted from Harrison et al. (2005)

EARLY SIGNS (ES)	LATE SIGNS (LS)
SpO2 90–95%	SpO2 <90%
SBP 80–100 mmHg	SBP <80 mmHg*
Pulse rate 40–49 or 121–140/min	Pulse rate <40 or >140/min*
SBP 181–240 mmHg	SBP >240 mmHg
Other	Other
BSL 16–25 mmol/l	BSL >25 mmol/l
Complaint of chest pain	Cardiac arrest*
Alteration in mentation	Unresponsive to verbal commands
Note of decreased urinary output	Anuric
Urine output <200 ml/8 h	Urine output <200 ml/8 h
GCS 9–11 or alteration >2	GCS< or = 8*
Respiratory rate 5–9 or 31–40 bpm	Resp rate <5 or >40/min*
BSL 1–2.9 mol/l	BSL <1 mmol/l
Uncontrolled pain	
Any seizure	Two or more Seizures with no return to baseline consciousness between*
New bleeding from any site	Excess blood loss unable to be controlled by local staff
>Expected blood loss	
PaO2 50–60mmHg	PaO2 <50mmHg
New pain	
>Expected drain fluid loss	
PaCO2 51–60mmHg	PaCO2 >60mmHg
Partial airway obstruction (excluding snoring)	Airway obstruction/stridor-complete*
Base deficit −5 to −8 mmol/l	Base deficit <−8 mmol/l or less
pH 7.2–7.3	pH <7.2
Pain changed in location or character	

** Liverpool Equivalent Sign (LES) - MET Call Criteria (MET)*

Causes of Failure to Rescue

DeVita et al. (2010) assert that if early or late signs (see table 1.1) of physiological deterioration are identified during patient assessment, and no triggering action is taken, the system is merely observing and documenting the onset of potentially preventable SAEs. The reasons for delays or failure to escalate the care of deteriorating patients are complex and have been acknowledged in the FTR literature as an important area of research since the implementation of RRS (McArthur-Rouse, 2001). As previously mentioned, there are many human, cultural, environmental and structural system factors that are likely to impact on the escalation process. However, many aspects of these factors are yet to be fully explained.

Human Factors

There are several human factors which exert influence on the decision-making processes when doctors and nurses encounter physiological deterioration in clinical practice. These include the effects of team interaction and communication, the structure and hierarchy of teams and the workload demands experienced by health care workers (Johnston et al., 2015).

In the last two decades, the FTR literature has consistently reported on common human factors perceived to be barriers and enablers to escalating the care of a deteriorating patient (Bagshaw et al., 2010; Cioffi, 2000b; Crispin & Daffurn, 1998; Jones, King, & Wilson, 2009b; Massey, Chaboyer, & Aitken, 2014; Radeschi et al., 2015). Though often quantifiable with valid and reliable survey instruments (Douglas et al., 2016; Radeschi et al., 2015), these influential factors are notoriously difficult to explain with purely empirical data. Understanding these issues often requires deeper exploration of the attitudes, beliefs and experiences of the doctors and nurses exposed to them in practice (Astroth, Woith, Stapleton, Degitz, & Jenkins, 2013; Chalwin, Flabouris, Kapitola, & Dewick, 2016).

Perceptions of how the team caring for a deteriorating patient communicate and interact has been recognised as having a substantial impact upon both arms of the RRS, however these human factors have frequently been implicated in the decision-making processes associated with escalating care (afferent arm) (Bagshaw et al., 2010; Cioffi, 2000b; Jones et al., 2009b;

Massey et al., 2014; McGaughey, O'Halloran, Porter, & Blackwood, 2017; Radeschi et al., 2015; Roberts et al., 2014). Nurses have reported feeling anxious about escalating care due to uncertainty about their assessment findings or fear that they may not be “doing the right thing” (Cioffi, 2000b). Another concerningly recurrent theme is the perception that escalating care may result in admonishment from colleagues, the person/s receiving the information or the rapid response team itself (Cioffi, 2000b; McGaughey et al., 2017; Radeschi et al., 2015; Roberts et al., 2014). These concerns and perceptions of hierarchical dysfunction in RRS have been reported by doctors and nurses alike (Johnston et al., 2015; Roberts et al., 2014).

Human error is another factor which has been identified as contributing to greater than 80% of iatrogenic SAEs (Harrison, Gibberd, Hamilton, & Wilson, 1999; Kohn, Corrigan, & Donaldson, 2000). In a more detailed analysis of the report on the quality of healthcare in Australia (Wilson et al., 1995), Harrison et al. report that from a total of 2940 SAEs identified, 15.8% (465) were due to "the failure to synthesise, decide and/or act on available information", 11.8% (346) as "the failure to request or arrange an investigation, procedure or consultation" and 10.9% (320) as "a lack of care and attention or failure to attend the patient". Harrison et al. also point out that most of the SAEs were highly preventable (Harrison et al., 1999).

Patient factors

Relationships between FTR and intrinsic patient characteristics such as the patient’s demographic profile, comorbidities and their dynamic physiological status have also been reported (Hravnak, Mazzoccoli, Bose, & Pinsky, 2017; Johnston et al., 2015). Significant relationships between FTR, demographic patient factors and comorbidities have been described in post-operative surgical patients (Busweiler et al., 2017; Johnston et al., 2015; Trinh et al., 2013) as well as generally in acute in-patients. For example Trinh et al. (2013)

demonstrated that FTR was significantly more prevalent in patients ≥ 75 years of age and patients who had ≥ three comorbid illnesses.

Though the physiological status of a patient has been recognised as a factor that can impact upon SAE and mortality, it is difficult to determine which vital sign and patient status thresholds are more likely to trigger an appropriate escalation to the afferent limb of an RSS (Hravnak et al., 2017). And though the tools (MET calling criteria and EWSs) used to help recognise a patient in crisis have demonstrated good sensitivity and specificity to indicators of clinical instability, they are heavily reliant on the assessment practices and actions of the doctors and nurses using them. However, regular, and accurate, assessment and documentation of physiological status cannot always be guaranteed (Odell, 2015).

System factors

There are also a several factors related to deteriorating patient's care environment which have been implicated in FTR. These factors are often attributed to the complex and dynamic nature of the system in which care is provided (Johnston et al., 2015). Ghaferi et al. (Ghaferi, Osborne, Birkmeyer, & Dimick, 2010) used multivariate logistic regression to identify the following system factors that impact on FTR:

- Nurse-patient ratios
- Whether the hospital was a teaching hospital (accounting for the largest reduction in the likelihood of FTR (OR 0.66, 95% CI 0.53 to 0.82))
- Whether the hospital provided technically advanced care services (e.g. organ transplantation)
- Hospital size
- Dynamic changes in hospital occupancy levels

There is, however a paucity of literature which describes the impact of dynamic ED factors such as staffing levels, occupancy levels and patient acuity on FTR in this specialised area of care.

Education factors

Education designed to support doctors and nurses in their efforts to rescue deteriorating patients has also been implicated as a significant factor which impacts upon FTR (Rao, Kumar, & McHugh, 2017; Theilen, Fraser, Jones, Leonard, & Simpson, 2017), and the actions taken by nurses when MET triggering thresholds are recognised (Cooper et al., 2016).

Acknowledged as the first link in the 'chain of prevention' (Smith, 2010), educational efforts to ameliorate FTR have been the focus of research globally since the advent of RRS. These efforts have yielded significant educational outcomes (knowledge, competence and confidence) and real-world improvements in clinical practice as they relate to the escalation and management of deteriorating patients (Connell et al., 2016). More recent systematic review reported that higher levels of education were associated with lower risk of FTR and mortality in 75% and 61% respectively of the observational studies reviewed (Audet, Bourgault, & Rochefort, 2018).

Studies have described FTR rates between 8.0 and 16.9% in the acute ward setting (Johnston et al., 2015). And while the description and exploration of FTR in general medical and surgical wards is wide-ranging, the same attention to specialised areas of healthcare is still developing. Recent studies have reported that the prevalence of patients who experience physiological deterioration in the ED is higher than that of patients in acute hospital wards (Considine, Rawet, & Currey, 2015a; Scott, Considine, & Botti, 2015), and FTR occurs in at least 12.9% of patients cared for in the ED.

1.2.7. Rapid Response in the Emergency Department

The last decade has seen the number of emergency department presentations increased between 23-49% globally (Hing, Bhuiya, & Statistics, 2012; Lowthian et al., 2012; Pitts, Pines, Handrigan, & Kellermann, 2012). The profile of the emergency department patient load is highly varied in age and complexity, patients are often undiagnosed and unknown to emergency department staff. The workload demand is largely unpredictable, frequently overwhelming and highly susceptible to errors from interruption and decision overload (Laxmisan et al., 2007). In an attempt to manage increasing demands on emergency department resources the Australian government introduced the National Emergency Access Target (NEAT) in 2010. The NEAT, or "4-hour rule", is a performance indicator that requires 90% of all ED episodes of care to be completed within four hours. While there is evidence that prolonged emergency department stays can be associated with increased patient mortality (Richardson, 2006; Sprivulis, Da Silva, Jacobs, Frazer, & Jelinek, 2006), there remains concern that admitting patients to the ward in less than 4 hours may compromise patient safety due to inadequate time to stabilise the acutely unwell patient.

Recent studies have also found higher prevalence of physiological deterioration in emergency department patients than that which is found on general acute wards and over half of the responses to physiological deterioration by RRS were for patients admitted via the ED (Hosking, Considine, & Sands, 2014).

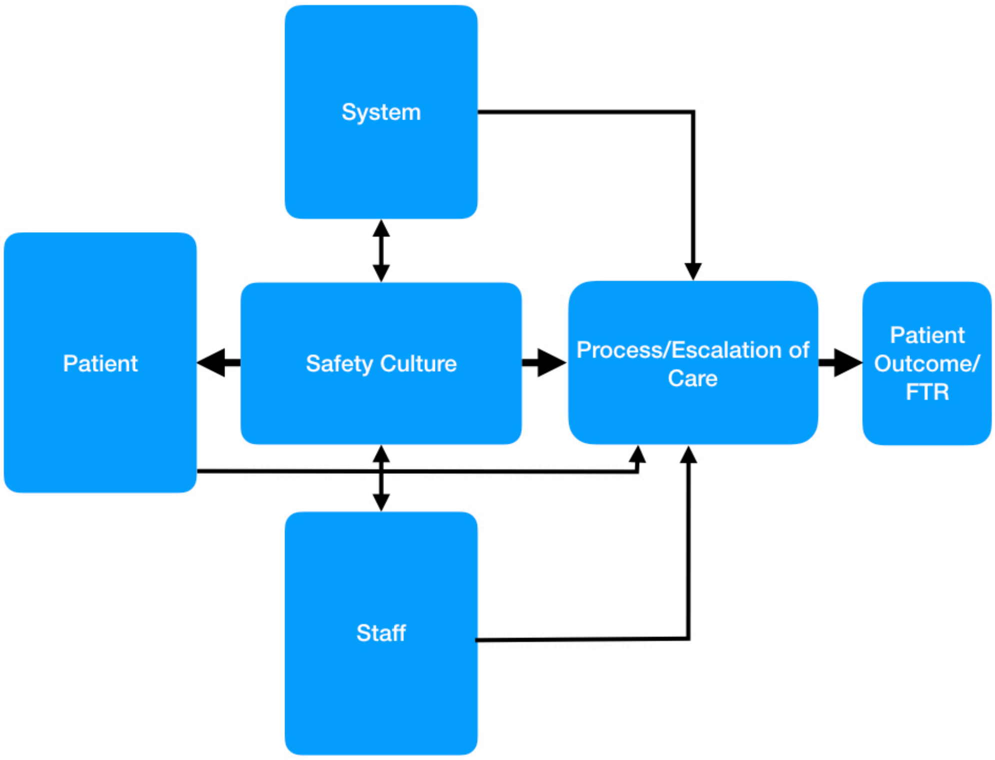
The application of RRS in the general ward area is well established. The application of a standard approach to a modified Emergency Department RRS is an emerging area of interest in the literature (Considine, Jones, & Bellomo, 2013; Considine et al., 2012; Corfield et al., 2013; Griffiths & Kidney, 2012b; Hosking et al., 2014) and has demonstrated to be effective in reducing unreported deterioration over time (Considine et al., 2015a). While there is a move for Australian EDs to incorporate modified alert criteria and responses to physiological deterioration, the factors that impact upon the activation of these systems warrant further investigation (Considine et al., 2012). A number of patient and environmental characteristics can influence the frequency of ED responses to physiological deterioration (Scott et al., 2015). Some of these characteristics have been described by Scott et al. (Scott et al., 2015) in a point prevalence study carried out in 2009. The authors found that physiological deterioration was more commonly under-reported when there were a higher number of older, sicker patients being cared for, and when department occupancy was high. There is, however no research that describes i) the relationship between escalation of care of the deteriorating patient and dynamic factors in the ED (workload, skillmix and patient acuity) and ii) the influences that social behaviour and organisational culture (safety climate) can have upon both arms of the RRS.

1.2.8. Safety Climate

Since the publication of *To Err is Human: Building a Safer Health System* (Kohn, Corrigan, & Donaldson, 1999) in 1999, the development, measurement and discussion of improving safety culture and climate has been an international concern (Colla, Bracken, Kinney, & Weeks, 2005; Davies, Nutley, & Mannion, 2000; Flin, Winter, & Cakil Sarac, 2009; Guldenmund, 2000; Singer, Lin, Falwell, Gaba, & Baker, 2009; Zohar, Livne, Tenne-Gazit, Admi, & Donchin, 2007). The concept of safety climate was first introduced to high risk industries and demonstrated effectiveness in reducing adverse events and harm (Guldenmund, 2000). That is, when safety climate scores are high, the frequency of errors and adverse events is low.

In their report for the World Health Organization, Flin and colleagues discuss the key factors influencing patient safety and provide an example of a system diagram commonly used to show relationships between organisational, human factors, errors and safety outcomes (Flin et al., 2009). Figure 1.3 shows an adaptation of their system diagram that provided a framework for the development of the research aims illustrates a logical relationship between the organisation systems and workplace behaviour that influence safety culture/climate and the behaviours associated with FTR. The patient's outcome is ultimately influenced by the processes of care to which they are exposed, and these care processes are affected by system (e.g. performance indicators), patient (e.g. condition) and staff human factors (e.g. communication). The interplay between these factors is represented by uni- and bi-directional arrows.

Figure 1.3 Factors influencing patient safety outcomes (adapted from Flin et al. (2009))



As described in the systematic review in Chapter 2, the impact that social behaviour and organisational culture has upon both arms of the RSS is not understood (Connell et al., 2016). There is, however, emerging evidence that these complex interpersonal relationships and organisational practices can affect the triggering of, and response to, physiological deterioration (Fein, Mackie, Chernyak-Hai, O'Quinn, & Ahmed, 2016; Massey et al., 2014). Organisational culture comes, in part, from the shared behavioural standards, beliefs, attitudes and values of colleagues working together in an organisation (Davies et al., 2000). An organisation's safety culture combines the broader organisation's culture with the structures and systems (e.g. RRS, medication safety checks and handover procedures) that are in place to promote patient safety (Singer, Lin, et al., 2009).

The concept of safety climate is often used inexactly and interchangeably with safety culture (Weaver et al., 2013). Whilst *safety culture* is a product of the organisational systems and shared behaviour, beliefs and attitudes, *safety climate* refers to perceptions of or attitudes towards the organisation's culture of safety (Zohar et al., 2007).

Measuring an organisation's safety climate provides a description of the shared perception of the organisation's safety culture (Hutchinson et al., 2006; Weaver et al., 2013). There is a direct link between safety climate scores and the frequency of errors and adverse events (i.e. high safety climate ratings are consistent with fewer errors) (Flin, Burns, Mearns, Yule, & Robertson, 2006; Flin et al., 2009; Singer, Lin, et al., 2009; Weaver et al., 2013).

In their chapter discussing RRS and the culture of safety (p. 53-57), Hillman et al, (2014) postulate that the culture of safety within a health service can not only impact the effective implementation of the RRS, but also that an effective RSS can positively influence the cultural temperature of the organisation.

In summary, RRS have evolved and diversified to support frontline health care workers to recognise a deteriorating patient and escalate their care to a highly effective expert response team. There are a large number of intricate human and system factors (e.g. casemix, workload and skillmix) that may impact upon the safe and effective implementation of these very same safety systems.

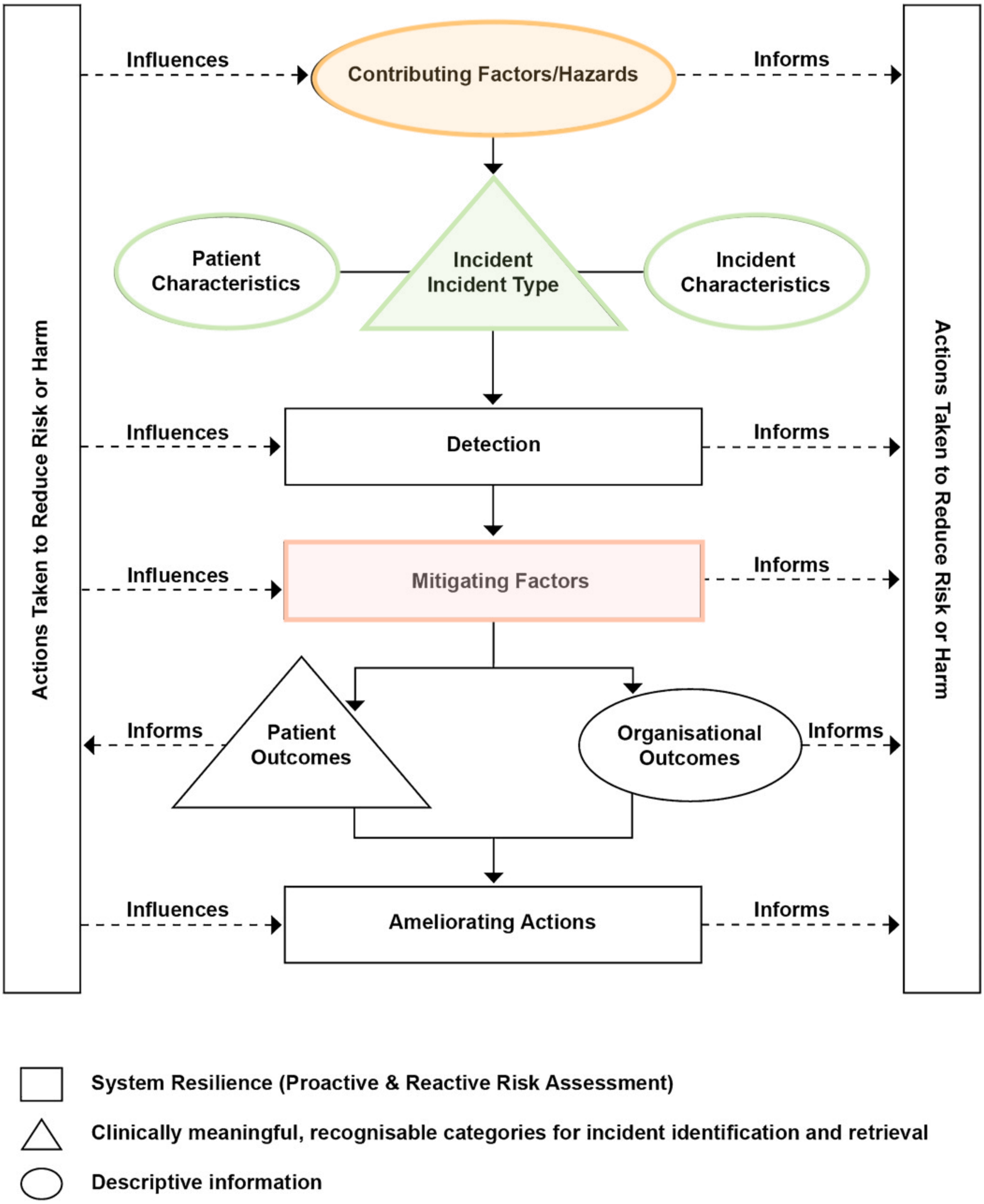
1.3. Theoretical Framework - International Classification for Patient Safety

The research is designed to improve understanding of how physiological deterioration is managed, as well as exploring the variables that influence care of the deteriorating emergency department patient. The overarching framework for this study is based upon the International Classification for Patient Safety (ICPS) (Sherman et al., 2009) (see figure 1.4). Sherman et al. describe a common format for examining patient safety information from a broad range of sources and systems. In their conceptual model the authors provide a tool for the standardisation and classification of ten overarching "higher level classes" and approximately 600 patient safety concepts "that group incidents into clinically meaningful categories, provide descriptive information, represent system resilience, and inform learning and analytical processes" (Sherman et al., 2009) (p. 4). The ten higher level classes are: incident type, patient outcomes, patient characteristics, incident characteristics, contributing factors/hazards, organisational outcomes, detection, mitigating factors, ameliorating actions and actions taken to reduce risk. The cyclical nature of the ICPS framework depicted in figure 1.4 illustrates how the actions taken to reduce risk and harm to a patient can exert influence upon that which contributes to a patient safety incident. These same contributing factors can be analysed, and the understanding that comes from this analysis can be used to inform changes to care practices which improve patient safety (i.e. the actions taken to reduce risk and harm to a patient). For example, if the evidence that a good culture of safety can affect the frequency of errors and adverse events (see section 1.2.8) is accepted, then understanding that same culture can help to inform further actions to reduce risk to patients.

The incident type (represented by the uppermost triangle in figure 1.4) addressed in this study is FTR deteriorating ED patients. Therefore, the primary aim of Phase One of this study is to generate understanding about the contribution of the ED safety climate to FTR, and ultimately inform actions taken to reduce risk for ED patients experiencing physiological deterioration.

Further to this, the aim of Phase Two of the study is to analyse the descriptive quantitative information, as well as staff experience and perceptions about the incident type (FTR). In particular, this phase of the study aims to explain the magnitude of FTR, patient and incident characteristics, the factors which contribute to FTR and their influences on mitigating factors (processes for escalation of care). The conclusions drawn from analysing these data is expected to inform policy and practice (actions taken to avoid FTR) in the ED setting.

Figure 1.4 International Classification for Patient Safety framework (adapted from Sherman et al., 2009)



1.4. Study Aim

The aims of the research were to describe the relationships between dynamic ED characteristics (workload, skillmix and patient acuity), organisational culture (safety climate) and the care of the deteriorating ED patient.

1.5. Research Question

The study was designed to address the research question: Are organisational climate and structure associated with the recognition and management of patient deterioration by health care professionals in an emergency department?

1.6. Research Objectives

The research question was addressed by mixing the results from two study phases with interdependent objectives.

The primary objective of Phase One was:

- To examine safety culture in a metropolitan Emergency Department (ED) towards escalating care of deteriorating patients.

The primary objectives of Phase Two were to:

I. Examine the period prevalence and characteristics of care escalation for deteriorating patients in a metropolitan ED

II. Examine relationships between organisational factors (staffing levels, staff skillmix, patient casemix, occupancy) and escalation of care in patient deterioration.

III. Explore the staff experience and perceptions of escalating care of the deteriorating patient.

1.7. Scope of the Study

The scope of the study spanned the attitudes, perceptions and experiences of ED doctors and nurses caring for deteriorating ED patients, to quantitative evidence about physiological deterioration in the ED and how it is managed. The scope of the study included a description of the proportion of ED patients experiencing physiological deterioration in a busy metropolitan ED over a two-week period. Furthermore, associations between the quality of care given to deteriorating ED patients and dynamic organisational factors such as staffing levels, staff skillmix, patient casemix and ED patient occupancy were explored. The ED patient group of interest were all patients who attended the ED requesting care at any time of day or night for a two-week period. This included all adult and paediatric patients presenting with medical, surgical, mental health and behavioural problems. Lastly, the perceptions of safety culture, attitudes and experiences of ED doctors and nurses who cared for deteriorating ED patients during the study period were explored. This included consultant emergency medicine physicians, registrars, career medical officers and interns, as well as emergency nurses with a wide range of experience, expertise and role descriptions.

The study did not address the perceptions of safety culture, attitudes and experiences of other ED workers (e.g. physiotherapists). The study was also limited to a single public ED in a large metropolitan healthcare service.

1.8. Significance of the Study

This study provides a comprehensive insight into the quality of care provided to ED patients experiencing physiological deterioration. The study also provides a unique description of the complex factors that influence the quality of care provided to deteriorating ED patients.

The outcomes of the study also deliver a valuable point of reference about the factors that impact upon patient safety in the wider ED community and how EDs might address their own inherent patient safety issues. The design of the study can also be applied to a wide range of ED settings, thus providing a type of template for evaluating the effectiveness of ED rapid responses to patient deterioration.

Finally, the study findings are expected to augment the emerging ED specific rapid response system literature and drive change to ED practice for recognising and managing patient deterioration.

1.9. Thesis Structure

The thesis is presented in eight chapters. This chapter introduces the background to the research area of interest and the research problem. The aims, objectives and research question, as well as the scope and significance of the study are then provided to describe the purpose of the research. Chapter Two addresses the state of the evidence related to the impact and effectiveness of education to support the recognition and management of deteriorating patients.

Chapter three provides a comprehensive description of the overall design and methodology (mixed methods) decisions, as well as the designs and methodologies used for each quantitative and qualitative strand of the study.

Chapters four, five and six present the results of the safety climate survey, medical record review and staff interviews respectively. These data and data analysis are reported using tables, comparative graphs and/or brief narrative statements.

Chapter seven provides an integrative discussion of the results and findings from Phase One Phase Two in the context of the broader published literature and the implications of the study outcomes to the wider ED community.

Finally, the overall conclusions, limitations of the study and the implications for ED care practice and research priorities which can be drawn from the study are presented in chapter eight.

1.10. Conclusion

The successful implementation of RRS rely upon effective educational support, regular patient monitoring, systems for recognising patient deterioration (track and trigger) and calling for help from a specialised response team. Furthermore, there is evidence that a number of patient and environmental characteristics can influence the frequency of ED responses to physiological deterioration. There is, however, limited research that describes i) the relationship between escalation of care of the deteriorating patient and dynamic factors in the ED (i.e. workload, skillmix and patient acuity), and ii) the influences that social behaviour and organisational culture (safety climate) can have upon RRS.

At the planning and design stage of the current study, educational interventions designed to support the successful implementation of RRS were (and still are) widely used. However, the evidence supporting educational effectiveness in recognising and responding to physiological deterioration was unknown. The aim of next chapter is to address the state of the evidence related to the first link in the chain of prevention (see figure 1.2). That is, Chapter Two comprises the published mixed-methods systematic literature review which was carried out to identify the evidence supporting educational effectiveness in recognising and responding to patient deterioration (Connell et al., 2016).

Chapter 2. Systematic Literature Review

2.1. Introduction

The previous chapter provided context for the aims, objectives, scope and significance of the research, as well as the theoretical framework that underpins the study and the chain of prevention (Smith, 2010) (see section 1.2.5 and figure 1.2).

The first link in the Chain of Prevention is education. Educational interventions to ameliorate FTR have been the focus of research globally since the advent of RRS, but the evidence for the effectiveness of these interventions had not been systematically reviewed during the planning stage of this study, nor had the outcome measures used to evaluate the effectiveness of their educational effectiveness been reported in aggregate.

The aim of this chapter is to report the state of the educational effectiveness and educational outcome measures at the time of designing the study, and is presented as a peer reviewed paper first published in 2016.

2.2. Literature Review

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Review

The effectiveness of education in the recognition and management of deteriorating patients: A systematic review

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ABSTRACT

Background: Survival from in-hospital cardiac arrest is poor. Clinical features, including abnormal vital signs, often indicate patient deterioration prior to severe adverse events. Early warning systems and rapid response teams are commonly used to assist the health profession in the identification and management of the deteriorating patient. Education programs are widely used in the implementation of these systems. The effectiveness of the education is unknown.

Aim: The aims of this study were to identify: (i) the evidence supporting educational effectiveness in the recognition and management of the deteriorating patient and (ii) outcome measures used to evaluate educational effectiveness.

Methods: A mixed methods systematic review of the literature was conducted using studies published between 2002 and 2014. Included studies were assessed for quality and data were synthesized thematically, while original data are presented in tabular form.

Results: Twenty-three studies were included in the review. Most educational programs were found to be effective reporting significant positive impacts upon learners, patient outcomes and organisational systems. Outcome measures related to: i learners, for example knowledge and performance, ii systems, including activation and responses of rapid response teams, and iii patients, including patient length of stay and adverse events. All but one of the programs used blended teaching with >87% including medium to high fidelity simulation. In situ simulation was employed in two of the interventions. The median program time was eight hours. The longest program lasted 44 h however one of the most educationally effective programs was based upon a 40 min simulation program.

Conclusion: Educational interventions designed to improve the recognition and management of patient deterioration can improve learner outcomes when they incorporate medium to high-fidelity simulation. High-fidelity simulation has demonstrated effectiveness when delivered in brief sessions lasting only forty minutes. In situ simulation has demonstrated sustained positive impact upon the real world implementation of rapid response systems. Outcome measures should include knowledge and skill developments but there are important benefits in understanding patient outcomes.

1. Introduction

Survival to discharge from in-hospital cardiac arrest is between 16 and 20% globally (Cooper et al., 2006; Ebell and Afonso, 2011; Larkin et al., 2010; Peberdy et al., 2003; Sandroni et al., 2007). Clinical features, including abnormal vital signs, often indicate patient deterioration in the hours prior to cardiac arrest (Buist et al., 2004; Franklin and Mathew, 1994). These same indicators often precede severe adverse events and unscheduled intensive care admissions (McQuillan et al.,

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1998; Winters et al., 2007). One Australian multi-centred prospective follow-up study (Hillman et al., 2002) reported that 60% of 551 patients requiring unscheduled ICU admission had documented life-threatening observations in the eight hours preceding admission.

Ward doctors and nurses are responsible for the care of increasingly complex patients, identifying signs of physiological deterioration and managing deteriorating patients (Hodgetts et al., 2002; Jones et al., 2011; Odell et al., 2009). Patients are more demographically diverse and patients with high dependency needs are now cared for on general medical and surgical wards (McGillis Hall and Doran, 2007).

Ward nurses have been shown to have varying abilities to recognise, document, report and respond to physiological deterioration (Odell et al., 2009). Medical students and junior ward medical staff have also been shown to have significant shortfalls in the interpretation of the signs and symptoms of clinical deterioration (Smith and Poplett, 2002). Similarly experienced doctors can be underprepared to respond to medical emergencies and acutely unwell patients (Frankel et al., 2004).

For almost two decades rapid response systems (RRS) have evolved to manage the prevention, recognition, and stabilisation of clinical deterioration (Winters and DeVita, 2011). The impact of Medical Emergency Teams (MET) upon the incidence of mortality has been debated since the landmark work of Buist et al. in 2002. During this time educational support for these systems has also developed to address the increasing demands upon potentially underprepared ward staff. These educational interventions have been applied nationally (Smith, 2003), at regional level (COMPASS®) and locally (Buykx et al., 2011; Liaw et al., 2011).

The efficacy of rapid response systems is topical, well documented and has been systematically reviewed (Odell et al., 2009; Ranji, 2007; Winters et al., 2007). The effectiveness of educational programs that have been designed to prepare health professionals for using these systems has not received the same attention. This review aims to identify: (i) the evidence supporting educational effectiveness in the recognition and management of the deteriorating patient and (ii) the outcome measures used to evaluate educational effectiveness.

2. Methods

A systematic search of the literature was conducted during January 2014. The search was conducted to identify peer reviewed quantitative, qualitative or mixed methods studies that measured the effectiveness of educating health professionals to identify and manage the deteriorating in-patient.

A 4 phase decision process including study identification, screening, eligibility and inclusion to the study was used (see PRISMA statement) (Moher et al., 2009) which is shown in Fig. 1.

Databases searched included CINAHL Plus, Medline, Embase, Cochrane, Proquest, ERIC, Scopus and the search engine Google Scholar.

An initial search to identify relevant keywords, subject headings and MeSH terms was carried out on the following terms:

• Training OR Education AND Deterioration (deteriorat*)

This search yielded 6908 results. These articles were reviewed for further keywords and subject headings. The following searches were then performed on all databases.

• Training OR Education AND Deterioration (deteriorat*)
• Rapid Response Teams OR Critical Care Outreach Teams OR Medical Emergency Teams
• Early Warning Scores OR Modified Early warning Scores OR (track AND trigger)

A manual search of potentially eligible study reference lists, relevant article bibliographies, related journals and professional body websites was also performed. This manual search was combined with database functions such as CINAHL's "find similar articles" function and a citation tracking (snowballing) approach.

The initial broad Boolean/Phrase search was limited to peer reviewed papers published in English between 2002 and January 2014 and where abstracts were available. The year 2002 was chosen as it coincided with the emergence of literature describing the implementation and outcomes of RRSs (Buist et al., 2002).

All duplicates were then removed and the Major Subject Headings were identified from the initial search and used to narrow the results. The abstracts of the remaining 794 results were read to identify any potentially eligible studies applying the following inclusion criteria:

• peer reviewed
• published between 2002–January 2014
• available in English language
• abstract available
• address the effectiveness of education in identifying and managing the deteriorating in-patient
• examine education provided to health professionals

The author and a second reviewer (JJ) read the resultant 47 studies. The second reviewer again applied the inclusion criteria. If there were conflicting opinions in the inclusion or exclusion of studies, the paper was discussed and the inclusion and exclusion criteria was reapplied. If the discrepancy was not resolved, expert third party (SC) opinion was sought. The process produced 23 studies for inclusion in the review.

26 studies were excluded. Some examples of the reasons for exclusion were:

• the study investigated the learners' perception of the education program and not the effectiveness of intervention,
• the study was designed to evaluate the tool used in measuring the participants' knowledge or confidence,
• the paper simply described the implementation of an education program with no evaluation of effectiveness,
• the study compared the application of specialised skills following two different modes of education.

The remaining studies (n = 23) were categorised by overall study methodology. The categories included quantitative, qualitative and mixed methods. Data for each study is presented at Tables 1, 2 and 3. The quality of the studies was evaluated based upon generalisability, reproducibility, relevance to the setting, appropriateness of sampling (size and methods) to study aim, risk of bias, use of validated measurement tools and appropriateness of the outcome measures. These quality indicators were guided by the Evaluation Tool for Quantitative Research Studies (Long et al., 2002b), Evaluation Tool for 'Mixed Methods' Study Designs (Long et al., 2002a) and the Critical Appraisal Skills Program (CASP, 2014) tool for the evaluation of qualitative research.

3. Results

The review included twenty quantitative studies (Buckley and Gordon, 2011; Cooper et al., 2013; Crofts et al., 2006, 2007; Featherstone et al., 2005; Fuhrmann et al., 2009; Gordon and Buckley, 2009; Harvey et al., 2014; Jones et al., 2006; Kelly et al., 2013; Kinsman et al., 2012; Lewis, 2011; Liaw et al., 2011, 2013; Lindsey and Jenkins, 2013; Ludikhuize et al., 2011; Sittner et al., 2009; Smith and Poplett, 2004; Straka et al., 2012; Theilen et al., 2013), two mixed methods (Hart et al., 2014; Wehbe-Janek et al., 2012) and one qualitative study (Unsworth et al., 2012). The study designs of the quantitative studies were predominantly quasi-experimental and prospective interventional with one time series analysis of patient records (Kinsman

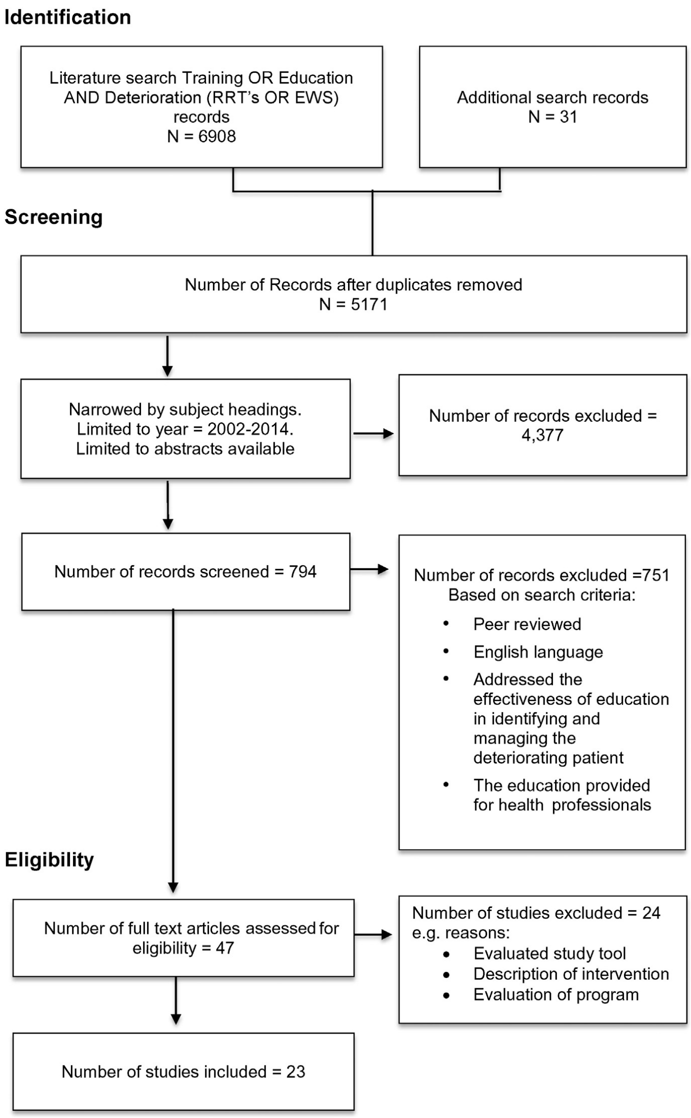

Fig. 1. Flow diagram of study selection.

et al., 2012). There was also one randomised control trial (Liaw et al., 2011).

The mixed methods studies used a descriptive exploratory design of the qualitative data and a quasi-experimental model for the quantitative data (Hart et al., 2014; Wehbe-Janek et al., 2012). The single qualitative study used focus groups and participant observation to investigate the role and effectiveness of simulation in developing mental health nurses' ability to recognise and respond to patient deterioration (Unsworth et al., 2012). All studies had a Focused Research Question except for Wehbe-Janek et al. (2012).

Effectiveness of the education program was measured using three types of outcome: learner outcomes, patient outcomes and system outcomes. Nineteen studies (Buckley and Gordon, 2011; Cooper et al., 2013; Crofts et al., 2006; 2007; Featherstone et al., 2005; Gordon and Buckley, 2009; Hart et al., 2014; Harvey et al., 2014; Kelly et al., 2013; Kinsman et al., 2012; Lewis, 2011; Liaw et al., 2011, 2013; Lindsey and Jenkins, 2013; Ludikhuize et al., 2011; Sittner et al., 2009; Smith and Poplett, 2004; Straka et al., 2012; Wehbe-Janek et al., 2012) measured the intervention's impact on perceived or real knowledge or performance, nine (Cooper et al., 2013; Featherstone et al., 2005; Gordon and Buckley, 2009; Hart et al., 2014; Harvey et al., 2014; Kelly et al., 2013; Lewis, 2011; Liaw et al., 2011; Wehbe-Janek et al., 2012) measured human factors or non-technical skills such as confidence, teamwork, leadership and communication, while one study measured the

Table 1
Included quantitative study details.

Author, year and setting	Title	Design Focused Research Question (FRQ[a]) (Y/N)	Aim	Intervention (I) Comparison (C)	Participants sample method Power calculation (Y/N)	Selection and allocation Validation of instrument (Y/N)	Bias risk	Outcome
Buckley and Gordon (2011) University Australia	The effectiveness of high fidelity simulation on medical–surgical registered nurses' ability to recognise and respond to clinical emergencies	Follow up survey FRQ: yes	To evaluate registered nurses' ability to respond to the deteriorating patient in clinical practice following training using immersive simulation and use of a high fidelity simulator.	I: 2 × 3 h high fidelity simulation workshop and 14 h of traditional classroom teaching. C: No comparison	50 post-graduate nursing students Convenience No	None No	Medium	Classroom teaching combined with immersive simulation improves nurses' perceived ability to respond to real world patient clinical emergencies.
Cooper et al. (2013) Rural Hospital Victoria, Australia	Managing patient deterioration: assessing teamwork and individual performance	Prospective, quasi-experimental pre-test and post-test design FRQ: yes	To assess the ability of rural Australian nurse teams to manage deteriorating patients.	I: A 2-hour session comprising 3 Objective structured clinical examination video-recorded high-fidelity scenario C: No comparison	44 Registered nurses Convenience No	Participant invitation No	Low	Observed skill performance Mean score across three scenarios (AMI, Shock, COPD) was 54% (SD 10.04) Situational Awareness Team leader scores = 50% 'Physiological perception' of team leaders averaged 38%, 'global perception' 24% and level of 'comprehension' 42% Projection' of the situation was 74% Higher situational awareness scores were observed in younger aged participants. Higher situational awareness scores were associated with higher knowledge scores. Team performance Mean total score = 44% • Leadership subscale: 55% (4.4/8, SD 1.69) • Teamwork subscale: 58% (16.3/28, SD 4.52) • Task management subscale: 54% (4.3/8, SD 1.34) Self-rated confidence and competence were positively impacted
Crofts et al. (2006) Hospitals United Kingdom	Training for shoulder dystocia: A trial of simulation using low-fidelity and high-fidelity mannequins	Randomised comparative prospective interventional study FRQ: yes	To compare effectiveness of training with low and high fidelity mannequins for the management of shoulder dystocia.	I: 40-minute practical workshop on the management of shoulder dystocia C: High fidelity and low fidelity simulation training.	140 midwives and doctors working in birth units. Purposeful Yes	Baseline randomisation to one of four training arms (1-day hospital course, 2-day hospital course, 1-day sim centre course or a 2-day sim centre course). Yes	Low	Overall, at 3 weeks postintervention, there was a statistically significant increase in simulated successful deliveries - pre 42.9%, post 83.3% ($p < 0.001$). Statistically significant increases in all basic skills ($p < 0.002$). Training with high fidelity manikins was associated with increased likelihood of successful delivery compared with training with low fidelity manikin ($p < 0.002$). Training with high fidelity manikins also associated with improved delivery ($p < 0.004$). Improved chance of delivering of the posterior arm ($p < 0.001$) and with less total force applied ($p < 0.006$). Training improved communication scores ($p < 0.001$).

Crofts et al. (2007) Hospitals United Kingdom	Management of shoulder dystocia: skill retention 6 and 12 months after training	Randomised comparative prospective interventional study FRQ: yes	To estimate the decay of skills at 6 and 12 months after structured training for shoulder dystocia.	I: 40-minute practical workshop on the management of shoulder dystocia C: 1. Pre-training group who could effectively delivery. 2. Trained group who learned to deliver from training. 3. Trained group who were unable to deliver pre- or posttraining.	118 midwives and doctors working in birth units. Purposeful Yes	Selection and allocation based on performance in previous study (Crofts et al., 2006). Yes	Low	A 40-minute dystocia training workshop resulted in a sustained improvement in performance and skill retention over a 12-month period. Successful delivery: 49% pre-training, 84% at 6 months, and 85% at 12 months. No significant decline in delivery times, maximum force used and communication. 17% failed to deliver at 6 and 12% at 12 months. This was predominantly represented by group 2 (learned to deliver posttraining)
Featherstone et al. (2005) ALERT™ Courses United Kingdom	Impact of a one-day inter-professional course (ALERT™) on attitudes and confidence in managing critically ill adult patients	Pre- and postquasi-experimental evaluation design. Single study group FRQ: yes	To evaluate the impact of ALERT™ course on the confidence and attitudes of healthcare staff in relation to recognition and management of the acutely ill.	I: Theoretical Inter-professional One-day interactive seminar with practical patient-based scenarios, e-learning, reference manual and slide presentation C: Pre- and post-testing	131 health care workers: Doctors (n = 43) Registered nurses (n = 80) Physiotherapists (n = 6) Other (n = 2) Convenience Yes	None Yes	Medium	Significantly improved confidence in the recognition ($p < 0.01$) and management ($p < 0.05$) of acutely ill patients. Improved recollection of simple life saving procedures ($p < 0.01$). Self-reported increase in knowledge ($p < 0.01$). Reduced anxiety ($p < 0.003$). Improved confidence in working as part of a team. Improved confidence in approaching senior staff for advice ($p = 0.05$).
Fuhrmann et al. (2009) Hospital Denmark	The effect of multi-professional education on the recognition and outcome of patients at risk on general wards.	A prospective quasi-experimental before-and-after study. FRQ: yes	To evaluate the effect of multi-professional full-scale simulation-based education of staff on the mortality and staff awareness of patients at risk on general wards.	I: 1 day inter-professional educational program incorporating lectures, case presentations, skills training, simulations and debriefing C: Pre- and post-testing	1563 patients (690 pre-test, 561 post-test) Convenience Yes	All patients present on two wards every evening between 16:00 h and 21:30 h pre- and post-educational intervention. Patients allocated to "normal" or "abnormal" vital signs groups. No	Medium	The education program did not increase nursing staff awareness of patients at risk, did not improve patient mortality over 30 to 180 days and did not decrease patient length of stay. Nurses' awareness of deteriorating patient was 41% pre- and 39% post-education ($p = 0.8$) 30 day mortality was 11% pre- and 11% post-education ($p = 1.0$) 180 day mortality was 29% pre- and 28% post-education ($p = 1.0$) Length of stay was 15 pre- and 13 post-test ($p = 0.11$)
Gordon and Buckley (2009) University Australia	The effect of high-fidelity simulation training on medical-surgical graduate nurses' perceived ability to respond to patient clinical emergencies	Descriptive pre- and post-survey FRQ: yes	To identify the effects of simulation on participant confidence in responding to the technical and non-technical skills needed to manage patient deterioration. A secondary aim was to identify the aspects of simulation that participants found most useful to their learning.	I: 2×3 h high fidelity simulation workshop and 14 h of traditional classroom teaching. C: Pre- and post-course evaluation	50 undergraduate nursing students No	None No	Medium	Significant perceived performance enhancement was demonstrated: Recognition of unstable patient ($p = 0.02$). Prioritising ($p < 0.0001$). Performance of technical interventions ($p < 0.0001$) All non-technical skills improved ($p < 0.0001$) No statistical significant change to call for help
Harvey et al. (2014)	Comparison of two TeamSTEPPS® training methods on nurse failure-to-rescue performance	Quasi-experimental, two-group comparison, pre/post-intervention study	To compare the impact of two types of evidence-based training methods (simulation-based training	I: 2.5-hour didactic educational program, titled 'ACT NOW (Alert-Communicate-	39 registered nurses No	Simulation-based training (SBT) or case study review (CSR) incorporating	Low	Increased knowledge and teamwork skills after education were seen in both groups ($p < 0.05$). The SBT group showed

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Table 1 (*continued*)

Author, year and setting	Title	Design Focused Research Question (FRQ[a]) (Y/N)	Aim	Intervention (I) Comparison (C)	Participants sample method Power calculation (Y/N)	Selection and allocation Validation of instrument (Y/N)	Bias risk	Outcome
Hospital USA		FRQ: yes	[SBT] vs. case study review, both incorporating Team-STEPPS® training, on Progressive Care Unit RN knowledge of early warning signs of patient deterioration, confidence, and teamwork and emergency clinical skills.	Treat-Nurses-Observing for-Warnings) and 60-minute simulation-based training (SBT) or case study review (CSR) session. C: educational outcomes from 60-minute simulation-based training (SBT) versus case study review (CSR) session.		TeamSTEPPS® training. Session participants allocated according to their care unit. No		greater improvement in all areas except knowledge, with greatest positive impact demonstrated in SBT teamwork skills ($p < 0.05$).
Jones et al. (2006) Hospital Australia	Effect of an education program on the utilisation of a medical emergency team in a teaching hospital	Prospective interventional study FRQ: Yes	To determine the effectiveness of an educational program on the utilisation of MET system	I: Lectures. Tutorial. Interactive focus groups. Grand round presentations. C: Pre- and post-course evaluation	109,250 consecutive medical and surgical admissions Yes	Not applicable Not applicable	Medium	A detailed program of continuing education was associated with a significant increase in MET utilisation over 3.5 year period. ($p < 0.0001$)
Kelly et al.(2013) University Australia	Empowering the registered nurses of tomorrow: Students' perspectives of a simulation experience for recognising and managing a deteriorating patient	Descriptive pre- and post-test FRQ: yes	To determine the impact of a deteriorating patient simulation in increasing senior undergraduate nursing students' ability to recognise and respond appropriately; and to examine the impact of program of study on students' responses and performance during the simulation.	I: 3 h Simulation C: No comparison	57 Nursing students. Final year Bachelor of nursing students (3rd year students, 2nd year Enrolled Nurses (EN) and Graduate Entry (GE) students) No	None No	Low	Positive impact upon self-rated knowledge, technical and non-technical skills and confidence.
Kinsman et al. (2012) Rural hospital Australia	The FIRST2ACT simulation program improves nursing practice in a rural Australian hospital.	Interrupted time series analysis FRQ: yes	To measure the impact of the Feedback Incorporating Review and Simulation Techniques to Act on Clinical Trends (FIRST[2]ACT) simulation program on nursing observations and practice relevant to patient deterioration in a rural Australian hospital	I: Two high fidelity simulated patient deterioration scenarios conducted in a 90-minute session. C: No comparison (not applicable)	34 Registered nurses Medical record audits Pre: 258 Post: 242 Yes	None Yes	Low	Improvements in the applicable • frequency of observations ($\beta\,2 = -0.112$, $t = -3.57$, d.f. $= 7$, $p = 0.009$) • and pain scoring ($\beta\,2 = -0.179$, $t = -4.585$, d.f. $= 7$, $p = 0.003$) Improvements in the administration of oxygen were not statistically significant ($p = 0.143$)
Lewis (2011) University United Kingdom	Learning the 'SMART' Way… Results from a pilot study evaluating an inter-professional acute care study day	Pre- and postquasi-experimental evaluation design. FRQ: yes	To evaluate and inter-professional education program. SMART® (Student Management of Acute illness Recognition and Treatment)	I: One day Inter-professional theoretical and medium fidelity scenario based education program. C: Pre- and post-course evaluation	88 students Third year student nurses ($n = 72$) Fourth year medical students ($n = 16$) Convenience No	None Yes	Medium	The results indicated an overall increase in self-reported clinical knowledge, confidence and comfort with inter-professional teamwork.

Liaw et al. (2011) University Republic of Singapore	Rescuing A Patient In Deteriorating Situations (RAPIDS): A simulation-based educational program on recognising, responding and reporting of physiological signs of deterioration	A prospective randomised controlled trial with a pre- and post-test design. FRQ: yes	To describe the development, implementation and evaluation of an undergraduate nursing simulation program for developing nursing students' competency in assessing, managing and reporting of patients with physiological deterioration.	I: 4 simulation scenarios in a 6 h education session C: Non-trained group	31 Nursing students Randomised Yes	Intervention group (N = 15) randomly assigned. Control group (N = 16) assigned using fish bowl method????? Yes	Low	Improved recognition, management and reporting of patient deterioration. Reported course satisfaction and confidence in clinical application. Clinical performance improved ($p < 0.0001$). Higher post-test reportage of deterioration ($p < 0.0001$). Participants report satisfaction and increased self-confidence. There were no comparison results here with the non-trained group.
Liaw et al. (2013) University Republic of Singapore	An interprofessional communication training using simulation to enhance safe care for a deteriorating patient	Prospective, quasi-experimental pre-test and post-test design Exploratory descriptive study was used to evaluate the students' satisfaction on the simulation learning. FRQ: yes	1. To evaluate the outcomes of the Sim-IPE program on the students' confidence level in communicating about patient deterioration and perceptions towards interprofessional learning. 2. To evaluate student satisfaction with the simulation learning	I: 3 h HF simulation based interprofessional session C: Pre- and post-course evaluation	127 pre-registration medical (4th year) and nursing (3rd year) students. Purposeful No	None Yes	Low	Self-rated confidence was positively impacted – Medical (M 7.18 (SD 5.17)), Nursing (M 6.37 (SD 4.99)) Participant perception was positively impacted – Medical (M 4.88 (SD 4.04)), Nursing (M 4.33 (SD 3.58)). Satisfaction with simulation learning was high Likert scale (1–5) Mean 4.46 (SD 0.37)
Lindsey and Jenkins (2013) University USA	Nursing students' clinical judgment regarding rapid response: the influence of a clinical simulation education intervention	Prospective, quasi-experimental pre- and post-test design FRQ: yes	To examine the impact of an educational intervention on student nurses' clinical judgment regarding the management of patients experiencing rapid clinical deterioration.	I: 1 day mixed mode lecture as well as simulated scenarios of patient deterioration. C: Non-trained group	79 nursing students Randomised Yes	Randomised intervention group No	Low	Overall greater positive impact on knowledge scores found in the intervention group (M = 90.91, SD = 8.73) over the control group (M = 64.80, SD = 19.69), $t(77) = 7.65$, ($p < 0.001$)
Ludikhuize et al. (2011) Hospital The Netherlands	Measuring adherence among nurses one year after training in applying the Modified early warning score and situation-background--assessment-recommendation instruments	Quasi-experimental prospective comparison study. FRQ: yes	To evaluate whether nurses trained in the use of MEWS and SBAR tools were more likely to recognise a deteriorating patient.	I: 1 h interactive MEWS and SBAR training session enhanced with posters, feedback and face-to-face conversations. C: Non-trained group	95 registered nurses Convenience Yes	None Yes	Medium	The trained nurses identified the deteriorating patient more frequently than non-trained nurses ($p = 0.026$). Improved notification to the physician of patient deterioration ($p = 0.037$) There was no significant Improvement in the trained group's implementation of SBAR and MEWS tools.
Sittner et al.[30] (2009) Hospital USA	Rapid Response Team Simulated Training for Enhancing Patient Safety (STEPS)	Prospective, quasi-experimental pre- and post-test design FRQ: yes	1. To assess the impact of the educational intervention on knowledge and clinical judgment. 2. To evaluate the protocol used in the study and its feasibility in application to a larger study.	I: High fidelity simulation and feedback (unknown length) C: Pre- and post-course evaluation.	11 registered nurses. Convenience. No.	All participants were enrolled through invitation Yes	Low	Statistically no significant positive impact on knowledge and knowledge retention over a 3-month period. Perception of and satisfaction with simulation was rated high to very high across all subscales measured.
Smith and Poplett (2004) Hospitals United Kingdom	Impact of attending a 1-day multi-professional course (ALERT™) on the knowledge of acute care in trainee doctors	Quasi-experimental prospective comparison study. FRQ: yes	To determine if and how the ALERT™ course had influenced the knowledge of acute care in trainees.	I: Theoretical inter-professional One-day interactive seminar. The seminar was built around practical patient-based scenarios, e-learning, reference manual and slide presentation. C: Non-trained group.	118 doctors (Senior House Officers). Convenience. No	36 ALERT™ trainees (post-test). 82 non-ALERT™ group (pre-test). No	Medium	Doctors knowledge of acute care can be improved by attending courses such as ALERT™ ($p < 0.05$)

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Table 1 (*continued*)

Author, year and setting	Title	Design Focused Research Question (FRQ[a]) (Y/N)	Aim	Intervention (I) Comparison (C)	Participants sample method Power calculation (Y/N)	Selection and allocation Validation of instrument (Y/N)	Bias risk	Outcome
Straka et al. (2012)	The impact of education and simulation on paediatric novice nurses' response and recognition to deteriorating.	Pilot quasi-experimental prospective comparison study. FRQ: yes	To determine if the use of high-fidelity simulation with novice paediatric nurses influences their knowledge of deterioration symptoms and potentially affects adverse events on the inpatient units.	I: Lecture based learning, skill stations and simulated patient deterioration. C: Pre- and post-course evaluation.	26 registered nurses. Convenience No	None No	Low	Positive effect on knowledge. Pre-(71.15%) and post-(87.69%) test scores ($p < 0.0001$).
Theilen et al. (2013) Hospital United Kingdom	Regular in situ simulation training of paediatric medical emergency team improves hospital response to deteriorating patients	Prospective cohort study. FRQ: yes	To evaluate the impact of regular team training on the hospital response to deteriorating in-patients and subsequent patient outcome.	I: Ongoing weekly 2-hour medium fidelity in-situ simulation. C: Pre- and post-course evaluation	7854 hospital admissions pre- and 8652 hospital admissions post- Purposeful. Yes.	None. No.	Low	Pre- and post- Reduced Time to recognition of deterioration (pMET: median time reduced from 4 to 1.5 h, $p < 0.001$), Increase in rate of consultant review (45%/76%, $p = 0.004$) Transfer rate to HDU increased (18%/37%, $p = 0.021$). Reduced Time to escalation of care to PICU (median time reduced from 10.5 to 1.5 h $p = 0.024$) Trend towards reduced PICU admissions, patients were less sick at time of PICU admission and reduced PICU mortality. Hospital mortality reduced 31/7854 to 11/8652 ($p < 0001$). This coincided with the implementation of the pMET and was not attributed to the education.

[a] FRQ – Focused Research Question, I – intervention, C – comparison, Y – yes, N – no.

Table 2
Included qualitative study details.

Author, year and setting	Title	Design Focused Research Question (Y/N)	Aim	Intervention (I) Comparison (C)	Participants sample method Power calculation (Y/N)	Selection and allocation Validation of instrument (Y/N)	Bias risk	Outcome
Unsworth et al. (2012) University United Kingdom	Recognition of physical deterioration in patients with mental health problems: the role of simulation in knowledge and skill development	Exploratory descriptive. FRQ: yes	To develop simulation scenarios and to assist mental health nursing students to recognise and appropriately manage physical deterioration in patients with mental health problems. The specific objectives of the project were to: • introduce mental health nursing students to simulation using whole-patient mannequins; • develop the skills and knowledge of mental health nursing students regarding the identification and appropriate management of the deteriorating patient; • develop intermediate fidelity simulation scenarios which address those clinical circumstances where rapid physical deterioration may occur; • evaluate the use of intermediate fidelity simulation scenarios as an approach to developing the skills and knowledge of mental health nursing student to manage physical deterioration.	I: Medium fidelity simulation C: no comparison	15 registered mental health nursing students Convenience No	None Yes	Low	Identified positive effects upon participants in four (4) learning domains as a result of the education intervention: 1. "Bridging the gap" between the need to develop skills in recognising and managing deterioration 2. Learning interprofessionally (student nurses and student mental health nurses) 3. Authenticity 4. Reflective learning

situational awareness of a team leader in a simulated patient deterioration scenario (Cooper et al., 2013). Only two of the studies (Crofts et al., 2007; Sittner et al., 2009) measured retention of skills or knowledge.

Four of the studies measured the impact on care (activation and responses of RRS, quality of patient assessment and documentation of care) or the impact upon patient outcomes (patient length of stay, patient mortality and ICU admission rates) (Fuhrmann et al., 2009; Jones et al., 2006; Kinsman et al., 2012; Theilen et al., 2013). Fuhrmann et al. (2009) were unable to show improvement in 30 day and 180 day mortality as a result of the education; while Jones et al. (2006) associated improved frequency of MET call activation to the education intervention. Theilen et al. (2013) prospective cohort study demonstrated positive impacts upon patient and system outcomes. These included reductions in the time taken to recognise signs of deterioration, increased frequency of consultant review and reduced time taken to escalate care. They also demonstrated measurable patient outcomes including increased ward to HDU transfers and reduced PICU admissions. Their paediatric patients were also less sick on arrival in PICU. Finally Kinsman et al. (2012) attributed improvements in the quality of patient assessment (appropriate frequency and quality of vital signs observation) and documentation of care (pain scores) to their educational intervention.

Based on these outcome measures, Tables 1, 2, and 3 show that most (21) of the educational interventions report positive impacts upon learner, patient and organisational system outcomes. The education proved to be effective in all outcomes measured with the exception of two interventions (Fuhrmann et al., 2009; Sittner et al., 2009).

The duration of the education interventions ranged from 25 min to 45 h with a mean time of eight hours. Seven of the interventions ran for a traditional eight hour "training day" model.

Most studies were potentially reproducible based upon the descriptions of the methods, the settings were relevant to the aim and sampling methods appropriate to the aims of the study. Though the quality of the studies was overall quite high, 10 (Buckley and Gordon, 2011; Featherstone et al., 2005; Fuhrmann et al., 2009; Gordon and Buckley, 2009; Jones et al., 2006; Lewis, 2011; Ludikhuize et al., 2011; Smith and Poplett, 2004; Wehbe-Janek et al., 2012) were at medium risk of bias due to participant selection methods, participant attrition or potential for selective reporting.

All studies were appropriately undertaken in acute hospitals (15) or universities (9). The studies were predominantly carried out in the UK (7), the USA (6) and Australia (6). There was one Dutch and one Danish study and two were from the same author at Singapore's National University.

4. Discussion

The evidence supporting educational effectiveness in the recognition and management of the deteriorating patient and outcome measures used to evaluate educational effectiveness was determined by

Table 3
Included mixed methods study details.

Author, year and setting	Title	Design Focused Research Question (Y/N)	Aim	Intervention (I) Comparison (C)	Participants sample method Power calculation (Y/N)	Selection and allocation Validation of instrument (Y/N)	Bias risk	Outcome
Hart et al. (2014) University USA	Effectiveness of a structured curriculum focused on recognition and response to acute patient deterioration in an undergraduate Baccalaureate of Science in Nursing (BSN) program	Quantitative research was quasi-experimental. Qualitative research was descriptive. FRQ: yes	1. Quantitative: To determine the effect of a structured education curriculum on under-graduate BSN students' levels of self-confidence, knowledge, perceptions of teamwork in acute patient deterioration situations. 2. Qualitative: To explore and describe the decision-making processes of students' in recognising and responding to patient deterioration.	I: 45-hour program structured into four components: 1) didactic lectures, 2) skill labs, 3) medium-fidelity simulations as well as three high-fidelity simulations, and 4) facilitator-led guided reflection sessions (GRS). C: no comparison	48 nursing students Convenience No	None Yes	Medium.	Quantitative: Significant positive effect upon self-rated confidence ($F(2.92) = 292.99$, $p < 0.001$) Significant positive effect upon knowledge ($F(2.92) = 236.99$, $p < 0.001$) Significant positive effect upon perceived teamwork performance (TEAM scores) ($F(1.46.65.85) = 122.27$, $p < 0.001$) Qualitative: 7 categories emerged from the qualitative data analysis. These included sources of knowledge, knowledge as a person, knowledge as a group, reasoning under pressure, feelings, real person versus simulation, and values. There was an overall positive effect upon these categories midway and following the intervention.
Wehbe-Janek et al. (2012) Hospital USA	Nurses' perceptions of simulation-based inter-professional training program for rapid response and code blue events	Mixed methods descriptive exploratory design using interpretive and iterative processes while the frequency of thematic emergence was quantified. FRQ: no	1. To examine the perspectives of hospital unit nurses who may be called on to perform in rapid response teams. 2. To examine nurses' perspectives of the value of simulation-based training for rapid response scenarios. 3. To implement a program evaluation for a simulation- based multidisciplinary training program.	I: 3 h team simulation training once per week over 3 weeks. Simulation training was augmented with didactic, online and staff meeting training. C: no comparison.	203 Registered nurses and licensed vocational nurses Convenience No	None No	Medium	Results indicated satisfaction with the course and minimal effect upon knowledge, skills, and confidence. The relevance of the program to patient outcomes was reported by only 2.7% of the sample. Self-reported increased knowledge (9.9%) Self-reported increased confidence and comfort (7.1%) Reported improvement to patient outcomes (2.7%)

a systematic a search and analysis of all current relevant research evidence. This review identified that a third of the outcomes measured were based upon participants' personal perception of knowledge, skills and technical improvements, while just over a third of the studies measured actual improvement in knowledge, skills and technical performance. Though these traditional outcomes are often applied to the evaluation of educational interventions, there is evidence that knowledge tests and self-rated confidence do not necessarily predict improved clinical management of deteriorating patients (Liaw et al., 2012). As such, the challenge is to demonstrate actual changes in behaviour that translates to sustained improvements in patient safety and quality patient care.

Two studies assessed the effectiveness of the education on measurable patient outcomes (Fuhrmann et al., 2009; Theilen et al., 2013), while three investigated the impact upon the triggering arm of the RRS or clinician behaviour (Jones et al., 2006; Kinsman et al., 2012; Theilen et al., 2013). Fuhrmann et al. (2009) attempted to associate measurable patient outcomes to the educational intervention. The study was not able to show any positive effect on patient mortality at 30 or 180 days as a result of educational intervention, nor was it able to improve nurses' awareness of the deteriorating patient. The authors pointed out that education alone did not alter patient outcomes when applied to a multi-faceted and complex organisation system such as a RSS (Fuhrmann et al., 2009).

Fuhrmann et al. (2009) also suggested that it would be important to re-evaluate the process and outcomes measured to include social behaviour and interaction. Measuring such outcomes was a common omission from the included studies. Social behaviour and organisational culture such as territorialism, professional resistance to change or hierarchy within the system have been described as potential barriers to the implementation of RRSs (Devita et al., 2006). The impact that social behaviour and organisational culture has upon the both arms of a RRS is not well understood but there is emerging evidence that these complex interpersonal relationships and organisational factors can affect the triggering of and response to physiological deterioration (Fein et al. 2016; Massey et al., 2014). Given the complexity of these variables, it is not surprising that most studies did not include these in their design and outcome measures.

In addition to social behaviour and organisational culture, there are a number of other organisational factors (e.g. patient condition, workload, skill mix and time of day) that may affect the escalation of care that the deteriorating patient requires (DeVita and Hillman, 2006). Where real world complications such as these are requisite when conducting simulation-based educational interventions (Cheng et al., 2014), the inclusion of these experientially realistic factors into the training can present design challenges and outcome dilemmas. The benefits of including this level of experiential realism into the simulation need to be weighed against the potential disadvantages. Augmenting simulated clinical situations with real world distractors can stimulate stress responses in intervention participants (DeMaria et al., 2010). The participant exposed to this type of high fidelity experiential realism can be at risk of reactive responses that rely upon learned behaviour at the expense of higher-level critical thinking. On the other hand, this level of realism can support higher-level decision-making, improvisation and long term learning benefits (Dieckmann et al., 2007). In situ simulation is defined as simulation that takes place in the participants' actual clinical environment (e.g. the Emergency Department) and can help to overcome some of the challenges of incorporating the organisational culture and reality into the intervention (Miller et al., 2008). In situ simulation was implemented by two of the included studies (Harvey et al., 2014; Theilen et al., 2013).

While Fuhrmann et al. (2009) demonstrate the difficulties of improving measurable patient outcomes, Jones et al. (2006) demonstrate the difficulty of connecting the educational intervention to the effectiveness of these complex systems. The aim of their study was to determine the effect of a detailed education program on the rate of MET call activations three and a half years after its introduction. Though the aims were clearly described, how much the educational intervention directly influenced the MET activations remains unclear. This highlights the fragmentary nature of relying solely upon education to ensure that multifaceted organisational strategies are well implemented, evaluated and sustained.

Theilen et al. (2013) did record a trend towards reduced paediatric intensive care admissions and length of stay; and while the implementation of a paediatric MET (pMET) coincided with a decrease in patient mortality, their study was not specifically designed to measure the effect of the education on this outcome. The study demonstrated the effectiveness of regular long-term in situ education to recognise and manage real world patient deterioration. In situ simulation is an educational strategy where the simulated scenarios take place in the environment that care is actually delivered. This is a highly appropriate learning strategy when interprofessional teams are required to communicate and manage complex system processes that are impacted by organisational culture and environmental barriers (Rosen et al., 2012). Theilen et al. (2013) were able to show that in situ simulation training can reduce the time taken to recognise deterioration, time to and frequency of escalation of care as well as the frequency of consultant review in a paediatric hospital. Harvey et al. (2014) was another (pilot) study to demonstrate the additional benefits to teamwork and confidence when in situ simulation was applied to nurses' ability to recognise and act upon early warning signs incorporating TeamSTEPPS® training (King et al., 2008).

Kinsman et al. (2012) also reported improvements in the quality of real world nursing practice from a 90 min simulation (FIRST^{2}ACT). Their interrupted time series analysis demonstrated an increase in the frequency of vital signs and documentation in the 10 weeks postintervention. It is tempting to interpret this outcome as an overall improvement in the quality of observation. However, it more likely demonstrates improvements in one aspect of nursing practice and does not necessarily indicate an increase in the quality of observation. Theilen et al. (2013) and Kinsman et al. (2012) highlight the feasibility of translational research in education by demonstrating clear links between educational interventions, patient safety and quality of care.

Various educational models were employed across educational interventions. All interventions included traditional didactic classroom teaching. This traditional model was blended with combinations of paper-based scenarios without simulation, e-learning, case studies and simulation. Medium to high fidelity simulation was used in >87.5% of the educational interventions.

The use of simulation is an educational strategy that has been widely applied to traditional uniprofessional and interprofessional undergraduate preparation, postgraduate education and ongoing professional development (Crofts et al., 2006; Fuhrmann et al., 2009; Witt et al., 2010). The review showed that simulation improves overall techniques and skills while medium to high fidelity simulation had additional benefits over low fidelity simulation. Knowledge and skill retention over time was one of the most encouraging outcomes of the Crofts et al. (2007) high fidelity simulation intervention.

Debrief and reflective review of participant video recorded performance was highly rated in one third of the simulated studies. This is a critically important element of the simulation process that requires further research to ensure the best standards of education (Neill and Wotton, 2011).

Simulation is often viewed as expensive, resource intensive and time consuming to implement (Jansen et al., 2010). While the mean duration of the educational interventions was just over eight hours, one of the most educationally effective simulation program was completed in forty minutes. However, it is important to note that most simulation sessions were blended with other educational approaches, therefore the outcomes could not be attributed to simulation alone. All participants in both studies by Crofts et al. (2006, 2007) were given equal, pre-simulation education preparation. This ensured participant standardisation before their exposure to the high and low-fidelity simulation. Sittner et al. (2009) was the only study that included an 18–25 min medium fidelity simulation intervention without blending any other learning mode. The aim of their pilot study was to assess the impact of the Simulation Training for Enhancing Patient Safety (STEPS) program on nurses' knowledge and clinical judgment as well as the feasibility of this approach for a larger investigation. However, no significant improvements in knowledge were identified which may indicate the need for a blended curriculum to improve the effectiveness of education in recognising and managing deteriorating patients.

Teamwork and leadership development was also a highly valued feature of the simulation programs where debrief and reflective review were included. Despite the rapid response system's reliance upon complex interprofessional interaction, less than a third of the education programs used an interprofessional learning approach. As such, there is a need for further development and evaluation of interprofessional educational programs to improve the effectiveness of recognising and managing patient deterioration. Future research should also include studies that are designed to measure the impact of education on the quality of patient care. Attention should also be focussed upon measuring retention of skills and knowledge in the recognition and management of the deteriorating patient.

5. Limitations

The systematic review should be interpreted in the context of the following limitations. Other than a single randomised controlled trial (level I evidence), most of the studies were quasi-experimental, prospective, pre- post-intervention studies that provide level III evidence or below (Council, 2000). However, despite the need for level I evidence, the design of the randomised controlled trial (RCT) may not support the context level adaptation required of education. For example, different learners and settings can require the education program to be flexible to the participant's style of learning or their learning environment. Sample contamination is also a high risk when employing an RCT to an educational intervention. The prospect of preserving a true control group with students or staff who interact between sessions and during the study is an unknown variable that does not suit the rigor required of an RCT. Dividing formed group learning relationships could also be considered fragmentary to the learning dynamics of an established learner group.

Given that the majority (21) of the included studies reported positive impacts upon learner, patient and organisational system outcomes, the findings of the review are also at risk of publication bias (Higgins and Altman, 2008) and/or reporting bias (Sterne et al., 2008). There were, however, no studies excluded based upon the impact of the intervention on outcomes. Small participant sample size ($M = 73$) was also a limitation of the review. Finally, the use of indirect outcome measures (e.g. self-rated improvements in confidence) in some studies may not provide reliable statistical evidence regarding the efficacy of the intervention. However, the review provides educators who are designing education to support RRSs an appraisal of the evidence supporting educational effectiveness in the recognition and management of the deteriorating patient and the outcome measures used to evaluate educational effectiveness.

6. Conclusion

The available evidence supporting educational program effectiveness in the recognition and management of the deteriorating patient indicates that simulation improves overall techniques and skills while medium to high fidelity simulation has additional benefits over low fidelity simulation. There is evidence that high fidelity simulation does require a large amount of time and has demonstrated effectiveness when delivered in brief sessions as short as 40 min and that regular in situ simulation has demonstrated sustained effectiveness in the real world implementation of rapid response systems.

The outcome measures used to evaluate educational effectiveness in the recognition and management of the deteriorating patient comprise of indirect (perceptions of knowledge, skills, technical performance and confidence levels) and objective measures (e.g. pre- post-intervention) of knowledge, skills and non-technical performance. The impact upon RRS's triggering (afferent), and response (efferent) arms are also outcome measures that are used to measure the effectiveness of education supporting these systems. Measurable patient outcomes such as patient mortality, ICU admission rates and patient length of stay have been used to measure the effectiveness of education but given the amount and complexity of uncontrolled variables these outcomes are difficult to equate with education alone. However, the quality of patient assessment and documentation of care can be used as an outcome measure to evaluate educational effectiveness in the recognition and management of the deteriorating patient.

Conflicts of Interest

None.

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2.3. Implications for the Study

This chapter provides valuable evidence from the wider literature that contributes to answering a key element of the research question: are organisational climate and structure associated with the recognition and management of patient deterioration by health care professionals in an emergency department? The educational support provided to ED doctors and nurses is a key element of the structure underpinning ED patient safety. The evidence also informs key recommendations for practice and future research (see section 8.12).

Finally, it is important to note that since the publication of the paper presented in this chapter, a systematic review reported that higher levels of education were associated with lower risk of FTR and mortality in 75% and 61% respectively of the observational studies reviewed (Audet, Bourgault, & Rochefort, 2018). However, the studies identified by Audet and colleagues did not contain studies that included doctors or undergraduates. Rather, their eligibility criteria were limited to studies that investigated the associations between registered nurses' education or experience and serious adverse events (e.g. mortality) and, unlike the mixed methods approach reported in this chapter, were limited to quantitative studies in the adult acute care setting.

2.4. Summary

The evidence supporting educational program effectiveness in the recognition and management of the deteriorating patient at the planning stage of the current study indicated that:

- Simulation improves overall techniques and skills in the recognition and management of the deteriorating patient.
- Medium to high fidelity simulation has additional benefits over low fidelity simulation.

- High fidelity simulation has demonstrated effectiveness when delivered in brief sessions as short as 40 minutes.
- Regular in situ simulation has demonstrated sustained effectiveness in the real-world implementation of rapid response systems.

Furthermore, the following outcome measures are used to evaluate educational effectiveness in the recognition and management of the deteriorating patient.

- Participants' perceptions of knowledge, skills, technical performance and confidence levels.
- Objective measures (e.g. pre- post- intervention) of knowledge, skills and non-technical performance.
- Impact upon the triggering (afferent) arm of the RRS (increased MET activation and clinician ability to recognise physiological deterioration).
- Impact upon the response (efferent) arm of the RRS (i.e. time to expert review).
- Measurable patient outcomes such as patient mortality, ICU admission rates and patient length of stay.
- Quality of patient assessment and documentation of care.

The next chapter provides a detailed description of the research methodology, design and protocol. A critique of mixed method research is provided and rationale for the broader research method, including key design decisions about the timing, priority and mixing of the quantitative and qualitative study strands.

Chapter 3. Research Methods

3.1. Introduction

This study is designed to address the research question: Are organisational climate and structure associated with the recognition and management of patient deterioration by health care professionals in an emergency department?

This chapter provides a detailed description of the research methodology, as well as the rationale for the chosen design. A critique of Mixed Method Research (MMR) is provided and rationale for the broader research method as well as key design decisions about the timing, priority and mixing of the quantitative and qualitative study strands. The study setting is described in detail in order to set the context for decisions about the methods used for each study phase. Details about the sampling methods and procedures for each of the three data collection periods across Phase One and Phase Two of the project are then provided.

Finally, the ethical issues considered in the design and conduct of the study are presented.

3.2. Research Design and Overview

The aims of the research were to describe the relationships between dynamic ED characteristics (workload, skillmix and patient acuity), organisational culture (safety climate) and the care of the deteriorating ED patient.

The aims of the research were addressed through a mixed methods design comprising three periods of data collection across two phases.

The primary objective of Phase One was to examine safety culture in a metropolitan Emergency Department (ED) towards escalating care of deteriorating patients.

The primary objectives of Phase Two were to:

I. Examine the period prevalence and characteristics of care escalation for deteriorating patients in a metropolitan ED

II. Examine relationships between organisational factors (staffing levels, staff skillmix, patient casemix, occupancy) and escalation of care in patient deterioration.

III. Explore the staff experience and perceptions of escalating care of the deteriorating patient.

A mixed methods explanatory sequential design was used in two phases of data collection:

Phase One	Safety climate survey.
Phase Two	Retrospective medical record review (MMR)
	Semi structured staff interviews.

The research procedure comprised a safety climate survey which was distributed to all medical and nursing staff working in the ED at the time of the study. The SCS was conducted to measure the staffs' perceptions of the culture of patient safety in the ED. The SCS was followed by a retrospective medical record audit to identify:

- episodes of patient deterioration during a two (2) week period,
- the characteristics of each episode of patient deterioration,
- the ED profile at the time of each episode of deterioration (skillmix, workload and patient acuity), and
- potential interview participants

The potential interview participants who were identified in the audit were invited to participate in a semi-structured interview to improve understanding of the outcomes from the SCS and the episodes of deterioration.

3.3. Philosophical Assumptions

The paradigm or worldview held by researchers describe the values, beliefs and assumptions that form the researcher's perspective and approach to their research practices at a philosophical level (Creswell & Clark, 2011). The worldview that many mixed methods researchers have adopted is that of pragmatism (Tashakkori & Teddlie, 2010). However, the research paradigmatic stance that guided this research is that which best related to each strand's research objectives (Creswell & Clark, 2017). That is, multiple worldviews were applicable across the two distinct phases of the research. Where Phase One and the quantitative strand of Phase Two were predominantly empirical enquiries, the research was guided by the postpositivist philosophical worldview (confidential axiology, ontologically shaped by one reality, epistemologically objective and systematic in its methodological approach (Mertens, 2014)), Phase Two utilised a constructivist philosophical worldview. The nature of the enquiry in Phase One and the MRR postulates that there is a single reality (safety climate rating is…, period prevalence of deterioration is…) and that the relationship between the safety climate and the qualitative data were determined as the qualitative data emerged in the semi-structured interviews.

The philosophical assumptions that were applicable in Phase Two were predominantly influenced by a constructivist perspective. An acceptance that there are multiple truths to how and why deteriorating patient care is escalated was a helpful vantage point both during the interviews and when interpreting the meaning in the different participant perspectives. The relationship between, and my own closeness to, the participants' experiences, voice and the subject matter also made the constructivist lens a good fit. Where the unbiased postpositivist standpoint of the quantitative strands of the study were appropriate, my own experience of ED nursing practice had brought about biases, that if left unaddressed, would have brought the risk of incomplete study outcomes.

Though the ontological, epistemological and axiological beliefs were very well aligned with the tenets of constructivism, the methodological approach was not in keeping with the inductive constructivist ground up approach but rather those of the pragmatist. As an alternative paradigm, pragmatism philosophically accepts that both singular and multiple truths can be accepted as a worldview that aids the researcher combine inductive and deductive reasoning to address the aims of the study in a practical "what works" manner (Creswell & Clark, 2017). Framework analysis was considered an ideal approach as a deductive technique of exploring the care of the deteriorating patient and how that care aligns with the policies and systems that exist to support patient safety.

3.4. Mixed Methods Design

Regarded as the third research methodology (alongside qualitative and quantitative research), mixed methods research (MMR) takes the strengths of qualitative research to augment the potential weaknesses of quantitative research and vice versa (Johnson & Onwuegbuzie, 2016).

Mixing quantitative and qualitative research designs has been described as a discrete form of research that emerged in the late 1950s and developed throughout the following decades until the late 1980s (Creswell & Clark, 2011). Though there is evidence that mixing quantitative and qualitative research methodologies existed long before Campbell and Fiske (1959) described the concept of triangulation (Maxwell, 2016), the principles and structural norms of the method have evolved over the last sixty years. The evolution of current MMR is rooted in the early formative period between the late 1950s to the 1980s, through a period of methodological debate across the 1980s to mid 1990s and procedural standardisation until the early 2000s (Creswell, Klassen, Plano Clark, & Smith, 2011; Johnson & Onwuegbuzie, 2016). Now in its so called reflective period (Creswell & Clark, 2011), the outcomes from MMR are often considered essential to inform government health policy decisions and clinical governance in the UK and USA (Coyle et al., 2016; Fielding, 2010; McKim, 2017; Plano Clark, 2010).

Creswell and Clark (2011) describe mixed methods research as a design approach where philosophical underpinnings guide the key decisions about the data collection and how that data is analysed. The mixed methods procedures centre around gathering both qualitative and quantitative data in single, or series of related studies. The rationale for this approach is that the integration of both types of data yields a broader description (quantitative) and deeper understanding (qualitative) of the phenomena under investigation (Creswell & Clark, 2011).

Though the mixed methods approach may appear to be an obvious and more complete research design choice, there are a number of reasons why a researcher may be compelled to follow an exclusively quantitative methodology or to investigate a phenomenon with a purely qualitative research design. These decisions are often informed by a number of factors, which include the researcher's experience, the feasibility of the study, but most importantly, the aims of the research and the research question or hypothesis (Ivankova, Creswell, & Stick, 2016). For example, it may be inappropriate to attempt to prove, through generalisation, the meaning that surfaces from the experiences or reflection of a study participant in a qualitative study, while testing a new medication does not necessarily require any further explanation to reject or confirm a hypothesis about the drug's efficacy. Mixed methods research is ideally suited to a research problem where a single type of data limits the completeness of the study findings (Teddlie & Tashakkori, 2009).

The research question underpinning this study was whether organisational climate and structure are associated with the recognition and management of patient deterioration by health care professionals (doctors and nurses) in a metropolitan emergency department. The question has a number of interdependent elements that rely upon different types of data to answer the overall question. For example, one cannot draw any conclusions about the workload demands created by increased patient occupancy, without quantifying the number of patients in an ED at any given time, or the impact of sicker patients (those with higher levels of acuity) upon staff resources without knowing how many patients requiring intensive and highly technical care were present in the ED. On the other hand, staff experiences of managing deteriorating patients would be difficult to explore without first identifying deteriorating patients and the staff who cared for them through an audit of the medical records.

3.5. Rationale for Mixed methods Study Design

The rationale for the study design was based upon its capacity to address the aims of the research. The quantitative strands (survey and audit) of the research were chosen to describe i) the ED staff collective views of, and principles related to patient safety, and ii) the organisational factors (staffing levels, staff skillmix, patient casemix, occupancy) that may influence staffs' abilities to recognise and manage deterioration. The qualitative strand (interviews) was chosen as a pragmatic, feasible and targeted way to map the processes, experiences and perceptions of the ED staff during each episode of care of the deteriorating patients identified in the audit.

Quantitative data from the survey and MRR alone may not have provided the "breadth and depth of understanding and corroboration" (Johnson, Onwuegbuzie, & Turner, 2007) (p. 123) needed to explain the impact of changing workload, patient casemix and the occupancy of the ED upon patient safety (recognising and managing deterioration). Accordingly, the qualitative data from the interviews would not have been able to provide the objective statistical data to describe the problem and the factors associated with staff experiences and perceptions of the episodes of deterioration.

By triangulating the results from the qualitative interviews with the empirical data from the survey, the positivist (e.g. what is true about safety climate?) approach of the survey was strengthened by the naturalist (e.g. why is the safety climate as it is?) perspective (Greene, Caracelli, & Graham, 1989). Finally, the quantitative data also brought generalisability of the findings to the wider emergency care setting (Tashakkori & Teddlie, 2010).

When mixing quantitative and qualitative research strands, it is important that the two meet, inform and/or influence the research procedure and/or the research outcomes (Teddlie & Tashakkori, 2009). This is known as the point of interface - the point at which the quantitative and qualitative strands of the research interact or merge (Creswell & Clark, 2011) – and varies depending upon the design of the mixed methods (Clark et al., 2014). The explanatory mixed methods design of this research involved analysing the quantitative data from the audit and the SCS to inform the interview schedule (questions and prompts) and participant selection of the interviews. Therefore, the point of interface for this research occurs both during data collection and during the interpretive stage. The final interview schedule (see appendix B) was unknown until the specific quantitative data, that required explaining, had been identified. At the interpretative stage, the data from the interviews described the staff experience of communication about, and management of each episode of deterioration and was interpreted to help explain any significant, non-significant and/or unexpected data identified in the audit and SCS (Creswell & Clark, 2011).

3.6. Mixed Methods Advantages and Disadvantages

The traction that mixed methods research has gained in the last 25 years has been attributed to a number of benefits that MMR brings to the outcomes of particular research questions. Many mixed methods authors agree on the principle that, given the right research aims, MMR can provide greater generalisability and depth of understanding than either quantitative or qualitative research can in isolation (Andrew & Halcomb, 2009; Creswell & Clark, 2011; Johnson et al., 2007; Teddlie & Tashakkori, 2009). The nature of combining both quantitative and qualitative data can simultaneously allow the researcher to both confirm a hypothesis and explore a phenomenon. Further to this, MMR can enable more inferences/meta-inferences to be drawn from the convergence, or triangulation, of the two types of data at the analysis or interpretive stage (Ivankova, 2014). This effect can help to offset the inherent weaknesses of each method, such as the utility of qualitative data to provide an explanation about why a given quantitative data set is as it is.

Teddlie and Tashakkori (2009) also describe the capacity for MMR to enhance divergent views that may be produced by the two different strands. If the research does in fact produce two different conclusions, this may improve the quality of the outcomes by forcing a re-examination of one or both of the strands, the quality of the interpretive stage, or the entire design of the research.

There are, however, a number of considerations that can be viewed as barriers to implementing MMR. The complexity and diversity of research methodology skills can mean that the researcher may not possess the expertise to design and implement MMR that has the level of convergence required of the method (Tashakkori & Teddlie, 2010). This same complexity may render the method too time consuming and/or expensive to be feasible (Johnson & Turner, 2003). An example of this may be when the research aims indicate a multiphase design, where there are concurrent and sequential strands in multiple projects that can be spread across multiple years.

3.7. Mixed Methods Design Decisions

There are four design decisions about the qualitative and quantitative strands when preparing MMR. These include how much interaction there will be between the strands, the priority given to each strand in relation to the other, the timing (sequence) of the strands and how the qualitative and quantitate strand will be mixed (Creswell & Clark, 2011; Ivankova et al., 2016).

The point of interface of the quantitative and qualitative strands may be classified as being independent or interactive (Tashakkori & Teddlie, 2010). This relates to how and where the two strands meet and influence each other. An independent point of interface is usually exemplified by each strand having distinct aims, data collection or analysis, and the two strands mostly interact in the discussion of the results and conclusion. The point of interface in this research was more interactive as the results from the SCS and the patient record audit were required to shape the interview schedule and priorities, while the audit was also key to the sampling method for the interviews. The interaction of the strands was also included in the interpretative stage of the research.

The priority or dominance of the qualitative or quantitative strands refers to whether there is greater weighting given to the qualitative or qualitative strands and their capacity to address the aims of the research (Tashakkori & Teddlie, 2010). The priority of the streams can be weighted in favour of the qualitative stream having greater capacity to address the research question, which is referred to as QUAL→quan (when the QUAL precedes the quantitative data collection) or QUAL+quan (when both strands are concurrent). An MMR project that has equal priority is QUAL→QUAN, and therefore a project that addresses the aims of the research with the quantitative strand having the greatest priority is known as QUAN→qual. However, the final priority of the strands may change in some situations where the power of one strand emerges during data collection or synthesis (Ivankova, 2014). This taxonomy can also indicate the sequence, or timing, that the methodology strands occur. For example, in this study, there are two QUAN data collection periods (survey and audit) that were scheduled to take place before the qual data collection period (interviews). Therefore, the priority of the study was expressed as QUAN→qual.

The timing of the two research strands is the last broad decision that was made. The timing refers to the sequence in which the data were collected and is influenced by how and where the results from one strand influences the other strand (Creswell & Clark, 2011). The decision about the timing of this research was again informed by the aims of the research. To answer the research question, the researcher needed to generalise about the ED staff perceptions of and attitudes to patient safety, as well as describe the characteristics of deterioration in an ED, and the appropriateness of care (escalation). The results from this QUAN strand were required before an explanation about care choices, and how they were influenced, could be sought. As previously stated, there were also a number of practical reasons (e.g. interview participant sampling) for choosing an explanatory sequentially timed design.

An explanatory sequential design is one of six common MMR designs comprising:

- Explanatory sequential design
- Exploratory sequential design
- Convergent design
- Embedded design
- Transformative design
- Multiphase design

The explanatory sequential design has two phases of data collection in which quantitative and qualitative data are collected. The first phase involves the collection of quantitative data followed by the second qualitative phase which further investigates and explains data from the first phase (Ivankova et al., 2016). The conventional weighting for the explanatory sequential design is QUAN→qual, however the sampling method required for the interviews created a participant-selection variant (Creswell & Clark, 2011; Teddlie & Yu, 2007). This type of variant usually indicates a need for a qualitative priority (quan→QUAL) as the researcher needs the quantitative data to identify the participants. Though this research requires the audit to identify the participants, this is not the only function of the audit results. The audit is equally responsible for unearthing empirical patient data that describe patient safety characteristics in relation to patient deterioration and care thereof.

The current design choices are therefore best described as a mixed methods sequential explanatory design which incorporates multiple points of interaction between the quantitative and qualitative strands (i.e. during data collection and data interpretation).

Finally, there were a number of possible alternatives considered within the broader mixed methods decisions (interaction, strand priority, sequencing and mixing). For example, the semi-structured interviews were originally proposed as a series of focus groups designed to explore the staff shared experiences and perceptions of escalating the deteriorating ED patient. However, interviews were considered to better serve the aims of the study based on feasibility and ensuring that a stratification of expertise and ED experience were represented in the qualitative data. That is, the feasibility of coordinating a time when a representative sample of novice to expert doctors and nurses were available was investigated with site management, and considered to potentially cause significant interruption to the sites work processes. The decision to interview a range of doctors and nurses which represented various ED team roles (e.g. NIC, CIC, junior doctors and nurses) also contributed to the credibility of the data by enabling triangulation of the various participant perspectives (data sources) during analysis.

Similarly, an exploratory case study of a single episode of patient care could have potentially provided a rich description of the sequence of events that occur when a patient exhibits signs of physiological deterioration. However, the diverse nature of emergency care, dynamic ED patient profile and team interactions were considered contain variables that were unlikely to be represented by a design which included an exploratory case study strand.

3.8. Setting

In order to contextualise decisions regarding the methods used to address the study objectives, key details about the structures and processes at the study site are presented.

3.8.1. The site

The study site is a metropolitan emergency department in Australia. The study site hospital is a general medical/surgical hospital with adult and paediatric specialist services, maternity, orthopaedic, mental health and intensive care services. The study site ED is a mixed emergency department (adult and paediatric) with 55 treatment areas. There were 119 nursing staff servicing the ED nurse staffing allocations, and 57 medical staff during the data collection period.

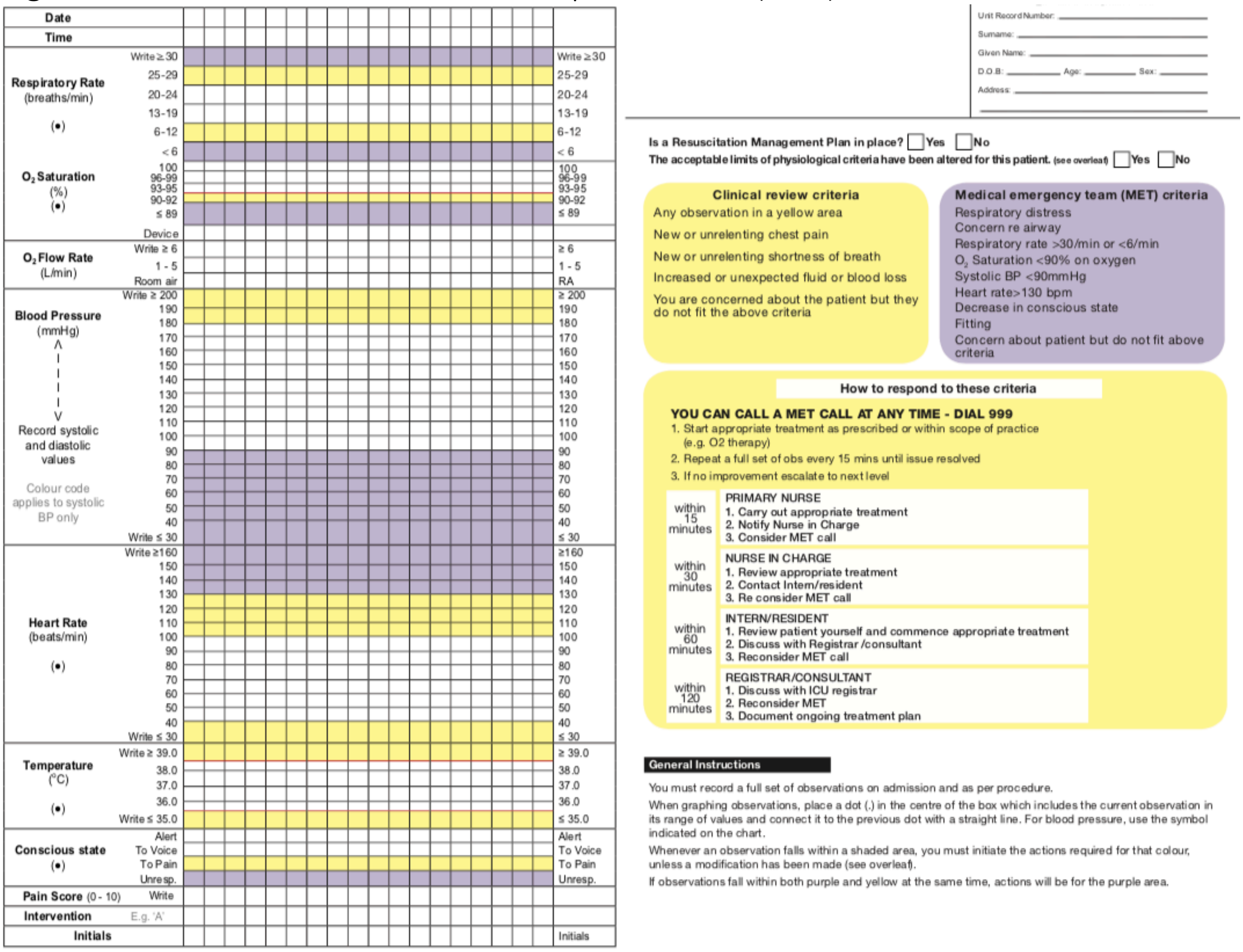
The study site was chosen based on three practical reasons: (i) its suitability to the aims of the study, (ii) the size, location and type of ED (i.e. mixed), and (iii) the researcher's professional links to the department (prior employment as a clinical nurse specialist and clinical nurse educator). Details regarding the management of this relationship are provided at section 3.13.

3.8.2. Policy and process for managing deterioration

In an effort to identify and manage physiological deterioration the site network introduced an ED specific Mandatory Alert criteria (EDMAC) across all EDs in March 2012. The EDMAC is based upon the healthcare network's Adult Medical Emergency Team (MET) call criteria and modified to identify physiological deterioration in paediatric patients (see full EDMAC policy and procedure in appendix A). The MET call criteria are a list of reportable physiological parameters that have been associated with and predictive of in-hospital mortality (Buist et al., 2004). The MET call criteria are the triggering event for the health network's rapid response system (RRS). There has been no formal evaluation of the EDMAC since its implementation seven years ago.

There are several tools, instruments and prompts that are used to support ED staff in their efforts to ensure that deterioration is recognised and responded to appropriately. For example, vital signs are graphically displayed on computer generated Observation and Response Charts (ORC) when ED staff enter physiological data about patients into the electronic medical record (EMR). The graphical charts are similar to those used in many Australian medical and surgical wards (National Safety and Quality Health Service Standards, 2015). An example of a typical ward ORC is provided in figure 3.1. In addition to the ORC format, when deleterious vital signs are entered, the system generates an automated "pop-up” alert dialogue box designed to remind the person entering the data that the patient’s care should be escalated. A suite of hand written paediatric specific ORCs (VICTOR charts) are also completed by ED nursing staff for paediatric patients when it is determined that they will be admitted to the ward.

Figure 3.1 Ward Observation and Response Chart (ORC)



3.8.3. Nurse skills-mix pathway

Two main ED competence development ‘pathways’ are available to nurses at the study site. Clinical competence progression can be supported through programmatically designed educational interventions. These programs may include graduate year program (GYP), transition to specialty practice (TSP) program and/or postgraduate emergency nursing qualifications (e.g. ED critical care certificate or Master of Emergency Nursing). The sites clinical nurse education team coordinate these programs, and in the case of the TSP and postgraduate streams, collaborate closely with a major tertiary university.

Nursing staff who do not enrol in an ED TSP or postgraduate stream are required to engage in a less programmatically designed progression model. This model is a formalised workplace competency assessment process comprising of a series of 12 emergency nursing critical care modules. The modules are designed to align with progressively more intensive processes of ED care. For example, module 10 includes competencies such as caring for patients with invasive haemodynamic monitoring and assumes that the staff member has both completed modules 1–9 and is working in a supervised capacity in the resuscitation cubicles. The modules are expected to be completed over a period that is titrated to the needs of the individual nurse and include approximately two-weeks of one-on-one clinical support from the clinical nurse educators in the workplace.

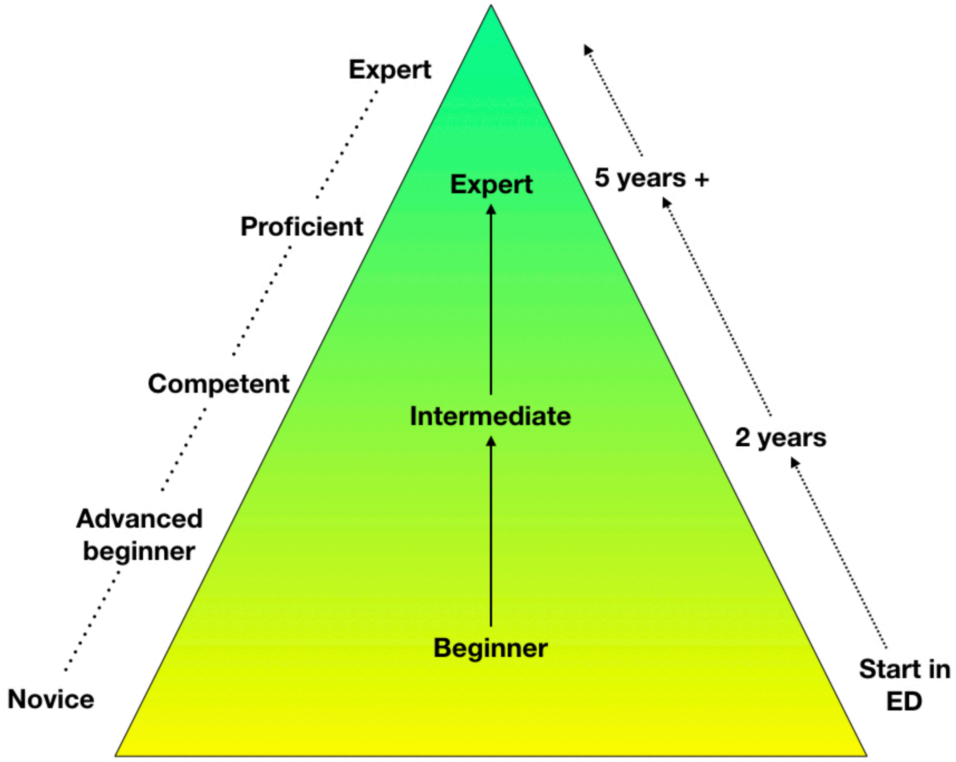
Both the programmatic and non-programmatic clinical competency progression pathways include medium to high fidelity simulation training and workplace-based training. However, there is very little insitu simulation training sessions other than informal simulations run by senior medical and/or nursing staff during workload ‘down-time’.

The ED nursing management collaborate every 2-3 months with the nurse education team to map all nursing staff against a modified Benner's expert to novice stages of clinical competence framework (Benner, 1982). The framework is called the Registered Nurse Professional Development Framework - Emergency (RNPDF) and describes the skill level of each staff member based on their clinical progression to higher acuity areas of the ED (e.g. cardiac monitoring area to resuscitation cubicles) and skills competence completion. A full copy of the framework is found in appendix C. The map of all staff is reviewed and updated when an individual staff member progresses to the next level of competence. A complete review of the map is also completed quarterly and with the intake of new staff in formal ED nursing professional development programs (e.g. Graduate year programs and transition to specialty programs). The competence mapping process ensures that staff continue to develop professionally and informs the rostering process to ensure that the correct skillmix is allocated to each shift.

Experience of staff refers to the length of time that a person has worked in the ED. Although it is not an indicator of expertise, nurses' clinical competence advancement at the study site is often aligned along a continuum of time spent working in the specialised emergency care setting. For example, novice and advanced beginners are typically nurses who have worked in the ED for approximately two years or less (see figure 3.2).

Though there is no widely accepted competency model which demonstrates valid and reliable measurement of ED doctors and nurses' level of competence (O'Leary, 2012). Like the RNPDF the Nurse Competence Scale (NCS) is derived from the Benner's novice to expert competency framework and has been shown to have acceptable (Cronbach's alpha 0.78) to excellent (Cronbach's alpha 0.91) sensitivity to measuring the competence levels of recently registered nurses working in intensive care and emergency care (Salonen, Kaunonen, Meretoja, & TARKKA, 2007). The Benner expert to novice clinical competence framework (the RNPDF competency model) is used throughout all acute and non-acute areas of the site's healthcare network. However, unlike the NCS, the validity at the site has not been formally established. This was considered to be an acceptable limitation to measuring the participants' level of competence, given its intrinsic role and integration into the site management agreed standard for staffing decisions around skillmix staffing levels.

Figure 3.2 Expertise and experience continuum - defined by the site nurse management and education team



3.8.4. Medical staff skillmix

The level of clinical competence for all doctors working in the ED are also documented in an up to date file managed by the medical education team and the senior medical staff. In a meeting between the researcher and the medical education and research team on 24 July 2018, the clinical competence of all ED doctors currently on the roster were mapped against the Benner's expert to novice stages of clinical competence framework (Benner, 1982).

3.8.5. Nurse staffing

The following rationale for staffing the ED (nursing) was outlined in an interview with three key clinical experts in the ED (Nurse Unit Manager, ED clinical Nurse Educator and Associate Nurse Unit Manager responsible for rosters). The interview took place on Monday 6th June 2016 and the objective of the interview was to establish the ED's nursing staff clinical progression (see figure 3.2), minimum skillmix standard per shift (nurse to patient ratio), the rationale for the standard and the process for ensuring the standard was achieved shift to shift.

The ED is categorised as a Group 1A emergency department under the Nurses and Midwives (Victorian Public Sector) (Single Interest Employers) Enterprise Agreement 2012-2016 (*Nurses and Midwives (Victorian Public Sector) (Single Interest Employers) Enterprise Agreement 2012-2016.*, 2012). Under this agreement, the ED nursing management were entitled to roster the ED shifts as outlined in table 3.1.

Table 3.1 Minimum rostering requirements - Nurses and Midwives (Victorian Public Sector) (Single Interest Employers) Enterprise Agreement 2012-2016

	Shift	Staffing requirements (*nurse-patient ratio)
Ratios	AM	1:3* + In-charge +Triage
	PM	1:3* + In-charge + 2 Triage
	Night Duty	1:3* + In-charge +Triage (Short Stay Unit 1:8 overnight)

The staffing requirements are based upon cubicles that are available to patients and not actual patient numbers in the ED (i.e. do not include waiting room patient numbers). Though the Enterprise Agreement allows for a nurse-patient ratio of 1:8 overnight, the study site ED staffed the Short Stay Unit (SSU) at 1:6. The RNPDF is used as a framework to align each staff member to a staff sill mix level that supports the standards set by the ED nurse management, education team and Clinical Nurse Specialist group. A complete description of the minimum skillmix level required for each shift is found in appendix E.

The Associate Nurse Unit Manager responsible for rosters assigns a roster to all nursing staff 6-8 weeks prior. The rostering process ensures there is adequate staffing to fulfil the minimum skillmix standard set for each area of the ED.

The ED is divided into a number of areas that staffed and equipped for various types of ED patient care needs. Patients are allocated to these areas and streams during the triage process. The triage allocations are based upon the patients' care needs (e.g. simple fractures are allocated to fast track). Each area and stream are allocated nursing staff comprising of various combinations of staff skillmix levels and numbers. The allocation of staff to each area is performed by a member of the education team prior to each shift and is based upon the skillmix of the staff rostered to each shift, equitable staff rotation through each ED area, as well as staffs' clinical progression requirements. The minimum standards for each area have been set through consultation with the ED nurse management, the ED clinical nurse education team and the ED's Clinical Nurse Specialist (CNS) group. The minimum skillmix standards were based upon the predicted profile of patients that would likely be allocated to each area (e.g. intubated patient allocated resuscitation area), as well as skills competence and leadership/communication attributes required by each team member. An example of this might be that an R2 may be proficient in caring for patient with acute pulmonary oedema, but still developing the expertise, leadership and communication skills required of the resuscitation team leader role.

In 2010, the ED implemented a government funded waiting room nurse. The role of the waiting room nurse was to specifically reassess and provide care to waiting room patients. Since its initial implementation, government funding has ceased. The role has, however, been retained by the ED management team the benefits which have been attributed to the role (e.g. improved patient satisfaction and decreased frequency of patients who 'did not wait')

3.9. Phase One

3.9.1. Safety Climate Survey

Safety climate surveys are instruments designed to measure the perceptions of healthcare workers that reflect the safety culture of the organisation (Brand et al., 2015). The surveys provide insight into how patient safety is handled and perceived from the perspective of the staff (Colla et al., 2005).

There are a number of safety climate measurement tools available (Colla et al., 2005; Flin et al., 2006; Hutchinson et al., 2006; Sexton et al., 2006; Valentine, Nembhard, & Edmondson, 2015). Most questionnaires measure five domains related to the climate of safety: leadership, policies and procedures, staffing, communication, and reporting. A review of the literature reveals that selecting a safety climate questionnaire should include those that are well validated with solid psychometric testing (e.g. internal consistency, interrater agreement (IRA) and reliability, structural validity and content validity (Flin et al., 2006; Valentine et al., 2015). The questionnaire should also be appropriate to the study setting (preferably has been used in a similar setting) and is quick and easy to complete (Colla et al., 2005).

A number of safety climate surveys have been developed and validated for use in different health care settings including emergency care. Safety climate surveys have been used in single site studies to a develop conceptual framework for patient safety in the ED (Alshyyab et al., 2019), as well as large multi-site studies to to assess the validity of a survey instrument that identifies systems factors contributing to errors in ED (Camargo Jr et al., 2012). A number of safety climate questionnaires were considered before deciding upon the Safety Climate

Survey (SCS) (Victorian Managed Insurance Authority and the Victorian Quality Council, 2015). This is the first time the SCS has been used in an Australian ED and the first time that the safety climate has been evaluated at the study site.

The SCS is a 43-item questionnaire adapted from the Safety Attitudes Questionnaire (SAQ) (Sexton et al., 2006) for use in the Australian healthcare setting. For example, the naming conventions of the roles were changed to suit the Australian setting. The SAQ is a valid and reliable (Colla et al., 2005) tool using seven domain items and a 5-point Likert scale, from disagree strongly to agree strongly. The SCS (see appendix E) includes a 6th point on the Likert scale (not applicable) and a free text item asking, "What are three (3) ways in which your health service can improve patient safety?". As with the SAQ, the SCS is designed to indicate frontline worker perceptions of the underlying culture of safety within their organisation and department.

The SCS was adapted from the SAQ by the Victorian Managed Insurance Authority (VMIA) in collaboration with the Victorian Quality Council and available for use by researchers and health care providers to improve patient safety and quality of care. The SCS is designed to indicate frontline worker perceptions of the underlying culture of safety within their organisation and was ultimately selected for use based upon its appropriateness to the study setting and the strength of previous psychometric testing of the SAQ (scale reliability α=0.9 and (Colla et al., 2005), and content validity index of 0.83 (Devriendt et al., 2012). Permission to adapt and use the SCS was granted by the VMIA via email in October 2017. No changes were made to the safety climate questions, but the demographic questions were modified to suit the ED setting (e.g. replaced "*What health service area, unit or department do you work in most?*" with "*What emergency department area do you work in most*?").

The SCS questions are designed to provide a measure of safety climate within healthcare organisations, across the following six attitudinal domains:

1. Teamwork Climate - Perceived quality of collaboration between personnel.
2. Safety Climate - Perceptions of a strong and proactive organisational commitment to safety.
3. Stress Recognition – Acknowledgement of how performance is influenced by stressors.
4. Job Satisfaction - Positivity about the work experience.
5. Perceptions of Management - Approval of managerial action.
6. Work Conditions - Perceived quality of the work environment and logistical support.

A full list of the survey items (questions) and their placement under the domains is found in appendix F.

The survey and its items were discussed with the site management, clinical nurse educators and a clinical nurse specialist to confirm the content validity and clarity of each item. No changes were suggested for the items under any domain.

3.9.2. Sampling

A convenience sampling method was used to recruit survey participants. All medical and nursing staff who were working in the ED at the time of the study were invited to participate in the study via email and flyer advertising within the ED (see appendix G). Medical and nursing staff were contacted via email by the ED executive assistant (not by any member of the research team) and invited to complete the survey online or in hard copy versions in the ED treatment areas. This was done to ensure the anonymity of potential participants to the researcher. At the time of the study, a total of 176 (119 nurses, 57 doctors) working various shifts in the ED were invited to complete the survey.

3.9.3. Procedure

All 176 medical (n=57) and nursing (n=119) staff employed in the ED at the time of data collection were invited to complete the SCS and were informed about the survey by a notification letter (see appendix G) sent via email as well as flyer advertising. The invitation to participate provided a clickable link to an on-line version of the survey as well as a description of where the paper-based copies could be accessed in the ED and how should be returned. The decision to offer a multi-modal (paper-based and on-line) survey collection was to create options for the staff to complete while on-duty or in their own time, as well as in an attempt to improve response rates (De Vaus & de Vaus, 2013; Kroth et al., 2009).

The paper-based version of the survey was distributed on April 12 2018 followed by the on-line version on April 13 2018. The survey distribution was followed up with regular visits to staff meetings and in-service sessions to improve the staffs' awareness about the survey. The ED management and clinical nurse education teams also advertised how to access the survey in their department "news" and departmental updates. A reminder email about the survey was sent to all staff 4 weeks after the initial distribution date.

Paper-based surveys were available in 2 areas that were highly visible to the staff. The surveys included a participant information sheet (see appendix G) describing the aims of the survey, expected time to complete (8-10 minutes), anonymity considerations and researcher contact details, as well as instructions for returning the survey. Sealed survey returns boxes were also available next to the where the surveys were placed.

The paper-based surveys were collected once per week for the duration of the data collection period. On-line surveys were downloaded directly from the on-line survey platform Qualtrics® at the end of the survey data collection period.

The survey was closed to data collection following a final email reminder and site visit 7 weeks after the survey was commenced.

3.9.4. Preparing data for analysis

The data collected from the paper-based were manually entered into the Statistical Package for Social Science (SPSS®) 2016 software by the researcher and checked by a second person with research data entry experience to reduce the chance of data entry errors. The data from the on-line version of the survey were downloaded directly from the on-line survey platform Qualtrics® as a .sav file and imported directly into SPSS® for data cleaning and analysis. The paper-based data and on-line data entries were merged in SPSS and were spot checked by a second person to ensure that the data row and columns aligned. The free text entry qualitative responses to the question "What are three (3) ways in which your health service can improve patient safety?" Were manually entered into SPSS® at the same time as the quantitative data then exported to Microsoft Excel before being directly imported into NVivo® version 12.0 (2018).

The quantitative survey data were examined for completeness when entering data into the database. Surveys were considered complete if at least 50% of each domain was completed and each part of the survey (demographic and Likert responses) had also been completed. The survey authors (Victorian Managed Insurance Authority and the Victorian Quality Council, 2015) recommend that the data from an individual survey should be removed if the respondent answered:

- less than one entire section
- fewer than half the items throughout the whole survey
- with the same response for every survey item

Two survey responses were excluded when these criteria were applied. When all quantitative survey responses had been entered into SPSS®, the data entered was closely scrutinised for any data that were not valid or missing. Invalid responses were classified as any data that were outside the range of possible responses for each variable. This process did not reveal any invalid entries. The data were also checked for any missing data. Where empty cells were found the original paper-based survey was reviewed to ensure that the response was missing from the original, and that the data were not overlooked, or that the cell had been skipped. No missing data in the cells were due to data entry error and were thus a true representation of the responses entered or missed by participants. Where missing data were identified in the item '*How is your current role best described?*', responses to the previous item (*How is your job level best described?*) were reviewed for clues to the participants role.

There are four questions (10, 18, 29 & 35) in the SCS that are negatively worded with scores of 1 or 2 indicative of a good safety climate. Negatively worded questions are included in the survey to correct for acquiescence bias (Moors, Kieruj, & Vermunt, 2014). This type of response bias can be identified where the negatively worded question response contradicts the participant's other responses. Acquiescence bias was not identified in any of the survey responses. The negatively worded questions were reverse coded before analysis commenced, but ratings of 6 "not applicable' were not recoded.

3.9.5. Survey data analysis

The statistical analysis choices for the quantitative data were made based upon the tenets of the MMR explanatory sequential design, the broader research question and the questions related to the data. The scale reliability of the original Safety Attitude Questionnaire (SAQ) was 0.94. Reliability of the SCS in this study was tested for internal consistency with Cronbach's Alpha.

Descriptive statistics were used to present participant demographic data and frequencies, means and standard deviation were calculated to describe the global safety climate rating and safety climate domains (e.g. teamwork climate, job satisfaction etc.).

Descriptive comparative frequencies of group (e.g. roles, years of experience) mean responses were reported using tables, comparative histograms and/or brief narrative statements about the safety climate rating of each item and domain (see appendix K).

A number of groups within the respondents were collapsed into larger and logical independent groups. This process enabled statistical analysis of differences between group's perception of the organisation's commitment to patient safety under all six attitudinal domains.

After consultation with an expert statistician the normality of the data was assessed with a combination of "eyeballing" graphical representations of the data and analysing the skewness of the group results for each domain.

Inferential statistical analyses were used to describe relationships and differences between the groups (e.g. work experience, roles). Testing for associations between variables was performed using independent t-tests.

Thematic analysis (Liamputtong, 2009) was used to identify codes and then broader themes in regard to the open-ended survey question "What *are three (3) ways in which your health service can improve patient safety?*". These data were used to guide the questions and prompts in the interview schedule.

3.10. Phase Two

3.10.1. Retrospective Medical Record Review

Retrospective medical record review (or audit) is a form of data collection where pre-recorded patient data are used as the primary source of information required to answer a research question. In the healthcare setting, this method of data collection is well suited to research that is designed to answer research questions about adverse events, patterns of behaviour and processes where randomisation and controlling is either not possible or not appropriate (Gregory & Radovinsky, 2012). One of the advantages of the method is the accessibility of large databases of real-world data that has already been collected and, depending on how the records are stored, are searchable either by hand or electronically. (Worster & Haines, 2004). There are, however, a number of inherent disadvantages related to collecting data retrospectively from medical records. The disadvantages include, but are not limited to the completeness, quality and timing of the data entry 'at the bedside' (Alpert, 2016). That is, human error, competing priorities (e.g. patient care) and standardisation of data entry models can lead to omissions and data entry errors. For example, a nurse who recognises a deleterious vital sign may actually escalate the patients care as per the hospital protocol, but may not record the escalation in the patient's medical record. To compensate and offset the risk of missing or misinterpreting data errors or omissions, other patient care processes were interrogated to establish whether the patient's care had, in fact, been escalated. For example, if the patient had been moved to an ED care area where a higher level of critical care could be provided, or an intervention was initiated which could only have involved review and intervention of a doctor or nurse in charge (e.g. commencement of IV fluid resuscitation).

A retrospective medical record review of patients cared for at this study site was decided upon based upon feasibility and the information needed to address the aims of this study. That is, to examine i) the period prevalence and characteristics of care escalation for deteriorating patients in a metropolitan ED, and ii) relationships between organisational factors (staffing levels, staff skillmix, patient casemix, occupancy) and escalation of care in patient deterioration.

The actions of health care staff who documented vital signs which met the EDMAC calling criteria are referred to as escalation practices throughout this thesis. In the context of the current research, appropriate escalation practice was defined as documented evidence that the patient's status has been reported to the consultant (CIC) and nurse in charge (NIC). A situation where there is no documented evidence that the patient's status had been discussed with the person/s in charge was deemed to be inappropriate escalation practice. Inappropriate escalation practices are also referred to as 'failure to escalate' (FTR) in this thesis.

3.10.2. Data collection tools

Three separate data analysis reporting tools were created in collaboration with the site's health network data analyst to identify the first episode of physiological deterioration of any patient who reached EDMA criteria during a two--week period and the characteristics (patient casemix and occupancy) of the ED. The source data for each data collection tool was the ED patient record management system called Symphony®.

Patient record audit tool

Version 1 (V.1) of the patient record audit tool was a Microsoft Excel® spreadsheet with pivot tables designed to identify any episodes of physiological deterioration documented during any patient episode of care (i.e. from admission to separation from ED or hospital). The spread sheet functions included filtering by date and site, then sorting for any patients with documented vital signs which met the Emergency Department Mandatory Alert Criteria (EDMAC) (see appendix A). These episodes are referred to as episodes of deterioration. The reliability of the tool was tested by conducting a manual hand audit of 377 ED episodes of care that occurred over a 48-hour period in April 2018. The episodes of deterioration identified during this process were then cross checked against the pivot table to ensure the reliability of the pivot table data. Though the V.1 pivot table audit tool identified all episodes of deterioration that were unearthed in the manual audit, false positives were also identified by the pivot table. This was thought to be due to irregular vital sign range limitations that were built into the pivot table. An example of irregular vital signs range limitations was the pivot table's peripheral oxygen saturation (SpO2) filter. The percentage values that were available to filter from were 100, 99 and so on down to 78. The next selectable value after 78 was 0001. The combination of these irregularities and the false positives indicated the that the tool was unreliable as a data collection tool.

Version 2 (V.2) of the patient record audit tool was redesigned to access the same source data, but vital signs data were not limited by irregular ranges. V.2 was also designed and built as a web interface to the Symphony® database. By entering a date range in the web interface, a report is generated containing the following de-identified patient details:

- Unique identifier number
- Gender
- Age
- Date of admission to ED
- Time of admission to ED
- Triage presenting problem
- Diagnosis
- Presenting problem (the category of illness/injury initially allocated by a triage nurse to all patients presenting for care at an emergency department
- ED length of stay
- Separation status (e.g. discharge, admit to ward, admit to ICU, transfer, SSU admission)
- All the recorded patient vital signs (respiratory rate, heart rate, systolic and diastolic blood pressure, SpO2 and Glasgow Coma Scores) for each patient episode of care

The patient details and all vital signs were then exported to an Excel® spread sheet to be examined for any patient with documented vital signs that meet the EDMA criteria. The reliability of the tool was again cross checked with episodes of deterioration in the manual hand audit of 377 patient records from April 2018. No false positives or false negatives were identified during this process, and the identification of all episodes of deterioration were replicated exactly through both search methods.

ED profile tool

The ED profile tool was developed as a web-based interface designed to describe the casemix, occupancy and acuity of the ED at the time of each first episode of deterioration. The ED profile tool generates a “snapshot” of the status of the ED at the time of each episode of deterioration from data stored in the Symphony® database. The report was accurate to the hour and shows the number of patients (paediatric and adult) being cared for in the ED, the triage category of each patient and the number of patients awaiting admission to the intensive care unit (ICU).

ED workload tool

The ED workload tool was a Microsoft Excel® spreadsheet with pivot tables designed to quantify how many new patients arrived each hour prior to the episode of patient deterioration. The reliability of this tool was cross checked against hourly arrivals directly from the Symphony® recorded arrival times of 50 patients who arrived in an 8-hour period. The arrivals were counted per hour and compared to the ED workload tool values. All data were the same for the workload tool and the manual counting process.

The rationale for collecting these data was based upon each variable's capacity to describe the demands placed upon the ED staff and the time of the episode of deterioration, as well as the feasibility of collecting that data. The number of patients being cared for describes how many patients the staff were managing at the time, the triage category data represents how unwell the patients were (acuity), and the number of patients awaiting transfer to ICU were a proxy for patients that required complex care and increased staff resources (e.g. 1:1 staff to patient ratio). Finally, the ED arrivals per hour represents workload fluctuation in the hours preceding each episode of deterioration. There are a number of clinician workflow performance indicators including a directive that each patient has a provisional diagnosis and plan of care documented within 2-hours of arrival in the ED. To meet this directive, the patient must be assessed, initial treatment commenced, investigations ordered, results reviewed, and if needed, specialist consultations commenced. There is also evidence that dynamic changes in workload can have a negative impact on recognition escalation of care of the deteriorating patient (Park, Blegen, Spetz, Chapman, & De Groot, 2012). Therefore, the number of patients who arrived in the hour which the episode of deterioration occurred, as well as the two hours preceding the episode provided an indication of the workload demands that were placed upon the staff during that time.

Data were also collected about the skill level of the team responsible for caring for the patient with documented signs of deterioration. Staffing allocations logs and Symphony ® records were searched to identify i) potential interview participants, and ii), the RN staff skill level profile at the time of the episode. This was done by comparing staff that were on duty, or made relevant entries in the patients' medical record, at the time of each episode with the site's corresponding current RN Professional Development Framework (see appendix C). This process allowed the researcher to categorise the nursing staff in alignment with the Benner's

Novice to Expert ranking (Benner, 1982) as well as compare the staffing skillmix and numbers with the staff minimum standard requirements described in section 3.8.3.

3.10.3. Sampling

The sampling method for Phase Two was chosen based upon its suitability to both the quantitative and qualitative strands of the research. That is, the sampling method was chosen to help identify:

i) the period prevalence of deterioration (QUAN),

ii) the period prevalence of failure to rescue (QUAN), and

iii) potential interview participants based upon their involvement with the care of the deteriorating patient (qual).

Quantitative sampling

The medical record review sample included all patients who were cared for during the 2-week data collection period commencing July 16 2018. This ensured that a range of all ED occupancy levels, times of day and staff shift types were represented during the period.

Qualitative sampling

Purposive sampling is used when a specific representative subset of people were required to provide the information that was needed to address the research question and specific aims of the research (Teddlie & Yu, 2007). This method of sampling was chosen to identify participants who had recently cared for a patient/s with signs of deterioration and could provide insight into the staff experience and perceptions of escalating care of the deteriorating patient.

The episodes of deterioration identified in the medical record review were used to identify potential interview participants and by using the staff roster logs and ED area staff allocations. Potential interviewees were contacted by the ED executive assistant (not by any member of the research team) and invited to participate in the semi-structured interview. The invitations were extended to participants within 48 hours of the episode of deterioration. This timeframe was chosen based upon the likelihood that participants will have better recollection of details related to the episode of deterioration (Memon, Meissner, & Fraser, 2010).

3.10.4. Procedure - Medical record review

A retrospective medical record audit was carried out in a process that included 5 steps each day during a 2-week period that commenced July 16 21018.

Step 1 - The patient record audit tool was used each day to generate the report described in the previous section. The report was sorted by each of vital sign column from lowest to highest for respiratory rate (RR), systolic blood pressure (SBP), SpO2 and Glasgow coma scale (GCS). Heart rate (HR) was sorted from highest to lowest to lowest to identify all episodes of patient deterioration from the previous day. There is no criterion for bradycardia in the EDMAC, therefore only patients with tachycardia (HR>130) were searched for. Any patient with a GCS <13 was included and their data were collected. The details of all patients with recorded vital signs that were found to meet the adult or paediatric early warning signs of the EDMAC (see appendix A) were included for data collection.

When each episode of deterioration was identified, the patient and episode details of each deteriorating patient described in the *Data collection tools* section were exported to a secure excel spreadsheet:

Step 2 - The patient medical record of each patient with documented evidence of physiological deterioration was then audited by hand to identify or confirm the following:

- The nature of the first episode of deterioration (i.e. heart rate, respiratory rate, blood pressure, oxygen saturation and conscious state).
- If indicated, whether care was appropriately escalated according to the EDMAC.
- If any actions were taken in relation to the episode of deterioration.
- These details were then manually entered to the corresponding rows of the secure spread sheet.

Step 3 - When the time of the first episode of deterioration had been established, the ED profile tool was accessed and a report containing the patient casemix profile, or snapshot, of the department at that time was generated and exported to the secure spreadsheet in rows corresponding to the episode details of steps 1 and 2. These data snapshots included the following details at the time of the first episode of deterioration:

- The total number of patients being cared for in the ED.
- The triage categories of all patients in the ED.
- The number of patients were awaiting transfer to ICU.

Step 4 - The final ED workload data collection tool was then accessed and the number of patient arrivals in the 2 hours prior to each first episode of deterioration from step 1 and 2 were recorded in the secure spreadsheet in corresponding rows.

Step 5 - Finally, the staff allocations and patient medical records were accessed and the names of the team members caring for the patient at the time of the episode of deterioration were recorded. The staff identified in this step were contacted on behalf of the researcher by a site employee and invited to take part in a semi-structured interview as soon as possible after the event.

3.10.5. Semi-structured interviews

In keeping with the conventions of a mixed method explanatory sequential design, the qualitative data were collected after the initial survey and audit quantitative data (Creswell & Clark, 2011). These data were collected during a series of semi-structured interviews to explain the findings from the SCS and the medical record audit.

Interviews are widely used in qualitative data collection with the assumption that purposive sampling is likely to provide participants with specific knowledge about the topic. This type of data collection can bring out rich information and insights into peoples' behaviours, experiences, thoughts, feelings and perceptions of the topic or events under investigation (Gubrium & Holstein, 2001). Interviews are also well suited to research questions that require information from different people who may have different or complicated perspectives about common events (Holstein & Gubrium, 2003).

3.10.6. Interview schedule

The aim of a semi-structured interview is to explore insider experiences, perspectives, thoughts and feelings about the study area (Liamputtong, 2009). The interview schedule was used to provide potential questions and prompts to elicit information about the participants experience and perceptions of recognising and responding to patient deterioration in the ED. The interview schedule was also guided by the interview responses and sequence with which information was provided by the participant. That is, the schedule was not always followed sequentially, but rather the information provided by the participant guided the flow and sequence of information gathering.

However, the structure of the interviews was planned in advance based upon the question types and sequence outlined by Johnson in Gubrium and Holstein (2001). The planned sequence of the questions followed an introduction to the topic by asking the participant about their understanding and experience of recognising and escalating the care of the deteriorating patient. The next questions were designed to transition and steer the conversation towards the episode of deterioration before the details of the event were explored in detail. The remaining questions were used to examine the participant's preferences, practice and ideas for improving care for deteriorating ED patients.

The interview questions began with some demographic data. The data collected here was included to help create typologies about the participants (role, experience etc.). The core interview questions were constructed based on the researchers experience of caring for deteriorating ED patients, the 'failure to rescue' literature and the expert opinions of ED nursing colleagues (ED clinical nurse educators, ED clinical nurse specialists and ED nurse practitioners). Given the timing of the interviews in relation to collecting data during the MRR, the data from the MRR were not yet fully analysed at the time of each interview. Therefore, trends and initial interpretations of the audit data were used to inform development of the interview questions and to provide credibility for the areas explored in the interview. Consequently, the questions were not piloted, but rather adjusted during each interview to facilitate data collection. The questions were also designed to be open ended and to avoid dichotomies to promote more in-depth information from the participants (Liamputtong, 2009). A full version of the interview schedule is available in appendix C.

3.10.7. Procedure - Interviews

As stated previously, participants were contacted via email by an individual who was an employee at the site but was not a member of the research team. Invitations included an interview explanatory statement (see appendix H) that described what the participation in the interview involved, why they had been contacted, the voluntary and confidential nature of the interview, as well as information about potential benefits and disadvantages of participating, how to lodge a complaint and contact details of the research team.

When participants contacted the researcher, a time and meeting venue were agreed upon that was mutually suitable to both the participant and the researcher. The interviews were conducted in a variety of places that ensured privacy.

The interviews begun with introductions to establish rapport and an overview of the aims of the research, as well as a brief outline of the interview process and its purpose. Motivation for the interview was relayed in terms of the potential for the information to help provide evidence to inform policy design, clinical governance and ED practice development related to patient safety, as well as providing ED clinicians with evidence to improve the quality and effectiveness of the care they provide. The expected interview time-line of 30-40 minutes were relayed and then participants were asked to read and sign the participant information and consent form before the interview began.

Before commencing the interview, each participant was reminded that the discussion could possibly elicit some degree of emotional discomfort, and the participant could terminate the interview or take a break if they wished.

The interviews were audio-taped and a notepad was used to take notes about ideas and information that the interviewer may have wanted to return to as well as details about the interview venue, date and time and participant. The interviewer also used these notes to return to ideas and discussion points that required clarification and confirmation of the interviewers understanding.

3.11. Preparing data for analysis

Data from the medical record review and the interviews were prepared in different ways.

3.11.1. Quantitative data preparation

The master secure spread sheet used to store all medical record audit data was prepared for importing to SPSS® by first removing all extraneous columns that had been included in the initial ED patient record audit tool (e.g. hospital name and data source identifier). Each column and row were visually inspected for any missing data before being prepared for importing into SPSS® for data analysis.

The data collected included categorical (e.g. Gender), ordinal (e.g. triage category), ratio (e.g. Vital signs) and interval (e.g. ED length of stay) levels of measurement. There were 39 items that required coding for entry into SPSS®. A codebook was created listing each item name, item variable, coding instructions and level of measurement. The coding instructions were different depending on the variable and its level of measurement. For example, gender was assigned the codes 1 = male, 2 = female, whereas the length of stay in minutes did not require recoding. Other data were assigned codes based upon their Symphony assigned codes (e.g Sprain/strain involving >1 body region = T039) and some codes were assigned by the researcher in a consistent way (e.g. Benner's novice to expert rating were coded 1 = novice, 2 = advanced beginner, 3 = Competent, 4 = Proficient, 5 = Expert).

Where required, grouped data were collapsed for different reasons. Grouped data were collapsed into larger groups either because of the groups represented a more logical representation of the data, or because of low frequency of data. For example, the competence levels of the staff who documented an episode of deterioration were collapsed into three logical groups that represent three distinct stages of the staff's clinical competence progression (beginner, intermediate and expert). Additionally, data about the staffing levels/skillmix were collected in categories of *at, below* or *above standard*. However, due to the low frequency (n = 2) of episodes that were above standard, the categories were collapsed into *below standard* or *at or above standard.*

3.11.2. Qualitative data preparation

The audio tapes of the semi-structured interviews were saved to a secure folder on the researcher's computer and backed up to a secure encrypted hard external hard drive. The files were labelled with dates, times, interview number and participant identifier information such as their role and a pseudonym to protect the participant's confidentiality. Each audio recording was listened to by the researcher to identify any recordings with low quality audio (i.e. difficult to understand what was said). Any recordings considered low quality were transcribed to a Microsoft Word file by the researcher. All other audio recordings were sent to a professional transcribing service recommended by the researcher's faculty/school. The interview transcriptions were returned to the researcher, whereupon each interview was listened to again while following along with the transcriptions. This part of the process was carried to out to confirm the accuracy of the transcriptions before being prepared for analysis.

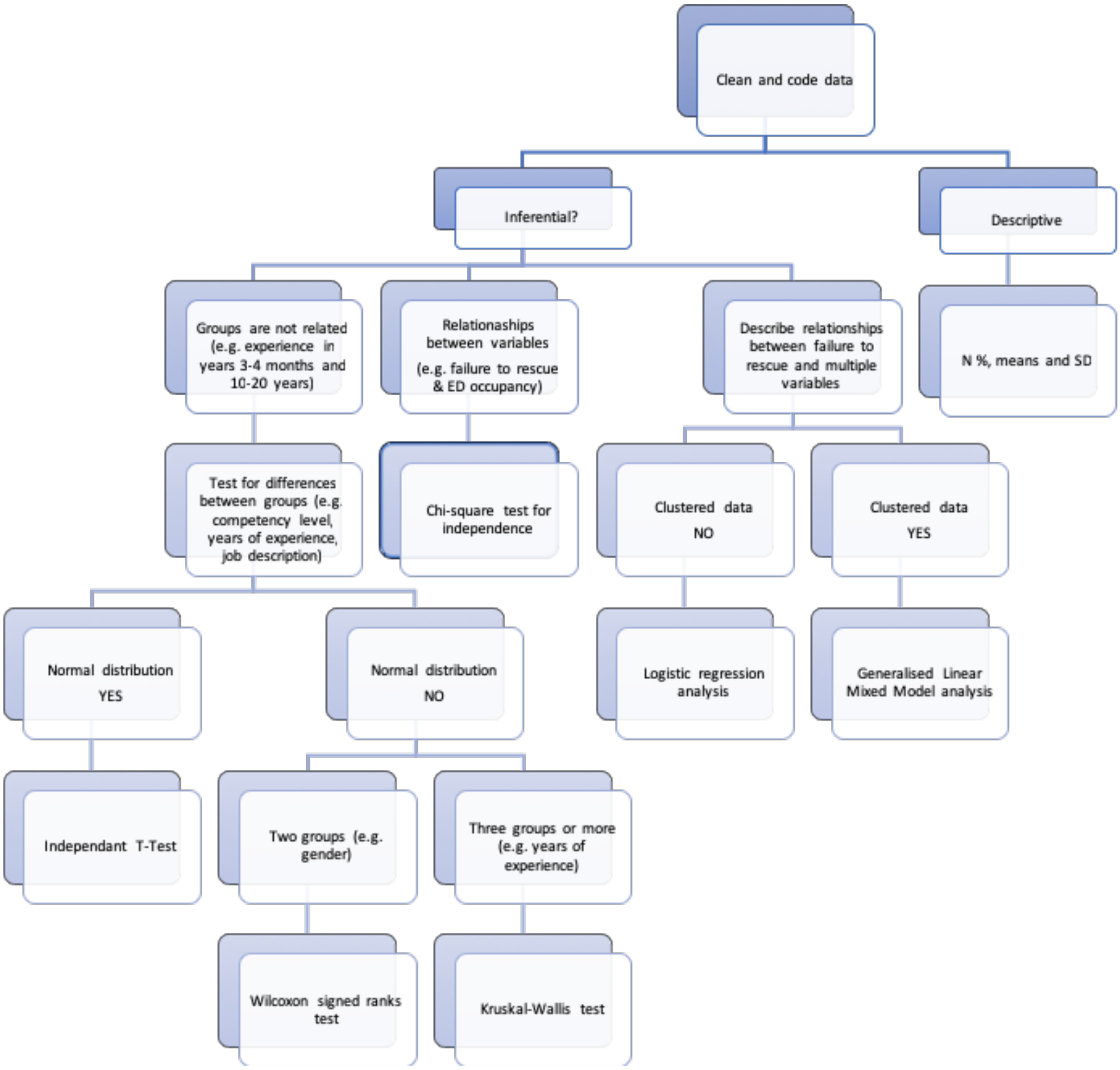
3.12. Quantitative analysis

As stated earlier the statistical analysis choices for the quantitative data were made based upon the tenets of the MMR explanatory sequential design, the broader research question and the questions related to the data.

After being prepared for data analysis, the medical record review data were imported into SPSS®. Descriptive statistics such frequencies, means and standard deviation were used to describe patient demographic data, characteristics of deterioration (e.g. age, nature of physiological deterioration), the organisational characteristics (e.g. ED occupancy) of each episodes of deterioration.

Inferential statistical tests were used to analyse relationships between variables (e.g. relationships between ED occupancy and failure to rescue or failure to rescue and staff skill level). Following expert statistical consultation, data were tested for normality by analysing the skewness of the data combined with what was logically expected. Chi-square tests for independence were used to explore relationships between independent categorical variables (e.g. competence level) and dependant categorical variables (escalate or not escalate). Following consultation with an expert statistician, a generalised linear mixed model regression analysis model was chosen as the most appropriate analysis to examine the relationships between staffing levels, staff skillmix, patient casemix, occupancy and escalation of care in patient deterioration. A visual analysis design tree (adapted from Wynter (2017)) was also used to guide analytic test decisions at the analysis stage of the study (see figure 3.3).

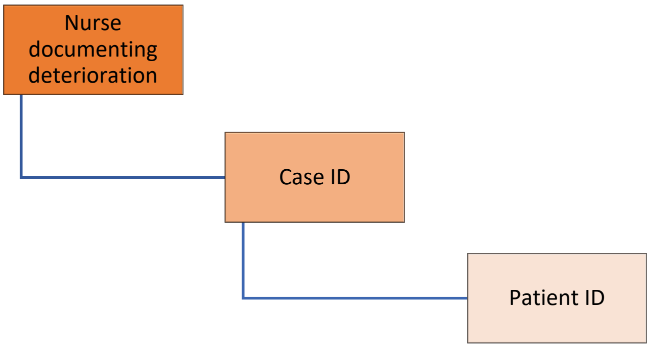
Figure 3.3 Data Analysis Decision Tree (adapted from Winter, 2017)



Generalised Linear Mixed Model (GLMM) Analysis is an extension of logistic regression analysis which accommodates for both fixed and random independent variables (predictors) (Hedeker, 2005; McCulloch & Neuhaus, 2014). Like logistic regression analysis, GLMM analysis (a type of Generalised Linear Modelling) is a predictive statistical regression model that can be used to analyse correlation with, and draw inferences about, independent variable impact upon categorical outcomes. Unlike logistic regression, which assumes that all variables are fixed observations that are independent of each other, GLMM allows for multilevel (clustered) data (Hedeker, 2005).

Initially all variables were entered into a GLMM and the data was nested into the following hierarchy: nurse ID → case ID → patient ID (see figure 3.4). The data collected for each of the 110 episodes of deterioration indicated that 11 of the nurses who documented the first episode of deterioration appeared in more than one case producing a clustered effect that needed to be considered when building a predictive regression model. There was also 1 patient who appeared in more than 1 case (n = 2).

Figure 3.4 Generalised Linear Mixed Model data structure



The probability distribution was considered to be a binomial distribution given the following criteria, and therefore a binomial probability was used in the model:

- Each case was a repeated investigation of the same possible dichotomous outcome (i.e. patient care was either escalated or not escalated)
- The probability of escalation/non-escalation was the same for each case
- Each case was independent of all other cases (i.e. the outcome of each case was not dependent on the outcome of any other case)

The target, or dependent, variable was a dichotomous variable (either escalated or not escalated). Where the frequencies of independent variables were too small to provide meaningful statistical results, the variables were recoded as aggregated categorical data or collapsed into logical groups before being entered into the model.

Initially all independent variables were added to the model as fixed effects and analysed to identify any data that were statistically significant and provided meaningful results. Variables were coded to provide a contrast series that represented a logical comparator. Where there was no obvious or logical contrast series, the series with the largest frequencies were used as the contrast.

3.12.1. Qualitative analysis

Framework analysis is a systematic qualitative data analysis research method that is a variant of thematic and content analysis. The method was developed in Britain in the mid 1980s as a deductive qualitative data analysis method that is well suited to policy related qualitative research questions and aims (Miles, Huberman, & Saldana, 2013; Spencer & Ritchie, 2002). Unlike the inductive nature of other qualitative analysis methods (e.g. Grounded Theory), framework analysis is a deductive approach to exploring an hypothesis with an a priori set of assumptions and theories (Pope, Ziebland, & Mays, 2000). That is, general theories, or hypotheses are explored in a systematic process that start with very specific questions and aims to arrive at a logical explanation, rather than a constructivist approach to building a theory from the ground up (Smith & Firth, 2011).

Framework analysis methodology has also been credited with improving upon some of the criticisms encountered by thematic analysis such as a lack of sufficient depth, potential subjectivity and a rationale for how themes were arrived at which may be opaque (Braun & Clarke, 2006). The strength of framework analysis is the transparency of the process for generating themes during the interpretive stage and the ability to move back and forth from the summaries to the themes and the original data. This improves the overall methodical nature of the analysis and transparency of the process (Barnett-Page & Thomas, 2009; Miles et al., 2013).

The technique reduces the data to summaries and syntheses rather than themes and requires the researcher to then link the summaries back to the interview data. Pope, Ziebland and Mays (Pope et al., 2000) provide an outline 5 stages for conducting framework analysis (Spencer & Ritchie, 2002) that were followed during the qualitative analysis of the interviews for this study as follows:

Stage 1: Familiarisation - The audio recordings are listened to initially and then again while reading the transcripts, referring to the hand-written field notes taken during the interviews and listing key ideas and recurrent themes.

Stage 2: Identifying a thematic framework - Not unlike conventional thematic analysis, during this stage the raw transcripts were examined to identify recurrent themes, ideas and concepts related to the implementation of the EDMAC policy and procedure that were discussed by the participants. This stage reduces the data to manageable yet detailed themes that are easily retrieved for further exploration.

Stage 3: Indexing - A thematic index of all of the transcript data was systematically applied to all text by coding the transcripts to “nodes” in the qualitative analysis software package NVivo® along with supporting text descriptors that elaborate on the index headings. This was done as a large number of different themes can often be identified within a short passage of text.

Stage 4: Charting - During this stage the data was rearranged according to the themes in the framework that enabled syntheses of the ideas expressed by one or more of the participants and summaries of the views, ideas and perceptions of the participants were extracted and recorded. The chart headings were created from the thematic framework and the a priori research questions.

Stage 5: Mapping and interpretation - The final stage of framework analysis involved using the charts created in the fourth stage to:

- describe and define the concepts identified,
- Search and identify associations, connections and explanations for the how deterioration is recognised and managed.

Mapping and interpretation were completed by defining and summarising the indexed interview data in NVivo®, then transferring the summaries with quotes from participants that illustrated their perceptions, opinions and experience of the factors that influenced escalation practices of deteriorating patients in the ED.

3.13. Rigour

Consideration about the rigour (trustworthiness) in relation to the credibility, transferability, dependability and conformability with which qualitative data were collected, analysed and synthesised are outlined in this section.

Credibility

The aim of semi-structured interviews is to explore insider experiences, perspectives, thoughts and feelings about the study area (Liamputtong, 2009). The interview schedule was used to provide potential questions and prompts to elicit information about the participants experience and perceptions of recognising and responding to patient deterioration in the ED. Therefore, the schedule was developed with expert supervisory review and opinion about the credibility of the question types. That is, their potential to best address the aims of the study contingent on an a priori set of assumptions about the focus of the enquiry. In other words, is the interview schedule likely to elicit the data that it is supposed to? The interview schedule was also guided by the interview responses and sequence with which information was provided by the participant. That is, the schedule was not always followed sequentially, but rather the information provided by the participant and guided by the flow and sequence of information gathering.

Transferability

In order to contextualise decisions regarding the methods used to address the study objectives, key details about the structures and processes at the study site are presented in Chapter 6. The description of the site structure, policy and practice is also provided to provide the reader with sufficient context about how well the study outcomes are transferable to their own practice setting. These details are an important element of the transferability, and therefore trustworthiness, of the research when considering the qualitative data and outcomes from the interviews (Given, 2008).

Dependability

The details of each element of the study method are described to communicate and strengthen the generalisability of the quantitative data and dependability of the qualitative method (Given, 2008).

Conformability

Given the researcher's prior professional links to the study site (see section 3.8.1), the researcher's confirmability (impartiality) was likely prone to bias when collecting and analysing the data. Through acknowledging this risk when designing the study, and maintaining awareness throughout the data collection, analysis and synthesis phases, the risk to conformability was considered to be minimised (Given, 2008).

3.14. Data management

The data collected during the survey, electronic patient data collected during the retrospective patient record audit were de-identified and stored in an encrypted database on a password protected computer and kept in a locked office of the primary researcher. The recordings and transcripts of the semi structured interviews were also stored in an encrypted folder on a password protected computer and kept in a locked office of the primary researcher. All printed survey documents were stored in a locked filing cabinet in the locked office of the primary researcher. All data relating to this research project will be kept for seven years before being securely disposed.

3.15. Ethical considerations

Prior to applying for ethical approval, the project was discussed with the Chairperson of the Emergency Research Committee, the Program Director Emergency Medicine and the Nurse Unit Manager to ensure appropriate arrangements have been made for the Emergency Department to assist with the project. Ethical approval for the research was sought and approved by [name of health service] Human Research Ethics Committee (HREC) and the Monash University Health Human Research Ethics Committee. This research was considered High Risk Research involving humans and a National Ethics Application Form was lodged with Research Directorate for HREC Review. Ethics approval was approved by [name of health service] HREC from 12 December 2017 (NMA HREC Reference Number: HREC/17/xxx/510) in accordance with the research conforming to the National Health and Medical Research

Council Act 1992 and the National Statement on Ethical Conduct in Human Research (National Health Medical Research Council, 2007).

Site-Specific Assessment (SSA) authorisation was required for the single site participating in the study. SSA was authorised (NMA SSA Reference Number: SSA/17/xxx/599) before the research project commenced.

This research was undertaken in line with the National Statement on Ethical Conduct in Human Research and reflects the values and principles of human autonomy, beneficence and confidentiality (National Health Medical Research Council, 2007). Autonomy is the notion that that participants have ultimate control over their choice to participate. The freedom to make this choice is indicated by the participant providing some form of confirmation that they consent to take part in the research (Avasthi, Ghosh, Sarkar, & Grover, 2013). Beneficence is the concept that no harm will come to the participants as a result of the research, but rather there is a premise that the outcomes of the research will be of some benefit to the participants. There is also an ethical obligation for the researcher/s to keep the participants apprised of potential harm might come from participating and what benefits are associated with the research (Sales & Folkman, 2000). Anonymity is also a firmly held principle that must be ensured for Individual participants and research sites alike. Researchers must provide a mechanism to ensure that the study site, participant information and data are not identifiable (Emanuel et al., 2008). The processes for autonomy, beneficence and confidentiality are different for each part of the present study and are described in the following sections.

3.15.1. Autonomy

Participant involvement in the study was completely voluntary and participants were informed that if they wished to withdraw from the study at any time had the right to do so.

The research was a series of 3 data collection periods in 2 phases. In Phase 1, emergency department staff were invited participate in a safety climate questionnaire via email and advertising within the ED. There was no obligation to participate in the surveys as participation was on an opt-in basis. In Phase Two, potential interview participants were invited on behalf of the researcher by a site staff member who was not a part of the research team and was not in a position of power over the staff who were invited. The invitations were distributed via email containing researcher contact details for those who chose to opt in. To ensure that potential participants in no way felt compelled to take part, there were no explicit or inferred consequence to taking part in the interviews, and participation or non-participation was not communicated to site management. Participant information and Consent Forms (PICF) (see appendix I) were distributed to the staff that agreed to participate in the questionnaire and semi-structured interviews.

3.15.2. Beneficence and Non-Maleficence

There were no foreseen risks or disadvantages to patients from the audit or to staff that take part in the SCS and interviews. Due to the retrospective nature of the audit, there was no interaction between the researcher and patient. However, minor interruption to work schedules may have been experienced by interview participants due to the time taken to conduct the interview. To minimise this, the interviews were conducted during double staffing time, or at a time best suited to the interviewee. There was also a small risk that interview participants may experience minor emotional discomfort when discussing experiences and perceptions of escalating the care of deteriorating patients. Participants could ask to stop the interview at any time and debriefing sessions to address any concerns if required.

There was no guarantee that the participants would benefit directly from the research, but it was proposed that the research will provide evidence to inform practice change locally, if appropriate, and to potentially feed into national policy design, clinical governance and practice development for patient safety in the ED.

3.15.3. Confidentiality

Anonymity and confidentiality were addressed in slightly different ways for Phase One and Phase Two of the study. In Phase 1, the SCS included demographic data items. It was essential that the combination of these items do not render an individual to be identifiable. The demographic data items were reviewed with clinical colleagues to minimise this possibility. The collection of grouped, rather than raw, data for items such as age and length of service was part of this process. Whilst raw data is preferable for analysis purposes, the need to optimise anonymity took priority.

In Phase Two, the retrospective audit data included de-identified demographic data (e.g. age, gender) and details of the episode of care (e.g. date of admission, triage presenting problem, vital sign measurements). The audit was conducted at the study site where each patient record audited was assigned a unique study identification number that is recorded in the audit tool.

The data collected during Phase One and electronic data collected during Phase Two were de-identified and stored in an encrypted database on a password protected computer and kept in a locked office of the researcher. All printed documents were stored in a locked filing cabinet in the locked office of the primary researcher. All data relating to this research project will be kept for 7 years before being securely disposed (National Health Medical Research Council, 2007).

3.16. Conclusion

A discussion of the overall methodology and the research design decisions have been provided in this chapter. A decision to use a mixed methods research design was influenced by the nature and complexity of the research aims, the capacity of the method to provide both quantitative breadth and qualitative depth of understanding to the research outcomes, and to strengthen the inherent weaknesses of each distinct strand of the study.

A mixed methods modified sequential explanatory design was chosen and the key decisions and rationales about timing, priority and mixing of strands have been discussed. The ethical considerations, sampling methods and procedures for each of the three data collection periods across Phase One and Phase Two of the project have been described in detail.

The results from the safety climate survey, medical record review and staff interviews will be presented in next three chapters.

Chapter 4. Phase One results: Safety Climate Survey

4.1. Introduction

The previous chapter included a detailed description of the methodology and design of the research. The aims of the research were addressed through a mixed methods design comprising three periods of data collection across two phases. The results of the quantitative and qualitative strands of both phases of the study are presented in two separate chapters. This chapter presents the results from the Safety Climate Survey (SCS), while the quantitative Retrospective Medical Record Review and qualitative semi-structured interview results are presented in chapters five and six.

In this chapter, the SCS response rates, participant demographics, survey item and attitudinal domain descriptive results are presented. The results of comparative means testing for groups and sub-groups perceptions of the safety climate in the ED are presented as figures, tables and descriptive text. Finally, thematic analysis of the free text responses to the last part of the survey which asks for three ways that the ED could improve patient safety (see section 3.9.1 and Appendix E) are described as themes and sub-themes, a frequency table and examples.

4.2. Survey Results

4.3. Survey response rates

As described in the previous chapter, surveys were distributed to all ED doctors and nurses electronically by email and paper-based copies. A total of 163 surveys were distributed to site ED doctors (n = 44) and ED nurses (n = 119). A total of 129 (79%) survey responses were returned from 23 doctors and 100 nurses. Two survey responses were excluded because they were incomplete.

A total of 127 surveys were included in the analysis. This comprised 84% of all nurses, 52% of all doctors. Two responses did not contain details about the respondents' role.

4.4. Survey respondent demographics

Roles

Table 4.1 represents the overall responses received by ED doctors and nurses.

Table 4.1 Overall response rate by carer groups

	Frequency	Percent
Doctor	25	19.7
Nurse	100	78.7
Role not specified	2	1.6
Total	127	100.0

There was a total of seven different roles that respondents identified as their professional role. The staff role was not indicated in five survey responses. The majority of responses were completed by registered nurses (n = 80, 63%), ED consultant physicians (n = 15, 11.8%) and clinical nurse specialists (n = 13, 10.2%) (see table 4.2).

Table 4.2 Survey participants by role

		Frequency	Percent %
Doctors	Consultant	15	11.8
	Registrar	3	2.4
	Resident	5	3.9
Nurses	Clinical Nurse Specialist	13	10.2
	Registered Nurse	80	63.0
	Enrolled Nurse	3	2.4
	Associate Nurse Unit Manager	3	2.4
	Total	122	96.1
	Missing	5	3.9
Total		127	100.0

Gender

Ninety-three (73.2%) respondents identified as a female, 31 respondents as males and three respondents that did not answer the survey item.

Employment Status

The majority of respondents were employed at the health service on a part-time basis (n = 95, 74.8%), whereas 20 (15.7%) were full-time and 10 respondents (7.9%) were employed in a casual/temporary capacity. Two respondents did not complete the employment status survey item.

Respondent age range, time working in health service and current role

The modal age range of respondents was 25 – 29 years and skewness of <2.0 showing that the respondents' age ranges were normally distributed. A detailed breakdown of respondent age ranges, time worked in health service and time in current role are provided in Appendix J.

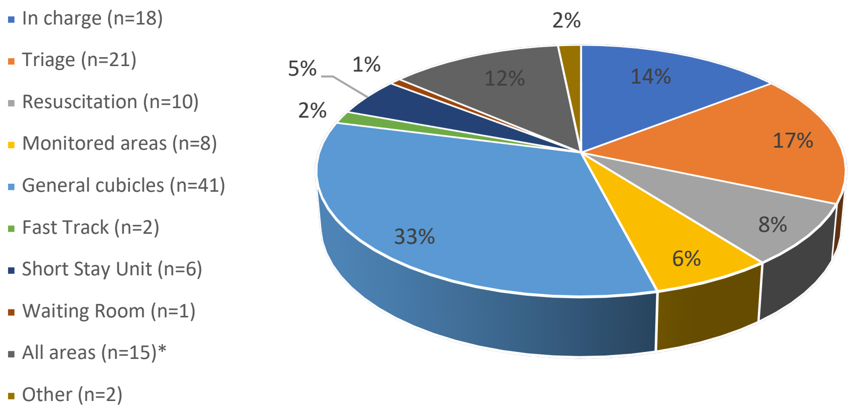
The respondent time employed in the health service as well as the time that the respondent worked in their current roles were also normally distributed as indicated by skewness of 0.22 and 0.00 respectively.

The ED respondents were moderately experienced in ED patient care. The mean range that respondents had worked in the health service and in their current role was 3 – 5 years. Staff with less than or equal to two years' experience was 28.3% of the respondents, and staff with greater than 10 years' experience constituted 24.4%.

Respondent ED area most worked

Respondents were asked to indicate the ED area in which they work most. Figure 4.1 graphically highlights that 33% (n – 41) of all the respondents worked most of the time in the general cubicles, 17% (n = 21) worked mostly in Triage and 14.2% (n = 18) spent the majority of their time in charge of the ED.

Figure 4.1 Respondent ED area most worked



* Respondents that work in all areas likely to also act in charge of the ED.

4.5. Survey item results

The 42 items on the Safety Climate Survey (SCS) are designed to provide a measure of safety climate within healthcare organisations, across the following six attitudinal domains:

1. Teamwork Climate - Perceived quality of collaboration between personnel.
2. Safety Climate - Perceptions of a strong and proactive organisational commitment to safety.
3. Stress Recognition – Acknowledgement of how performance is influenced by stressors.
4. Job Satisfaction - Positivity about the work experience.
5. Perceptions of Management - Approval of managerial action.
6. Work Conditions - Perceived quality of the work environment and logistical support.

A full list of the survey items (questions) and their placement under the domains is found in appendix F.

Each item had a Likert scale of 5 possible responses (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree). There was also an option to rate the item 6 = not applicable. Not applicable responses did not provide meaningful ratings of the SCS items. Following expert statistical consultation, not applicable responses were excluded from means analysis. Analysis of the domains will be addressed in section 4.6.

Descriptive results that represent ED staff survey responses for each individual Likert scale item are found in appendix K providing an overall impression of their perception of the climate of patient safety in the ED.

The responses to all survey items exhibited skewness of less than 2.0 indicating that the data were normally distributed. The mean response to each survey item (nested within the attitudinal domain) as well as the skewness of each item is shown in Appendix L.

Reliability of survey items

According to Sexton et al. (Sexton et al., 2006), the Safety Attitudes Questionnaire has good internal consistency, with a Cronbach alpha coefficient reported of 0.9. In the current study the Cronbach alpha coefficient was 0.94, suggesting very good internal consistency reliability with this sample.

4.6. Survey domain analysis

Table 4.3 Safety Climate Survey attitudinal domains statistics

	Stress Recognition	**Team Climate**	**Job Satisfaction**	**Working Conditions**	**Safety Climate**	**Perception of Management**
Valid responses	125	125	127	125	125	127
Missing	2	2	0	2	2	0
Mean	4.13	3.76	3.70	3.50	3.49	3.34
Std. Deviation	.727	.450	.778	.855	.529	.865

Other than in the stress recognition domain ($M = 4.13$, $SD = 0.723$), survey participants rated the patient safety climate as unsatisfactory (see table 4.3). That is, the remaining mean domain responses were all less than 4 (agree). Table 4.3 also shows the missing data for stress recognition ($n = 2$), team climate ($n = 2$), working conditions ($n = 2$) and safety climate ($n = 2$). All participants completed all items under the domains job satisfaction and perceptions of management

Doctors and Nurses

An independent-samples T-test was conducted to compare the attitudinal domain mean scores for doctors and nurses. There was a significant difference in mean domain scores for doctors and nurses in safety climate ($p < 0.05$), stress recognition ($p < 0.05$), team climate ($p < 0.05$) and work conditions ($p < 0.05$). Although the nurses rated job satisfaction and perception of management higher than doctors, the differences for both domains were not statistically significant ($p > 0.05$) (see table 4.4).

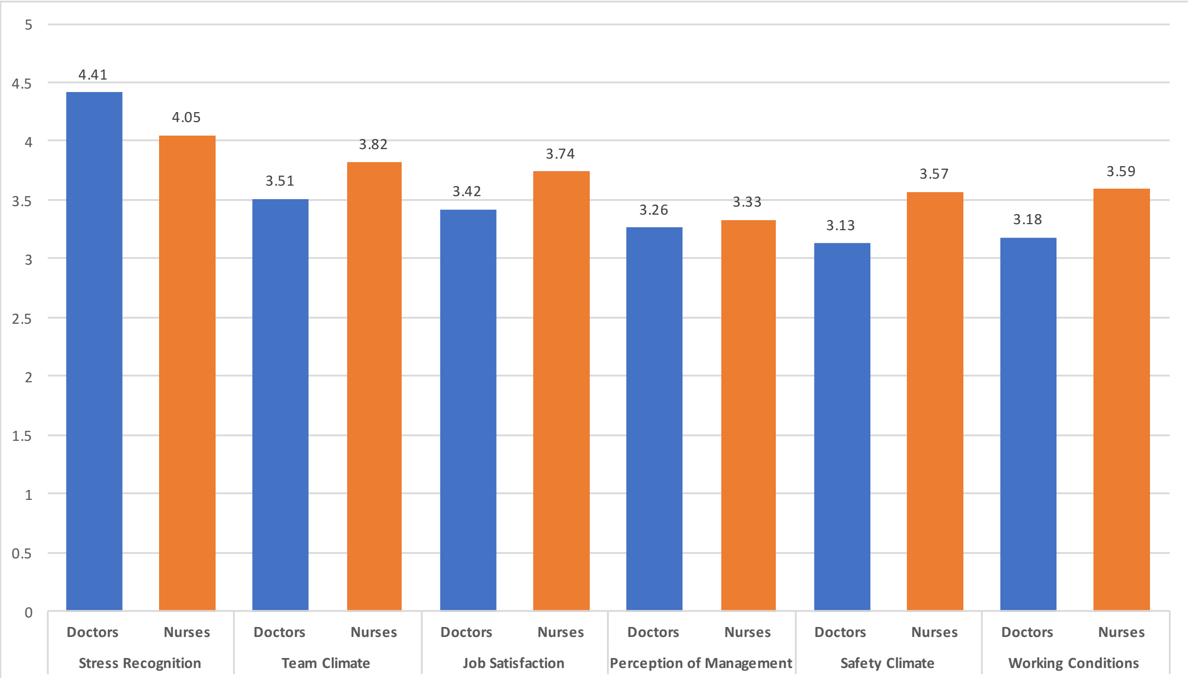
Table 4.4 Independent-samples T-test for doctors and nurses for all domains

	Levene's Test for Equality of Variances*		T-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Job satisfaction	0.038	0.845	-1.804	121	0.074	-0.315	0.175	-0.66	0.031
Perception of management	2.868	0.093	-0.353	121	0.724	-0.069	0.196	-0.456	0.318
Safety climate	1.115	0.293	-3.749	121	0.000	-0.436	0.116	-0.667	-0.206
Stress recognition	1.956	0.165	2.217	121	0.029	0.366	0.165	0.039	0.694
Team climate	0.514	0.475	-3.064	121	0.003	-0.311	0.101	-0.511	-0.11
Working conditions	0.017	0.895	-2.075	121	0.04	-0.406	0.196	-0.794	-0.019

* Equal variance assumed for all domains

Overall doctors and nurse did not perceive that there is a strong organisational commitment to patient safety. With the exception of stress recognition, nurses rated the organisation's commitment to patient safety higher than doctors in all remaining attitudinal domains. Both groups acknowledge that fatigue, increased workload and workplace tension (stress recognition) negatively impacts upon patient safety (see figure 4.2).

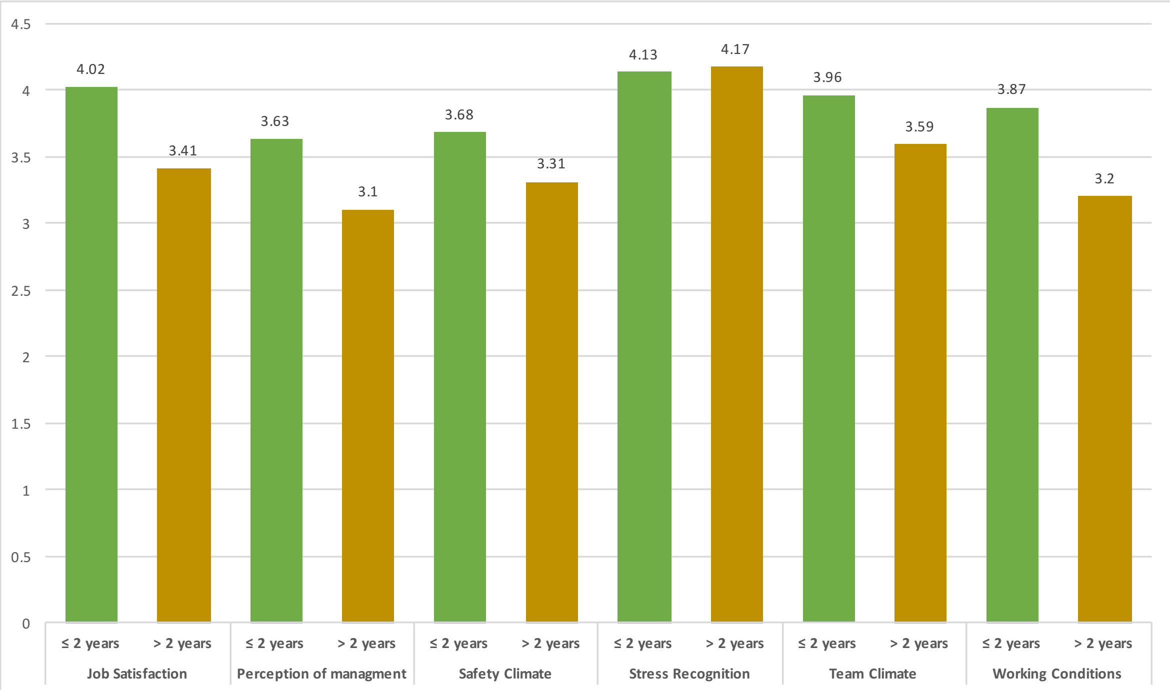
Figure 4.2 Mean attitudinal responses – doctors and nurses



ED work experience

With the exception of stress recognition, participants with ≤ two years of experience rated the ED safety climate higher than those with greater than two years work of experience working in the ED (see figure 4.3).

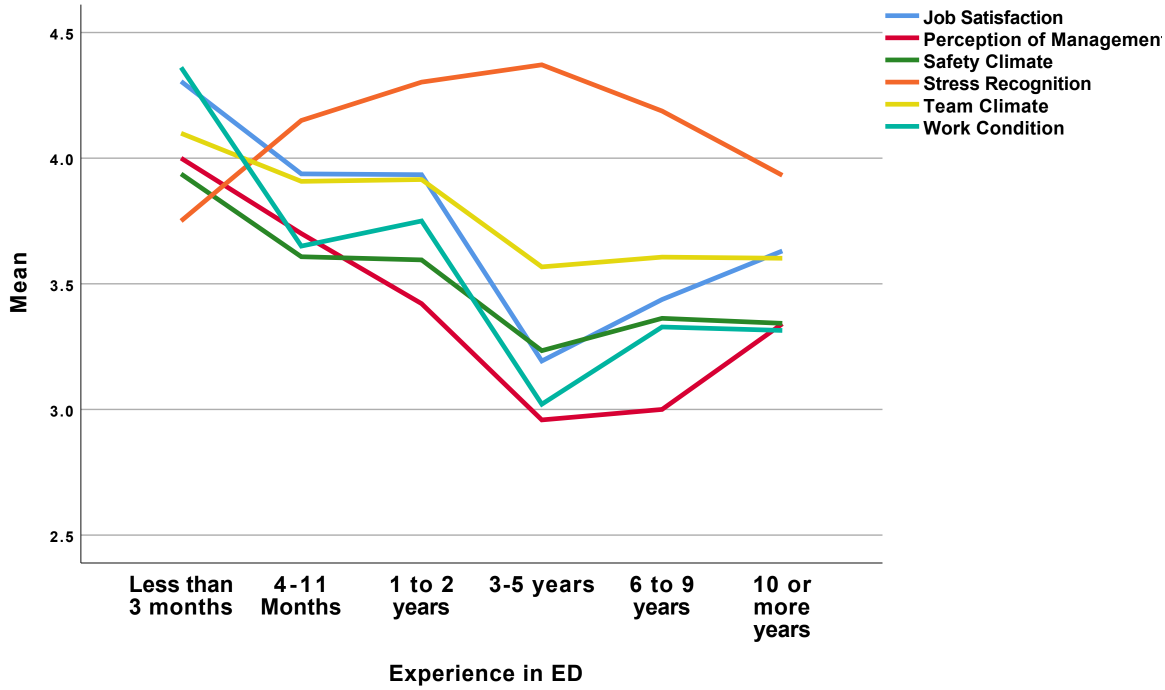
Figure 4.3 Mean attitudinal responses – years of experience



The mean safety climate ratings in figure 4.3 were reported as aggregated safety climate ratings of both doctors and nurses with ≤ 2 years of experience and > 2 years of experience. This was a conscious decision to ensure that the objective of the SCS was addressed by examining the whole ED culture of safety in the ED towards escalating care of deteriorating patients, and not the culture within each professional group. A more detailed view of changes in participant mean attitudinal ratings over time is presented in figure 4.4.

There was a sharp decline in perceptions of the safety climate for participants after 1 – 2 years of experience in all domains except stress recognition. Conversely, as is seen in figure 3.3, stress recognition mean rating reach the highest in this domain between 3 – 5 years of experience (*M* = 4.37, *SD* = 0.694).

Figure 4.4 Domain mean score over time



An independent-samples T-test was conducted to compare the attitudinal domain mean scores for those participants that had worked in the ED for less than or equal to two years and those that had worked in the ED for greater than two years. There were statistically significant differences in the safety climate ratings for these two groups in job satisfaction (p = < 0.05), perception of management ($p < 0.05$), safety climate ($p < 0.05$), team climate ($p < 0.05$) and working conditions. There was no significant difference between the groups' ratings of the stress recognition domain (p = 0.808) (see table 4.5).

Table 4.5 Independent-samples T-test for ED work experience for all domains

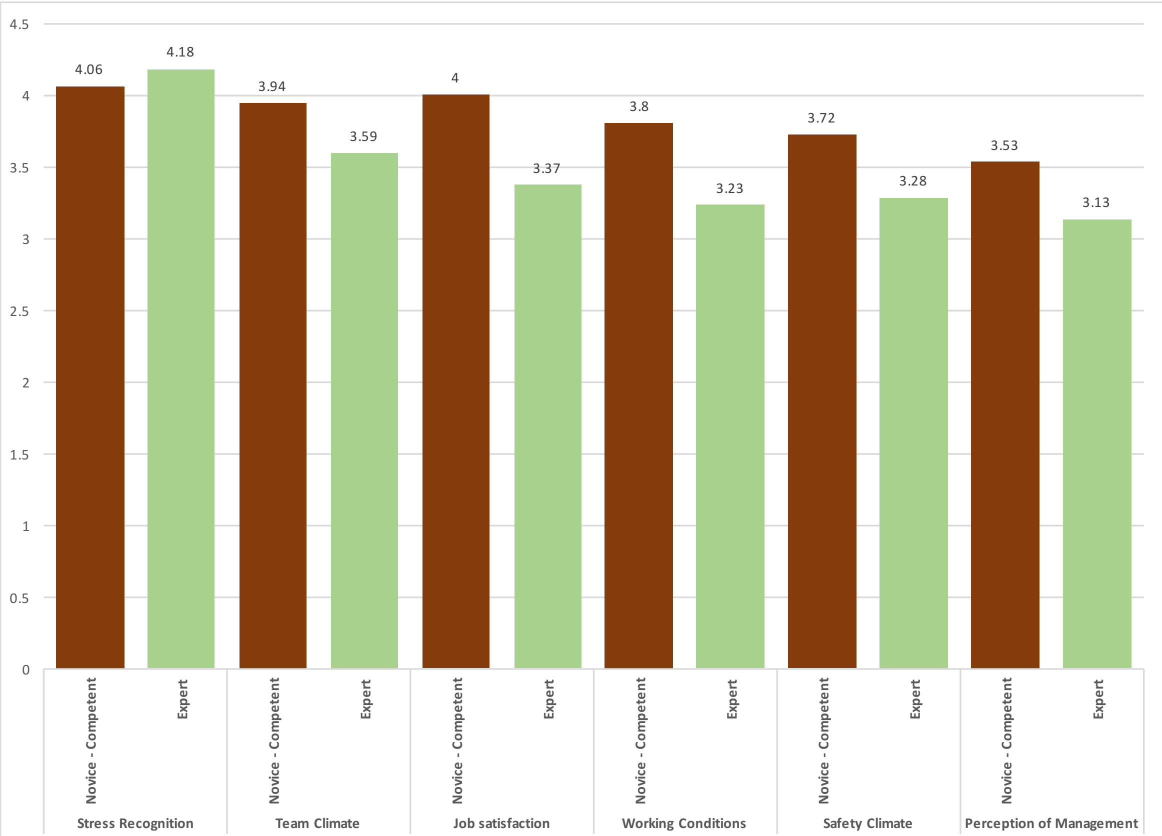
	Levene's Test for Equality of Variances		T-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Job satisfaction	6.875	.010*	5.093	97.754	.000	.612	.120	.373	.850
Perception of management	1.190	.278	3.312	98	.001	.527	.159	.211	.842
Safety climate	8.582	.004*	4.376	97.853	.000	.374	.085	.204	.543
Stress recognition	.723	.397	-.244	98	.808	-.036	.149	-.333	.260
Team climate	4.601	.034*	4.957	97.939	.000	.367	.074	.220	.514
Working conditions	2.526	.115	4.182	98	.000	.664	.159	.349	.979

* Equal variance not assumed

Level of Clinical Competence

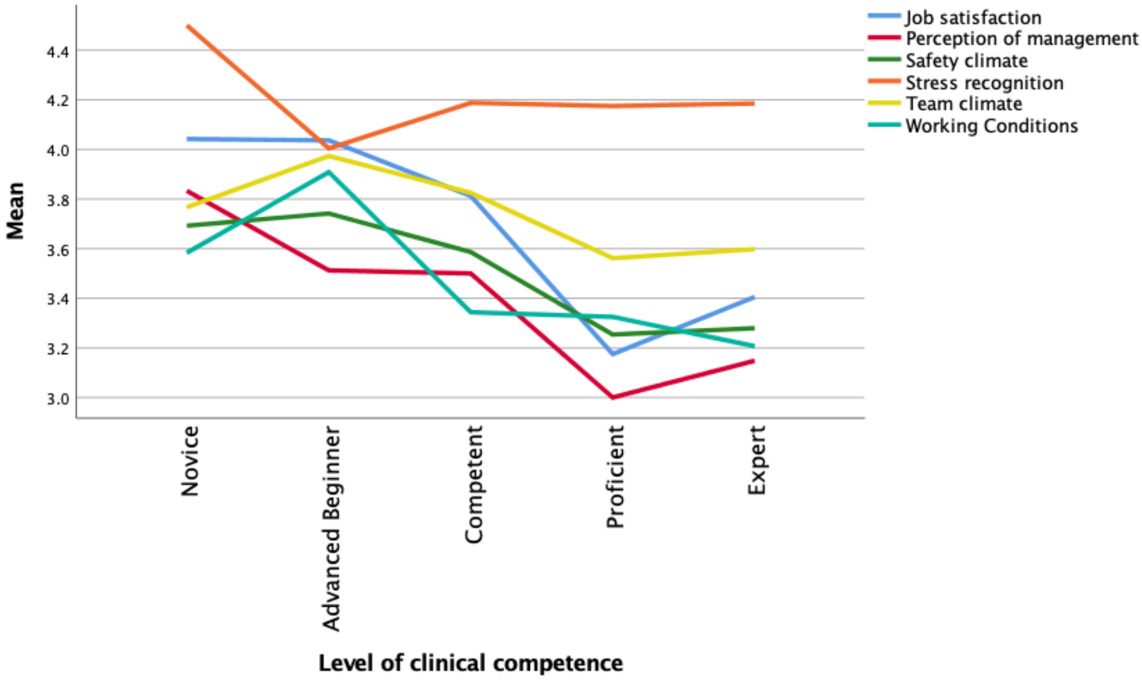
Level of competence groups were collapsed into two logical groups at either end of the novice to expert continuum. Participants with a clinical competence of either novice, advanced beginner or competent were grouped together into to form the group *Novice-Competent*. Participants with a clinical competence level of either proficient or expert were collapsed into a group called *Experts*. Novice-Competent participants rated the ED's safety climate higher than those who in the expert group in all domains except for stress recognition (see figure 4.5).

Figure 4.5 Mean attitudinal responses – level of competence



The more detailed competence level data points in figure 4.6 indicates that there was a trend for declining safety climate ratings as the clinical competence level increased across all domains except stress recognition. Again, stress recognition was rated consistently high across these groups, with the lowest ratings recorded under this domain for advanced beginners.

Figure 4.6 Domain mean scores and clinical competence level



An independent-samples T-test was conducted to compare the attitudinal domain mean scores for those participants classified as either novice, advanced beginner or competent (i.e. novice – competent) and those who were classified with a proficient or expert (i.e. expert) level of clinical competence. There was a statistically significant difference in the safety climate ratings for these two competence groups in job satisfaction ($p < 0.05$), perception of management ($p < 0.05$), safety climate ($p < 0.05$), team climate ($p < 0.05$) and working conditions ($p < 0.05$). There was no significant difference between the groups' ratings of the stress recognition domain ($p = 0.37$) (see table 4.6).

Table 4.6 Independent-samples T-test for clinical level of competence for all domains

	Levene's Test for Equality of Variances		T-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Job satisfaction	4.939	.028	4.970	114	.000	.633	.127	.381	.886
Perception of management	1.808	.181*	2.732	113.994	.007	.404	.148	.111	.697
Safety climate	4.783	.031	4.909	114	.000	.440	.090	.262	.617
Stress recognition	.045	.833*	-.901	109.464	.370	-.123	.136	-.393	.147
Team climate	1.422	.235*	4.656	113.765	.000	.347	.074	.199	.494
Working conditions	1.040	.310*	3.881	109.914	.000	.578	.149	.283	.873

* Equal variance not assumed

4.7. Open ended questions – analysis

At the end of the survey Likert type items, respondents were invited to provide open-ended responses to the question "What *are three (3) ways in which your health service can improve patient safety?*". These responses were analysed and are presented in order of popularity of the most common ways that the participants believe the ED can improve patient safety.

Themes

There were eight themes that were represented by the key words and ideas that were expressed by the survey respondents. Table 4.7 shows the eight themes that emerged from the analysis including examples of responses under each theme. *Staffing and skill*-mix was most commonly identified as an area for improving patient safety. The majority of responses in this theme referred to the need for increasing the amount of staff overall and specified the need to increase the number of ED support staff such as constant patient observers and security staff. There were many references under *staffing and skill-mix* that recommended improvements to skill-mix only. That is, there was no reference to increasing staff numbers but rather altering how the mix of staff with different levels of clinical competence are deployed.

The *processes and strategies for patient safety* were also identified as an area for improvement. The sub-themes in this broader theme mainly centred around falls prevention, patient assessment, compliance with policy and teamwork. The remaining ideas were diverse references to improvements to patient care processes such as reducing waiting times for investigations like radiology and pathology.

The third theme was *education and supervision*. In this theme, there were a large number of references to general and specific staff training, needing improved supervision and support of junior staff as well as improving patient and public health literacy.

Communication for safety was identified as the fourth theme. In this theme respondents identified a number of sub-themes that required some form of improvement to improve patient safety. These include, but were not limited to types and delivery of feedback, handover practices, escalation, communication with patients, interdisciplinary communication and management's approach to communicating feedback and safety updates.

Table 4.7 Themes and examples

	Themes	**Examples**
1	Staffing & skill-mix	- Right skillmix of staff per area - More nurses and doctors overall especially on night duty - more security staff
2	Processes and strategies for patient safety	- Keeping high risk patients in easy view areas - Constant evaluation of current policy - Record a patient's vital signs in an appropriate timeframe from presentation to ED (sometimes not recorded)
3	Education & supervision	- Adequate staff training and clinical support in work area - Incidents happened should be shared as education more often - Education on alert criteria
4	Communication for safety	- Further encourage and insist on effective communication - Listen to patient's and family members concerns - Debrief for end of each shift
6	Staff well-being	- Acknowledgement form management for hard work above and beyond. Arrange adequate cover for breaks and reward hard work - Prioritise staff safety - not tolerate so much abuse and assaults by patients - Maintain positive climate for feedback
5	Resources	- Provide enough resources for departments to perform their quality and risk tasks adequately - Purchase low-low trolleys so at-risk patients can be settled more safely - Need more equipment
7	Patient care over KPIs	- Caring more about patients and not KPIs - Recognise that KPIs are not always the most important - Focus on patients not numbers
8	Improving bed access	- Ensure adequate bed access at ALL TIMES - Dealing with overcrowding better - More places to see patients

The respondents indicated that there was room for improvement in the following key areas:

- staffing levels and how the skillmix is deployed,
- the processes and standard operating procedures for the day-to-day care of ED patients,
- the implementation of education, training and clinical supervision of staff and the ways in which information is communicated in the ED.
- staff well-being,
- the prioritisation of care to meet key performance indicators to focus more on the quality of care, and
- improving bed access featured as areas for improving patient safety.

4.8. Conclusion

This chapter provides the results from Phase 1 of the study, the safety climate survey. Overall doctors and nurses perceived that the culture of safety was unsatisfactory. However, nurses rated the ED's safety climate higher than doctors in all domains except for stress recognition. There was a significant difference between doctors and nurses' safety climate ratings in all domains except for job satisfaction and perception of management. These findings suggest that while ED doctors are significantly more doubtful about the safety of ED patients, both doctors and nurses alike perceive that there is:

- diminished collaboration between personnel,
- a poor organisational commitment to safety,
- performance which is negatively influenced by workplace stressors,
- negative attitudes towards the ED's working experience, environment and logistical support, and

– limited approval of managerial actions related to patient safety

Staff who had worked in the ED for ≤ two years also rated safety climate higher than those who had worked in the department for longer than two years in all domains except stress recognition. With the exception of stress recognition, there were also significant differences in mean domain ratings for these groups.

These findings suggest that ED carers become more doubtful about the provision of a safe caring environment for ED patients as they gain more ED experience. In particular, ED carers perception of patient safety sharply declines after two years of ED working experience.

The differences between mean domain ratings for participants with different levels of clinical competence (expertise) were also analysed. Overall, with the exception of stress recognition, participants became less confident about the provision of safety for ED patients at the same time that they transition from advanced beginners to a more competent level. Interestingly, this often coincides with having completed around 2 years of working experience in the ED. These findings suggest that ED doctors and nurses have, not only experienced a substantial amount of safety issues during their first two years, but also have the competence to recognise the efficacy of the ED's strategy for ensuring patient safety.

There were eight main themes that were identified by respondents under which the health service can improve patient safety. The breadth and consistency with which ED carers propose improvements to patient safety suggests that there are valuable insights to be gained from frontline ED workers that would benefit the safety of their patients.

Chapter 5. Phase Two Quantitative Results: Medical Record Review

5.1. Introduction

In this chapter, the results from the quantitative Retrospective Medical Record Review strand of Phase 2 are presented. The period prevalence of patients exhibiting physiological deterioration for the first time are described. The characteristics of the first episode of deterioration are also presented so as to describe the variables that are relevant to the primary objectives of the study.

The results regarding escalation practices in the ED are also reported to describe the proportion of appropriate escalations of care and failure to escalate care appropriately.

Associations between escalation/non-escalation practices are reported in relation to i) the care area in which the patients were cared for, ii) the casemix of patients being cared for in the ED, iii) the patients' presenting problems, iv) workload demands experienced by the ED staff, v) staffing levels, skillmix and level of clinical competence.

The final quantitative results describe the predictive impact of 13 independent variables related to the patient, staff skillmix, ED casemix and workload upon escalation practices.

5.2. Period Prevalence of Deterioration

In this study, the period prevalence of deterioration is defined as the proportion of the ED patient population that experience an episode of physiological deterioration (vital sign which reaches the ED mandatory alert criteria) in a two-week time period.

A total of 2668 ED patient records were searched. This sample included all patients who were cared for during the 2-week data collection period commencing July 16 2018. Of the records searched, the 2-week period prevalence of initial episodes of physiological deterioration was

10.08% (n = 269). Using the Wilson confidence interval method, there was 95% confidence that the prevalence of first signs of deterioration of all patients in the ED was between 9% and 11.28%.

The period prevalence of the age groups: term-12 months, 1-4 years, 5-12 years, 13-18 years and adults are presented in table 5.1.

Table 5.1 Confidence interval for deterioration prevalence by age groups

Age group	Number positive 1st episode of deterioration	Prevalence	Lower 95% CL	Upper 95% CL
Term – 12 months	6	0.0022	0.0010	0.0049
1 – 4 years	12	0.0045	0.0026	0.0078
5 – 12 years	1	4e-04	1e-04	0.0021
13 – 18 years	6	0.0022	0.0010	0.0049
Adult (>18 years)	244	0.0914	0.0793	0.1010

Confidence level - 0.95, CI method - Wilson

5.3. Deteriorating Patient Demographic data

Of the 2668 episodes of care audited, there were 269 discrete first episodes of physiological deterioration identified. Of these 269 episodes, 110 were found to meet the search criteria and were included in the 5-step audit process described below. That is, all patients with deranged vital signs that fell within the ED Mandatory Alert Criteria (EDMAC), and if categorised within the Australian Triage Scale (ATS) as category 1 or 2, and subsequently experienced normalisation of their condition for at least 1 hour. Patients who had documented evidence of a treatment plan that included a *do not resuscitate* or not for resuscitation plan were not included.

The 5-step audit process is described in full in section 3.10.4 In short, each day the following five steps were carried out:

1. All ED patient records were examined to identify any patient with signs of physiological deterioration reaching the EDMAC.
2. Each patient episode of care was then reviewed to gather information about the episode of deterioration, including whether care was appropriately escalated.
3. The patient casemix profile being cared for in the ED at the time of the episode of deterioration was collected.
4. The workload measures (occupancy, recent patient arrivals) at the time of the episode of deterioration was collected.
5. Staffing levels, skillmix and details about the staff member who entered the vital sign indicating physiological deterioration.

There were 110 patients who were included in the 5-step audit procedure. The demographic data for these patients revealed that 51.8% (*n* = 57) were male and 48.2% (*n* = 53) female. The mean age was 48.29 (SD 29.07) years. Eighty percent (*n* = 88) of the patients were adults. The age groups of all included patients are represented in table 5.2.

Table 5.2 Age groups as percentage of deteriorating patients

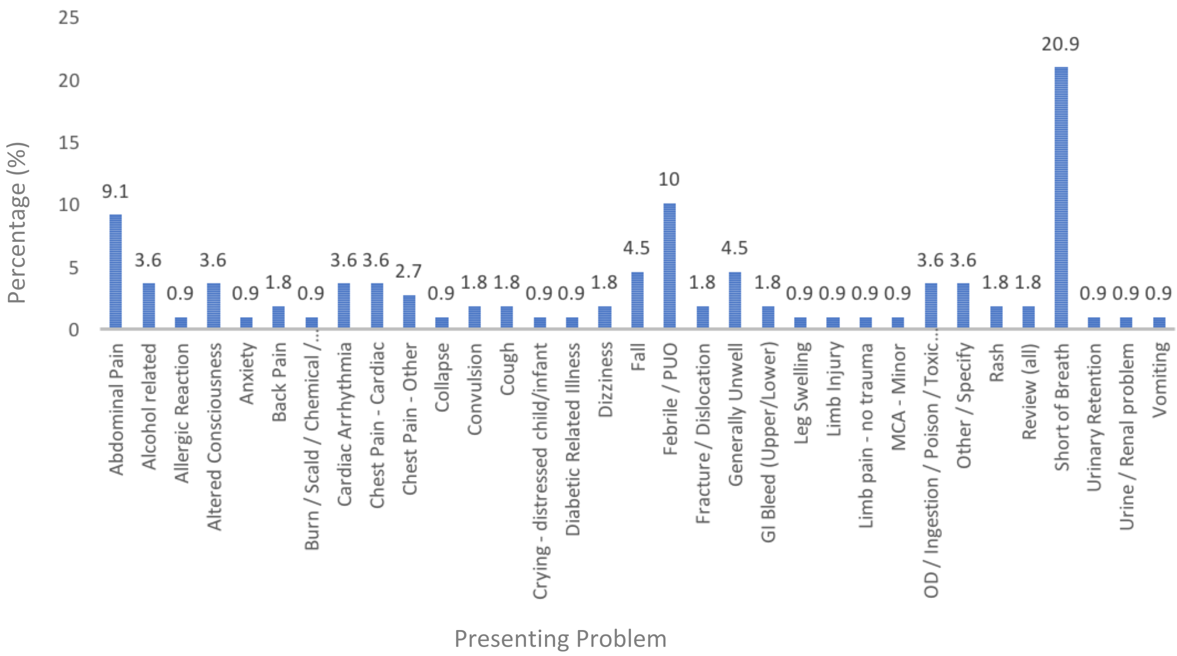
Age range	*n*	%
Term < 12 months	6	5.5
1 - 4 years	11	10.0
5 - 12 years	2	1.8
13 - 18 years	3	2.7
Adult	88	80.0
Total	110	100.0

5.4. Characteristics of deterioration

Presenting Problem

There were 33 different presenting problems that were assigned to the 110 patients identified in the medical record audit. The frequencies of each presenting problem are presented as percentages in figure 5.1. The top 3 frequencies of presenting problems were shortness of breath (n = 23), abdominal pain (n = 11) and febrile / pyrexia of unknown origin (PUO) (n = 10).

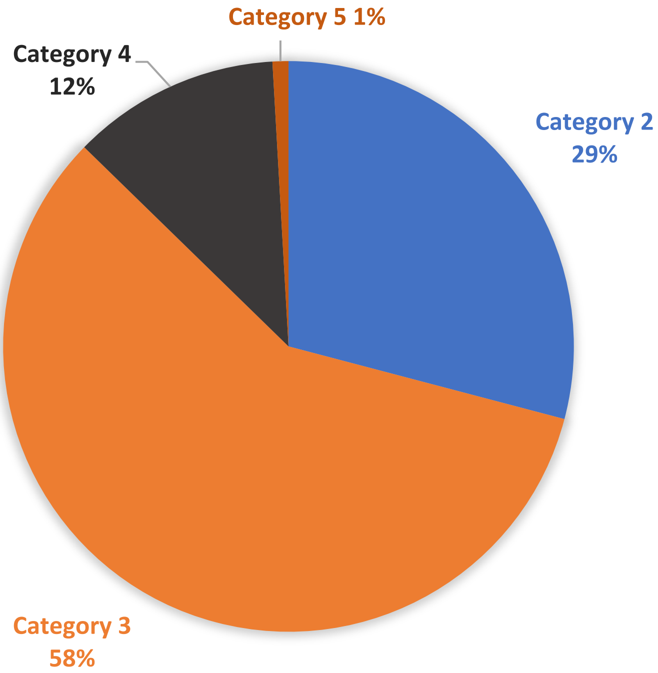
Figure 5.1 Triage presenting problems as a percentage of all deteriorating patients



Triage categories

More than half (n = 64, 58.2%) of the deteriorating patients were allocated an Australian Triage Scale (ATS) category 3 and 29.1% (n = 32) were ATS 2 (see figure 5.2). No category 1 or 6 patients were identified in the search.

Figure 5.2 Australian Triage Scale categories of all patients with signs of deterioration



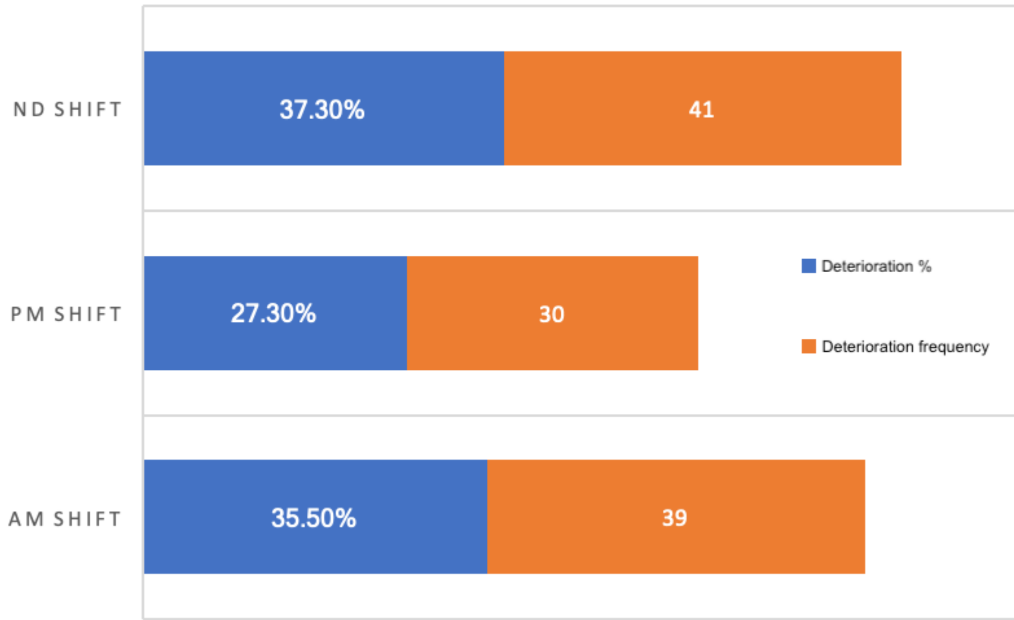
Intensive Care Flag

Less than 10% (n = 9) of the deteriorating patients were flagged by the triage nurse as potentially needing Intensive Care Unit (ICU) admission. The remaining 91.8% (n = 101) were not flagged for ICU.

Time of first episode of deterioration

There was little difference between the 3 main shifts of the ED, with deterioration recorded less during the PM shift (n = 30, 27.3%) (see figure 5.3).

Figure 5.3 Time of day that first episode of deterioration was documented



AM (morning) shift: 07:00 – 15:30hrs, PM (evening) shift 13:00 – 21:30, ND (night duty) shift 21:00 – 07:30hrs

Vital sign

The most common vital sign that met the EDMAC criteria during the first episode of deterioration was initial pulse rate (n = 34, 30.9%), followed by systolic blood pressure (SBP) (n = 28, 25.5%) and respiratory rate (n = 20, 18.2%). All vital signs frequencies and percentages are presented in table 5.3.

Table 5.3 Frequencies and percentages of first episodes of deterioration vital sign

Vital Sign	Frequency	%
Pulse	34	30.9
SBP*	28	25.5
Respiratory rate	20	18.2
GCS*	15	13.6
SpO2*	13	11.8

*Systolic Blood Pressure (SBP), Oxygen Saturation (SpO2), Glasgow Coma Scale (GCS)

5.5. Emergency Department Characteristics and Failure to Escalate

5.5.1. Prevalence of failure to escalate

The prevalence of documented deterioration that was not escalated ('failure to rescue') according to the EDMAC was 47.3% (n = 52). There was sufficient documented evidence in the audited patient records that 52.7% (n = 58) of the care for deteriorating patients was appropriately escalated according to the EDMAC.

5.5.2. ED Care Area Association with Escalation

There was a significant association between escalation practices and the area of the ED that the patient was being cared for when their first sign of deterioration is recorded, X^2 (4, n = 110) = 12.86, *p* = 0.01. The patients' care is more likely to be escalated when they are located in the resuscitation cubicles (n = 15, 75%) and less likely to be escalated when they are located in the Waiting Room (n = 11, 84%) or the Short Stay Unit (n = 7, 63.6%) (see table 5.4).

Table 5.4 Care area association with escalation of deteriorating patient care

		Escalated	Not escalated	*p*
ED care area	Resuscitation	15 75.0%	5 25.0%	0.01
	General Cubicles	33 56.9%	25 43.1%	
	Fast Track	4 50.0%	4 50.0%	
	Waiting Room	2 15.4%	11 84.6%	
	Short Stay Unit	4 36.4%	7 63.6%	
Total		58 52.7%	52 47.3%	

5.5.3. Association between escalation and casemix

The casemix of high acuity patients present in the ED when care was either escalated and not escalated was examined as a point of measure. There was no significant difference between escalation practices when the ED contains no ATS category 1 patients and when there are one or more patients with this ATS category, X^2 (1, n = 110) = 0.13, *p* = 0.72. Similarly, there was no significant difference between escalation practices when the ED staff are caring for 1 - 10 ATS category 2 patients and when there are > 10 ATS category 2 patients in the ED, X^2 (1, n = 110) = 0.14, *p* = 0.91. The presence of patients who were waiting for transfer to the intensive care unit (ICU), also did not make a difference to escalation practices, X^2 (1, n = 110) = 0.35, *p* = 0.56.

Therefore, there is no significant association between escalation practices when the ED casemix contains patients of higher acuity that require more intensive care (see table 5.5).

Table 5.5 ED Casemix Association with Escalation Practices

ED Casemix		Escalated	Not Escalated	*p*
ED triage category 1 status	No category 1 patients	43 51.2%	41 48.8%	0.72
	≥ 1 category 1 patients	15 57.7%	11 42.3%	
ED triage category 2 status	1 - 10 category 2 patients	24 54.5%	20 45.5%	0.91
	> 10 category 2 patients	34 51.5%	32 48.5%	
ED patients waiting ICU admission status	No patients waiting ICU admission	42 55.3%	34 44.7%	0.56
	≥ 1 patient waiting ICU admission	16 47.1%	18 52.9%	
Total		52.7%	47.3%	

5.5.4. Presenting Problems

There were 33 presenting problems that were identified across the group of deteriorating patients. There was no significant association between escalation practices and the patient's presenting problem (p = 0.59). A full list of all presenting problems and frequencies can be seen in appendix M.

5.5.5. Association between escalation and workload

There were some differences in escalation practices seen when the ED was experiencing varying levels of workload demand. Two aspects of ED workload were examined; occupancy levels and number of patients arriving in the hour, and preceding two hours, that that the episode of deterioration was documented. The most notable result was the escalation practices when the ED was between 75–100% occupancy, when just under 61% of deteriorating patient care was escalated, although the differences did not reach significance, X^2 (2, n = 110) = 3.01, p = 0.22 (see table 5.6).

Table 5.6 ED Occupancy Association with Escalation Practices

		Escalated	Not Escalated	*p*
ED Occupancy	<75% occupancy	11 55.0%	9 45.0%	0.22
	75 - 99.9% occupancy	26 61.9%	16 38.1%	
	100 – 150% occupancy	21 43.8%	27 56.3%	
Total		52.7%	47.3%	

Similar non-significant results were found as the ED patient arrivals changed. There was also no statistically significant difference between escalation practices when the ED received ≤ 5, between 6 – 10, 11 – 15 and > 15 patient arrivals in the hour that the episode of deterioration was documented, X^2 (3, n = 110) = 0.98, p = 0.81. Patient arrival numbers in the two hours prior to deterioration were collapsed into three parameters to avoid violating the assumptions of chi-square. That is that the 'minimum expected cell frequency' was > 5. A similar non-significant difference in escalation practices were observed when the ED received 1 – 10, 11 – 20 or > 20 patient arrivals in the two hours prior to the documented episode of deterioration, X^2 (2, n = 110) = 0.94, p = 0.62 (see table 5.7).

Table 5.7 ED arrivals in Hour of Deterioration with Escalation Practices

		Escalated	Not Escalated	*p*
ED Arrivals in same hour of deterioration	0 – 5 arrivals	20 58.8%	14 41.2%	0.81
	6 – 10 arrivals	17 51.5%	16 48.5%	
	11 – 15 arrivals	15 46.9%	17 53.1%	
	> 15 arrivals	6 54.5%	5 45.5%	
ED Arrivals 2 hours prior to deterioration	1 – 10 arrivals	16 59.3%	11 40.7%	0.62
	1 – 20 arrivals	19 54.3%	16 45.7%	
	> 20 arrivals	23 47.9%	25 52.1%	
Total		52.7%	47.3%	

5.5.6. Association between escalation and staffing levels/skillmix

The data collected for the nursing staff levels and skillmix was recoded as being either *below standard* or *at or above standard*. This indicates that the staffing numbers and mix of competence level were appropriate according to the standards set by the ED management team. There was no significant difference between escalation practices when the ED is staffed at or above the standard set by management, X^2 (1, n = 110) = 0.11, *p* = 0.75 (see table 5.8).

Table 5.8 ED staffing and skillmix association with escalation practices

		Escalation practices		
		Escalated	Not escalated	*p*
Staffing and skillmix at or below standard	Above standard	34 50.7%	33 49.3%	0.75
	Below standard	24 55.8%	19 44.2%	
Total		58 52.7%	52 47.3%	

5.5.7. Association between escalation and competence level

Data relating to the competence level were collected for the staff who documented the first episode of deterioration. Competence levels of the documenting staff were collapsed into three logical groups that represent three distinct stages of the staff's clinical competence progression (beginner, intermediate and expert). There was a significant difference between escalation practices and the competence level of the nursing staff who recorded the first episode of deterioration X^2 (4, n = 110) = 15.09, *p* = 0.005. That is, staff ranked as *intermediate* competence are significantly more likely to appropriately escalate care of deteriorating ED patients (see table 5.9).

Table 5.9 Competence level of nurses documenting deteriorating vital signs

		Escalated	Not escalated	*p*
Competence Level	Beginner	13 44.8%	16 55.2%	0.005
	Intermediate	23 56.1%	18 43.9%	
	Expert	12 40%	18 60%	
Total		52.7%	47.3%	

There was also an obvious relationship seen between non-escalation and *beginner* nurses (n =16, 55.2%) and *expert* nurses (n = 18, 60%) (see table 5.9).

5.5.8. Generalised Linear Mixed Model Analysis

All variables that were included in the GLMM and the groups were recoded to allow frequency sizes that provided meaningful output from the model (see table 5.10).

One variable that was omitted from the model was the patient presenting problem. As shown in appendix M, the frequencies were too small to be included in the model as un-grouped data and the variable proved impossible to collapse into logical groups with meaningful associations throughout all groups. Moreover, when the presenting problem variable was grouped and included in the model, the confidence intervals were too wide (e.g. cardiac (OR 7.18, CI 8 .084 - 617.808)) to contribute to the predictive value of the model.

A generalised linear mixed model analysis was performed to assess the impact of 13 independent variables on escalation practices of ED nurses when a primary episode of physiological deterioration was documented in a patient's electronic medical record. The independent variables included in the model are also shown in table 5.10.

Table 5.10 Grouped and aggregated fixed independent variables

	Independent Variable	Collapsed groups/aggregated data
Patient variables	Patient gender	Male Female
	Patient age group - Adult or Paediatric	Adult Paediatric (≤ 18 years)
	Patient triage category	Triage category 2 Triage category 3 Triage category 4 &5
	Patient vital sign that reached EDMAC	Pulse rate Respiratory rate SBP SpO2 GCS
	ED care area where deterioration was experienced	Fast Track and general cubicles Resuscitation cubicle Waiting room Short Stay Unit
Staff skillmix variables	ED staffing skillmix at or above) or below standard	Skillmix at or above standard Skillmix below standard
	Nurse Benner novice-expert ranking	Beginner (novice + advanced beginners) Intermediate (competent + proficient) Expert
Casemix variables	ED ICU status (patients that were waiting for ICU admission)	No patients awaiting ICU 1 or more patients awaiting ICU
	ED Category 1 status (ATS cat 1 patients in ED)	No cat 1 patients ≥ 1 cat 1 patient
	ED Category 2 status (ATS cat 2 patients in ED)	1 - 10 cat 2 patients 10 cat 2 patients
Workload variables	Arrivals at hour of episode recoded	0 - 5 arrivals 6 - 10 arrivals 11 - 15 arrivals > 15 arrivals
	Arrivals in 2 hours prior to episode recoded	1 - 10 arrivals 11 - 20 arrivals > 20 arrivals
	ED occupancy	<75% occupancy 75 - 99.9% occupancy 100 - 150% occupancy

The model was found to have good predictive accuracy correctly predicting 93.1% of the observed escalation cases and 92.3% of the non-escalated cases. This indicates that the model accurately predicts 92.7% of the non-escalations. The positive predictive value of the model is represented by the number of predicted non-escalated cases divided by sum of total predicted cases (i.e. esc + non-esc) expressed as a percentage. The positive predictive value of the model was 92.31%.

Table 5.11 Variance in random effect (nurses documenting vital signs)

Random Effect					95% Confidence Interval	
Covariance	Estimate	Std. Error	Z	Sig.	Lower	Upper
Variance	2.904	1.452	2.000	.045	1.090	7.736

There was a statistically significant variability (p = .045) in how the nurses managed deterioration (see table 5.11). That is, individual nurses exhibit different probabilities of escalating and not escalating the care of the deteriorating patient which explains the significant amount of variability in escalation practices in the ED.

Generalised linear mixed model analysis of the fixed variables that were included in the model and their predictive value for escalation practices are provided in table 4.12. The table highlights that two of the independent variables made a distinct statistically significant contribution to the model (systolic blood pressure and *intermediate* nurse competence level). The strongest extrinsic predictor of appropriate escalation of patient deterioration was when the nurse who documented the deteriorating vital sign was either at *competent* or *proficient* competence level (p = .037) with an odds ratio of 9.006. This indicated that nurses at *intermediate* competency level were nine times more likely to escalate care appropriately when compared to *experts* and *beginners*. However, the confidence interval for this odds ratio was wide (95%, 1.148 – 70.636) which shows that the variable was imprecise despite its strong predictive properties. When compared with table 5.9, it can be inferred that appropriate escalation practices are associated with, and can be predicted by, the competence level of the nurse that recorded the vital signs.

When the vital sign that indicated physiological deterioration was systolic blood pressure less that 90mmHg, the documenting nurse was significantly more likely to escalate care appropriately (OR11.9, 95% CI1.2 -118.7, p = 0.034) by a factor of eleven. Again, the wide odds ratio indicates the imprecise nature of the finding despite its strong predictive value.

Though they did not reach statistical significance as predictors within the model, the significant association between the patients' ED care area (highlighted in table 5.4) and escalation practices (p = .01) warrants emphasising here. That is, patients who were cared for in the waiting room (95%, OR 0.139, CI 0 – 2.7) and short stay unit (95% OR 4.29, CI 0.3 – 62.3) were less likely to have their care escalated appropriately. Though also not statistically significant, escalation practices were more likely to be appropriate for patients who had documented deteriorating vital signs when the ED occupancy was between 75 – 99% (95%, CI 3.35, OR .37 – 30.12, p = 0.277). That is, patients were more than three times more likely to have their care escalated appropriately when the ED was between 75 – 99% occupancy.

Table 5.12 Generalised Linear Mixed Model – Fixed variable correlation with escalation practices

Variables	Groups	Coefficient	*p*	Exp. (Coefficient)	95% Confidence Interval for Exp. (Coefficient) Lower	Upper
Gender	Female	.118	.861	1.125	.295	4.297
	Male	0[a]	.	.	.	.
Age groups	Adult	-.152	.885	.859	.106	6.981
	Paediatric	0[a]	.	.	.	.
Triage Category	Cat 3	.381	.629	1.464	.307	6.976
	Cat 4 &5	-.282	.794	.754	.088	6.426
	Cat 2	0[a]	.	.	.	.
Deteriorating vital sign	GCS	.467	.683	1.595	.166	15.321
	Sp02	-1.308	.294	.270	.023	3.176
	SBP	2.484	.034	11.993	1.212	118.665
	Resp	1.099	.332	3.000	.320	28.114
	Pulse	0[a]	.	.	.	.
ED care area	Short stay unit	1.456	.282	4.290	.296	62.270
	Waiting Room	-1.972	.164	.139	.009	2.266
	Resuscitation cubicles	.451	.628	1.570	.248	9.917
	Fast track & general cubicles	0[a]	.	.	.	.
Competence level	Expert	.868	.439	2.383	.259	21.924
	Intermediate (Competent & proficient)	2.198	.037	9.006	1.148	70.636
	Beginner (Novice & advanced beginners)	0[a]	.	.	.	.

Variables	Groups	Coefficient	*p*	Exp. (Coefficient)	95% Confidence Interval for Exp. (Coefficient)	
					Lower	Upper
Patients waiting for ICU admission	1 or more patients awaiting ICU	-1.093	.172	.335	.069	1.625
	No patients awaiting ICU	0[a]	.	.	.	.
Skillmix and staffing levels at/above or below standard	Below standard	.272	.722	1.312	.290	5.944
	At or above standard	0[a]	.	.	.	.
ED triage category 2 status	> 10 cat 2 patients	-.147	.866	.863	.153	4.876
	1 - 10 cat 2 patients	0[a]	.	.	.	.
ED triage category 1 status	≥ 1 cat 1 patient	.653	.486	1.921	.300	12.303
	No cat 1 patients	0[a]	.	.	.	.
Patient arrivals in hour that deterioration was documented	> 15 arrivals	-1.358	.373	.257	.013	5.229
	11 - 15 arrivals	-1.525	.167	.218	.025	1.916
	6 - 10 arrivals	-.030	.975	.971	.150	6.277
	0 - 5 arrivals	0[a]	.	.	.	.
Patient arrivals in 2 hours prior to deterioration	> 20 arrivals	.127	.920	1.135	.094	13.778
	11 - 20 arrivals	.491	.634	1.634	.212	12.594
	1 - 10 arrivals	0[a]	.	.	.	.
ED Occupancy	100 - 150% occupancy	.645	.616	1.906	.149	24.330
	75 - 99.9% occupancy	1.208	.277	3.347	.372	30.124
	<75% occupancy	0[a]	.	.	.	.

[a] Coefficient set to zero because it is the contrast group and therefore redundant.

5.6. Conclusion

The period prevalence of deterioration was found to be 10.08%. There was very little difference in the prevalence of deterioration for these patients during the most common shifts. Afternoon (PM) shifts did, however, exhibit less frequent episodes than AM and ND shifts. The most common vital sign that met the EDMAC criteria during the first episode of deterioration was patient pulse.

Patients exhibiting signs of deterioration were predominantly adult and equally represented by both genders. The most common presenting problem was shortness of breath and more than half of the patients were assigned the ATS category 3.

Nearly half of the deteriorating patients did not have documented evidence that their care was appropriately escalated. This indicates that the ED suffers from an unsafe level of 'failure to rescue'.

Patient care was more likely to be appropriately escalated when they were located in the resuscitation cubicles of the ED. Appropriate escalation is less likely to take place when patients were located in the waiting room or the Short Stay Unit. Therefore, it would appear that the safety of deteriorating patients being cared for in the waiting room and SSU is compromised.

There was no association demonstrated between escalation practices and the casemix profile of patients in the ED. There was also no statistically significant association between escalation practices and the patient's presenting problem.

No statistically significant association was demonstrated between escalation practices as workload demands fluctuate. However, patient care was appropriately escalated more frequently when the ED was between 75 – 100% occupancy.

Staffing levels and skillmix that were at or above the accepted standard were not associated with improved escalation practices when compared to staffing and skillmix which was below standard.

There was, however, a statistically significant association between the competence level of the nursing staff who recorded the first episode of deterioration. That is, staff who were ranked with an intermediate (competent or proficient) level of competence were more likely to appropriately escalate care of the deteriorating patient ($p < 0.05$). Though not statistically significant, novice and expert nurses were less likely to escalate care appropriately. Further to this, generalised linear mixed model (GLMM) regression analysis with a good positive predictive value revealed that the strongest predictor of appropriate escalation of patient deterioration was when the nurse who documented the deteriorating vital sign was at an intermediate level of competence ($p = .037$), and that nurses with an intermediate level of competence were nine times more likely to escalate care appropriately when compared to experts and beginners. These results suggest that there may be attitudes, motivations and behaviours that are more conducive to appropriate escalation in ED doctors and nurses "in the middle" of their journey from novice to expert.

Regression analysis also revealed that the patient's systolic blood pressure is also a strong predictor of whether the patient's care is escalated appropriately ($p < 0.05$). Regression analysis also indicated that patients with hypotension are almost 12 times more likely to be escalated appropriately (OR 11.99). These results indicate that a single parameter track and trigger system may not demonstrate adequate sensitivity to consistently trigger appropriate escalation of care for the deteriorating patient.

Key results

In summary, the key results from the MRR indicate that:

- the period prevalence of physiological deterioration is 10.8% in the ED,
- "failure to rescue" is a substantial safety issue for ED patients,
- dynamic changes in ED workload, casemix or staffing/skillmix levels do not significantly influence the rate of 'failure to rescue',
- nurses who are at intermediate competence level are nine times more likely to appropriately escalate the care of deteriorating ED patients
- novice and expert ED nurses do not escalate deteriorating ED patients appropriately,
- There is a significant relationship between where the ED patient is cared for and the likelihood that their care will be escalated appropriately, and
- hypotension is a strong predictor of appropriate escalation practice in the ED

Chapter 6. Phase 2 qualitative results: Staff Interviews

6.1. Introduction

The previous chapter reported the results of the quantitative Retrospective strand of Phase 2 (medical record review). The results of the qualitative strand of Phase 2 (semi-structured interviews) are reported in this chapter. The results are presented as descriptive text, tables and Illustrative figures in two parts. The first part describes the interview participants and the interview details, while the second part describes the results of framework analysis of the qualitative interview transcript data.

Staff experience of the processes which take place when a patient exhibits signs of physiological deterioration are discussed throughout this chapter. The processes, actions and behaviours of staff, as well as the real or perceived influences on their actions, are reported to explain the reasons why a patient's care was appropriately escalated or not. That is, why the staff rescued, or failed to rescue, the patient in crisis. The concept of failure to rescue (FTR) describes any patient with documented deleterious vital signs who does not have their care appropriately escalated according to an agreed triggering threshold (see section 1.2.6). However, it is important to highlight that, in the context of these data, physiological deterioration refers to an unexpected decline in the patient’s condition, but does not refer to an expected response (or sequence of responses) to emergency treatment or interventions (Silber et al., 2007).

6.2. Interviews and participants

Thirty-one semi-structured staff interviews were conducted over a two-week period from July 27 to August 1 2018 including doctors (*n* = 9) and nurses (*n* = 22). Participants were identified during the 5-step MRR process and then invited to be interviewed. Following the interview schedule described in section 3.10.6, demographic data were collected about each participant. Grouped demographic details are provided at table 6.1; individual participant details are at Appendix N.

Table 6.1 Participant grouped demographic data

<table>
<tr><th></th><th></th><th></th><th>n</th><th>%</th></tr>
<tr><td rowspan="7">Age</td><td rowspan="7"></td><td>< 24</td><td>5</td><td>16</td></tr>
<tr><td>25 – 29</td><td>9</td><td>29</td></tr>
<tr><td>30 – 34</td><td>3</td><td>10</td></tr>
<tr><td>35 – 39</td><td>2</td><td>6</td></tr>
<tr><td>40 – 44</td><td>2</td><td>6</td></tr>
<tr><td>45 – 49</td><td>3</td><td>10</td></tr>
<tr><td>50 – 55</td><td>7</td><td>23</td></tr>
<tr><td rowspan="2">Profession</td><td rowspan="2"></td><td>Doctors</td><td>10</td><td>32</td></tr>
<tr><td>Nurses</td><td>21</td><td>68</td></tr>
<tr><td rowspan="10">Competence Level</td><td rowspan="5">Doctors</td><td>Novice</td><td>3</td><td>9.6</td></tr>
<tr><td>Advanced Beginner</td><td>0</td><td>0</td></tr>
<tr><td>Competent</td><td>0</td><td>0</td></tr>
<tr><td>Proficient</td><td>3</td><td>9.6</td></tr>
<tr><td>Expert</td><td>4</td><td>12.9</td></tr>
<tr><td rowspan="5">Nurses</td><td>Novice</td><td>1</td><td>3.2</td></tr>
<tr><td>Advanced Beginner</td><td>3</td><td>9.6</td></tr>
<tr><td>Competent</td><td>6</td><td>19.5</td></tr>
<tr><td>Proficient</td><td>0</td><td>0</td></tr>
<tr><td>Expert</td><td>11</td><td>35.6</td></tr>
</table>

Age-groups

The majority of participants were aged 25 – 29 years of age (*n* = 9) and 50 – 55 years of age. (*n* = 7)

Interview process

On average, the interviews lasted approximately 30 minutes and participants included a range of ED medical and nursing roles, clinical competence levels and ED working experience (see Appendix N).

6.3. Framework analysis results

Framework analysis was used to examine the interview data in a five-stage process (see section 3.12.1). In short, the process involved the following five steps:

1. Initial familiarisation with the data (listening to recordings, reading and rereading all transcriptions and field notes).
2. Identifying a thematic framework.
3. Thematically indexing all transcript data.
4. Charting (rearranging) the transcript data according to the themes in the framework.
5. Mapping and interpreting the charted data by defining and summarising the indexed, then transferring the summaries with quotes from participants that illustrated their perceptions, opinions and experience of the factors that influenced escalation practices of deteriorating patients in the ED.

Framework analysis revealed five themes that emerged from the interview transcript data. The details of these themes, and their constituent sub-themes, are reported in the sections with the prefix Theme 1 - 5 as descriptive text. The descriptive text includes direct quotes that illustrate the meaning associated with the participants' perceptions, opinions and experience of escalating care of the deteriorating patient. The five themes to emerge from the semi-structured interview data were:

1. Understanding deterioration and the escalation processes
2. The influence of the patient factors
3. The influence of the environment
4. The influence of the staff
5. The influence of the organisation

6.3.1. Themes

The themes, their constituent sub-themes and their relationships are presented graphically in figure 6.1. This diagram also shows the relationship between the themes that emerged from the data in this study. This has been done to provide a manageable overview of the themes and point of reference to the complex concepts reported in the descriptive text that follows. It should be noted that there are two cogs without text. The inclusion of these in the diagram is intentional and they are included to illustrate that there may be other factors that affecting the interplay between themes. A more detailed illustration of the relationships between the themes and subthemes are presented as a relationship dendrogram in appendix O.

Figure 6.1 Influences on Escalation - themes and sub-themes

The nature of the concepts described in the first theme were placed at the beginning of this section to provide an account of the participants' familiarity with the content. This was also considered a logical starting point for this section of the results

Theme 1 - Understanding deterioration and the escalation process

The Interviews commenced by exploring the participants' knowledge of, and thoughts about what is meant by recognising and responding to the deteriorating patient in the context of the emergency department, and what policies currently exist.

Describing deterioration

Participants generally viewed the topic of recognising and managing ED patients who exhibit signs of physiological deterioration to be an important quality of care and patient safety issue. The participants held several views about the concept that were expressed in a number of ways which formed the first meaningful theme called *Understanding deterioration and the escalation process*. There were several participant viewpoints indicating that patient deterioration involved observing for a change in the patient's condition over time. One participant described a frequently voiced ongoing reassessment process that did not rely upon any single set of observations:

> *"...how they were when you last saw them or laid eyes on them and how that's changed to when you're looking at them now."* (4/D/P)[1]

While the idea that deterioration is represented by a change in the patient's condition over time was a commonly held opinion throughout many of the interviews, there was variability on whether deterioration can also be indicated by a single set of vital signs or patient

[1] Interview participants are identified by their corresponding interview number, carer role (doctor (D), Nurse (N)) and competence level (novice (N), advanced Beginner (AB), competent (C), proficient (P)) (e.g. 1/N/AB).

observation. One participant précised the views that were expressed by several of the doctors, saying that *"...even one-off findings should be escalated"* (23/D/P). There was a perception that though a one-off finding may lead to nothing more than increasing the frequency of observation, this in itself was seen as an important element to improving the chances of recognising an undesirable trend in the patient's condition.

The discussions around what best indicates that a patient is deteriorating exposed the notion that deterioration may also be identified in the absence of abnormal vital signs, where the treating nurse or doctor are simply just concerned about the patient. This idea of pattern recognition and reliance on clinical judgement presented itself throughout the interviews, and as one consultant ED physician put it:

> *…there are all these very well-known indicators* [of deterioration]*, but then there's some nuanced ones, what do you call it, enteric based medicine or I've just seen this before, I know where it's going to go.* (6/D/E)

Overall, there was very good understanding of the reasons for, and component parts of, the recognition and escalation processes but with a consistent message that knowledge of the existence and/or details of a formalised EDMAC was limited. That is, participants were very aware of the concept, but not the policy. When reminded by the researcher of the policy and procedure that exists on the health service's policy management system, PROMPT, participants stated that they were "...vaguely..." (14/N/N) aware of being told about the EDMAC but were unsure how they had become aware of it. Some indicating that the process was introduced during their induction to the ED workforce, while other participants stated that there is no formal process and that "*it's* [escalating care] *just been what I've sort of thought was logical*" (25/N/AB).

The EDMAC and how it works

Again, the fundamental principles of the escalation process were well understood, although the details and interpretations of the formal procedures varied. In particular, the team members to which escalations should be directed. Despite general agreement that any episodes of deterioration should be escalated to a doctor and the nurse in charge (NIC) of the shift, there was i) variability about which doctor was to be informed (i.e. the treating doctor or the consultant in charge), and ii) agreement that the NIC was very often not informed. The reasons for this second circumstance were mostly unclear to the participants, however a lack of time and difficulty locating the NIC were cited as some potential reasons. The associate nurse unit managers that were interviewed expressed frustration that they "*often don't know about things until things are quite dire"* (16/N/E) and emphasised that escalations to the NIC would allow them to flex the staffing workload allocations and provide support to the team with the deterioration patient. As participant 29 put it, "*I could have reduced the workload"* and "*it's just frustrating because you can't fix a problem if you don't know there is a problem"* (29/N/E).

With overwhelming agreement that the NIC were regularly not informed about patients with signs of deterioration, the NICs described several strategies that they would use to ameliorate the consequences to the non-escalated patient's care. These included but were not limited to: reviewing patient vital signs in the electronic medical record system (Symphony), rounding or "*eye-balling*" [29/N/E] patients, communicating with the CIC and listening in to what the staff were telling the CIC about patients of concern.

The EDMAC was also seen as an important system for insuring uniform "trigger points" (15/D/E) for all ED staff to escalate care, therefore removing the "*danger with that it* [escalation] *becomes ad-hoc"* and "*…because it raises the awareness and it raises consistent* *awareness"* [15/D/E]. The idea of consistency went beyond how the process might affect each individual patient but included the value of consistency to the larger health service's approach to patient safety. And though there was also acknowledgement that ED management remain cautious about taking away staffs' clinical judgement, including their threshold for escalating care, ED management took a broader view of compliance with the escalation policy:

> *"It's* [non-escalation] *not necessarily just about that one patient. You start saying, 'that's okay', you start putting up with a lot of other stuff".* (31/D/E)

Theme 2 - The influence of patient factors

As the interviews progressed beyond knowledge of, and thoughts about what is meant by recognising and responding to the deteriorating patient, synthesis of the analysis framework revealed a second overarching theme. This theme has been called *the influence of patient factors* and refers to the deteriorating patient's history of presenting complaint, their status/condition, their medical history and background or the effect that ED treatment or care might have on escalation practices. This theme also included the influence that the deteriorating patient's fellow patients was perceived to have on these same practices.

The patient's status/condition

Participants indicated several factors related to the patient that they perceived played a role in the variations to escalation practices. The severity of the signs of deterioration influenced the decisions that P2 made about which team member was the most appropriate person to escalate the patient's care:

> *"Depends on the severity I suppose. I normally would just go to the doctor that's looking after them. If I'm seriously worried about them, I'll go to the consultant and I'll tell the nurse in charge if I think that they're going to have to go to resus* [resuscitation

> cubicle] *or something like that and increase their care, then I'll inform further. But if it's just something mild, it's the treating doctor I'll normally go to*" (2/N/C)

There was also a link between the organ system that was exhibiting signs of deterioration and the escalation practices of the staff. Participant 2 made obvious distinctions about prioritising according to the organ system "…*that the heart rate obviously not ideal to be sitting at 130 the whole time, but it wasn't immediately life-threatening compared to his airway"* (2/N/C). The links between the organ system and prioritisation of escalating care were aligned closely with the primary, secondary and focussed assessment technique commonly adopted by ED doctors and nurses (i.e. Airway, Breathing, Circulation etc.).

Perceptions of the time critical nature of the signs of deterioration to be was also highlighted as an indicator of how likely the participants were to delay escalating care. This was summed up by one participant when discussing the factors considered when documenting vital signs that fell within the EDMAC:

> "*If I find that it's immediate and they really crash, then straight to the doctor in charge. If I've noticed some abnormality that, you know, we could sit on it for a bit longer, doesn't need immediate attention but it needs monitoring, then I go to the team leader*[2]." (3/N/C)

Treatment, care and ADLs

Participants also indicated that they are less likely to escalate care where the sign or symptom of deterioration may be iatrogenic, or simply caused by patient anxiety, movement or positioning. For example, "*if you're giving a patient burst therapy with Ventolin, I know they're* (the CIC and NIC) *not going to care if their heart rate is 120*" (4/D/P). Doctors echoed this

[2] The team leader is a nurse leading a small team of nurses caring for 6 – 8 patients.

rationalisation when discussing the variability in escalation practices due to factors such as the effects of treatment:

> *"…like the child's had a lot of Ventolin so they're tachycardic… it's all very well having numbers but you need to review the patient as well"* (20/D/E)

The effects of patient drug and alcohol use was another factor that was identified as influencing factor in the decision-making process about escalation of care. Unlike the side effects of treatment administered in the ED, the effects of illicit drugs were viewed slightly differently:

> *"I think the fact he'd said he had ICE, …the rationale was that's probably why his heart rate was high. And if he hadn't, to be God honest, if he hadn't even told me about the amphetamine use, I probably would have been more concerned about him, because we know the reason for his heart rate* [tachycardia]*"* (30/N/E)

The "other patient" factors

There were also features related to the deteriorating patient's fellow ED patients that were acknowledged as influencing factors for the decisions that explain escalation practices. The severity and intensity of other ED patients' conditions and care needs, mental health and behavioural problems, as well as emotional needs were perceived to have an impact upon escalation practices. When a patient with signs of physiological deterioration is identified at the same time as a patient who is requiring intensive care, such as resuscitation, participants identified an effect upon their escalation practices that was articulated as follows:

> *"So, if they're* [CIC] *involved in a resus, and I know that they're very busy, so I need to be watching this patient a bit more carefully. Even though I've escalated it, I know that in their* [CIC] *priorities, that's probably down a little bit still.* (17/N/E).

This caused participants to make decisions about modifying the escalation process as is described here:

> "*If there's a resuscitation going on that makes it really difficult because you don't want to go in and interrupt and steal people from things that are going on, so you try and manage it by yourself a bit. If they've already been accepted by an inpatient team sometimes you try and escalate to the inpatient team but that usually doesn't go that well*" (18/D/N).

Participants also acknowledged that it was not only the care of patients with signs of deterioration that they were concerned about, but also the care requirements of the "…*other patients that were in the waiting that needed equally as much attention*" (30/N/E).

Theme 3 - The influence of environmental factors

There were many factors that influence escalation practices and are part of the ED physical environment (e.g. care locations, vital sign observation charts), workflow practices (e.g. communication, teamwork) and patient care processes. These factors formed the categories that related to the next theme that was identified – *The influence of environmental factors*.

The theme comprised several sub-themes including constant environmental variables (i.e. tools and instruments, automated prompts and alerts, assessment and documentation and patient care locations) as well as variables that are influenced by dynamic changes day-to-day and shift-to-shift (i.e. communication and team interaction, mitigating strategies and workload demands).

Tools and instruments

Participants described their use and preferences regarding several ED specific assessment and documentation instruments. The instruments discussed were mostly electronic data entry and patient data review tools including Symphony's colour coded vital signs charts and the web-based interface of a similar colour coded chart with additional data such as GCS. Preference for which, and how, the different electronic charts were used varied, but many participants consulted to the trends at some stage while assessing or documenting a patient's observations. Review and reflection were seen as an important part of each episode of assessment.

> "*…but I feel like the most important thing that we have is that obs chart that comes up as soon as you put your vital signs into the computer*" (2/N/C).

A paper based paediatric vital sign chart with human factor elements such as colour, font and layout which assist clinicians to recognise and respond to clinical deterioration in newborn and paediatric patients was also discussed. The Victorian Children's Tool for Observation and Response (VICTOR) chart was seen by many participants to contain a more credible and accurate record of paediatric vital signs. One participant summarised the comments of others with an observation about the alignment of the two modes of observation and response.

> *"…because sometimes they* [vital signs] *pop up in the orange or the purple zone on the computer but then you look on the victor chart and it's* [vital sign] *actually not in that criteria. I've done a victor chart because I was worried about where they were, and it actually was completely different to the computer"* (2/N/C).

The VICTOR chart was also relied upon when assessing and documenting paediatric patient status due to the added complexity of caring for a patient type that is unfamiliar.

> "*…we don't deal much with children. Adults are in my head, whereas kids, because there are so many varied for so many age groups, that I tend to really rely on* [the VICTOR chart]" (19/N/E).

Most participants agreed that the VICTOR chart was used in combination with the Symphony electronic vital sign chart, though the implementation of the paper-based chart was inconsistent. Some participants completed the chart and the Symphony chart for every paediatric patient's vital sign entry, while others completed the charts only when a decision was made that the child would be admitted to the ward. As participant 21 put it, "*If I think the child is going to stay in, I'll grab a VICTOR Chart at the start and do both*" (21/N/C).

The utilisation of the prompts in the various observation charts were viewed differently by the participants. Some found that the charts "*will give you a prompt straightaway rather than to have to think about it, especially with everything else going on*" (3/N/C), while others were more reliant on their own interpretation of the data stating that *"…I already knew that* [the patient was deteriorating] *before I put the obs in*" (7/N/E) or combined their own cognitive processing with the prompt built in to the charts.

> "*Obviously, you would know that meeting MET call criteria but as soon as you put those obs in, it will tell you then and there "hey this person's meeting MET call criteria*" (22/N/AB).

There was overwhelming agreement amongst participants Symphony's interface was "*so slow, that's just one of the things I find that I cut out of - to save time*" (4/D/P), and significantly affected the staffs' efficiency when reviewing and documenting patient data.

> "*It's* [Symphony] *gotten a little bit slow is probably the best way to describe it, that if you're constantly trying to flick between screens to see what everyone else is doing, you actually achieve nothing else yourself that day*" (31/D/E).

Alerts

There are automated prompts built into Symphony's interface that activate a visual cue to escalate care to the CIC and NIC when a deleterious vital sign meeting the EDMAC is entered into the system. The utility of these prompts was also considered "*to be more irritating than helpful*" (2/N/C) due to the additional workload that the prompt generates. However, there were suggestions that the prompts should be designed to be a more targeted alert directed to the NIC and CIC.

> "*the patient safety is number one... It might be frustrating... but if it alarmed not only the team leader, but also the consultants, that maybe this is important*" (28/N/C).

The concept of prompts and alerts to help escalate care were also viewed as a tool that should be implemented judiciously. As one participant articulated:

> "*We've got so many alarms, and we've discussed this at our meetings, about oh we need an escalation process or a notification process. I know let's do another pager, let's make another noise, and as a group, we've sort of gone there is just so much noise, we just can't go down that path of adding another one*" (6/D/E).

Alert fatigue

Staffs' sensitivity to the automated prompts and alerts was perceived to diminish over time due to the frequency of activations. This idea was described by many of the participants when discussing the prompts to escalate care.

> "*If you see the same alerts coming all the time, you just get a bit bored with them and not pay attention*" (14/N/N).

and,

> "*We only have the important ones* [automated prompts] *and I still think we have too many. There's a lot of ones that can just get rid of, because that intrudes on the what's important*" (6/D/E).

However, the automated prompts were also seen as useful at times of increased workload and that they were "*probably a good idea, particularly when it's busy, having something that reminds people*" (20/D/E).

Assessment

Participants described a consistent approach to assessing patients that was common to ED staff. The primary (DRSABCD), secondary and focussed assessment technique was identified as an important technique to help identify deterioration that is an accepted fundamental element of undergraduate to postgraduate ED training.

> *"Yeah, Uni emphasised the importance of respiratory state and actually counting them per minute as an important indicator of a deteriorating patient"* (15/D/E).

The primary assessment technique was often augmented with other data while assessing the patient. In particular, the patient's appearance and continuous cardiac monitor data was combined with the vital signs to analyse the patient's status. Though the EDMAC is largely based upon numeric data, one participant articulated the notion that "…sometimes things might look good, but the patient doesn't" (18/D/N), describing a situation where escalation is required despite normal vital sign findings.

Team leaders and in charge team members use different assessment techniques that do not necessarily require direct observation of the patient. For example, staff behaviour can indicate a patient's status.

> *"You can kind of tell* [if there is a problem with a patient]. *Sometimes I can sort of go why have they* [treating doctors] *been in there for so long?"* (29/N/E).

These types of observation techniques were echoed by a CIC. When referring to team behaviours indicating that there is a problem with a patient, participant 6 stated "*You hear things, see things, see someone's approach, how people respond. Running worries me, it means there's something afoot*" (6/D/E).

Documentation

Participants revealed that documentation was an important element for communicating a patient's status that can later be consulted to disclose signs of deterioration. However, participants revealed that the accuracy and timeliness of their documentation practices were influenced by overwhelming workload. As one participant stated:

> "*Sometimes I've forgotten to write notes until the end of the shift and I'll have to stay back, so I make a conscious effort to - even if it's insanely busy*" (25/N/AB)

Accurate documentation of appropriate escalations was also acknowledged as an area for improvement. When asked about their thoughts on how well escalations were documented, one participant stated "*Potentially they were escalated - I've got to say, one thing I don't think we do well is document our escalations*" (19/N/E). When pressed for potential reasons for this, participant 19 was unable to illuminate any further but revealed that "*once it's fixed you sort of go, okay. We're good. And document what you've done but not - you don't tend to put in that middle step* [escalation]".

Participants revealed that their actual escalations to the NIC were inconsistent, documentation of escalations to the NIC were also identified as an area for improvement.

One participant articulated a common acknowledgment by participants that "*Most likely, they were either aware …like I always notify them, I just am bad at putting it in my notes*" (21/N/C).

Communication and Team Interaction

Participants also identified several features of communication and team interaction that impacted upon effective escalation practices. These features were related to the nuances of interpersonal interactions, modes of communication (e.g. handover), team-to-team communication, communication through documentation and reflections on one's own communication practices.

Junior doctors and nurses as newcomers to the ED workforce proved to be in an ideal position to comment on the communication practices of more expert ED staff. This was evidenced by general observations about more experienced ED workers. One of the residents summarised the strength of experience on communication stating:

> *"I think probably the main difference with someone whose experienced is they will tell you this is what's wrong can you come and do this as opposed to someone who's just telling you something and you're not really sure what they want or what they hope or expect you to do".* (19/N/E)

Also, much like the influence of education on assessment practices, communication also featured as an important element in the participants' training.

> *"…it's been heavily hammered into us that good documentation is very important. It's a form of communication to other team members and to your colleagues as well and we all have to try our best to improve our communication"* (11/D/N)

Other participants made similar observations about their own communication skills in a pressured environment stating that "*we tend to be very direct. Not too much fluff"* (20/D/E).

There were however several matters that were perceived to negatively impact on effective communication about patient deterioration. These ranged from the terminology used while communicating to larger influences such as fluctuations in workload demands. Terminology and identifying the patient correctly was seen as essential to effective communication when escalating care. One example given was the ED staffs' tendency to refer to a patient by their care location (cubicle number). Identifying patients in this way was perceived as an element that delayed the communication process, whereas the influence of workload was consistently identified as a patient safety issue.

While describing how workload pressures can be attributed to a reduction in the frequency and quality of handover, one participant described her experience.

> "*They kind of just got wheeled across from resus and then they were busy tubing patients, so it was just, "Cop this patient and read up as much as you can*"" (2/N/C).

This account was however countered by many descriptions of increased communication efforts in times of high workload demands. This was especially true within the smaller nursing teams allocated to particular ED care areas. The frequency of communications within the team was perceived to increase as patient acuity intensified and workload indicators like patient turnover increased. These episodes of *within-team* communication were analogous to micro-escalations to the nurse team leader of the ED care area and were perceived as important adaptations to the team's communication. The micro-escalations were also acknowledged by team leaders as a performance indicator.

> *"So at the end of the day, if something's not done, it looks bad on the team but it also looks bad on myself because I'm not delegating or communicating well with my team"* (23/N/P).

Communication between the ED and the admitting teams was also seen as an area for improvement with potential to hinder effective escalation practices. Examples provided by participants indicated an inconsistent escalation process when the patient had been accepted for admission but physically remained within the ED. When one such patient deteriorated and eventually required ICU admission, the interview participant described that the ED staff "*…were constantly pushing that he was deteriorating all day, but it was just trying to get a concrete plan on where we were going with him"* (8/N/E).

Participants also acknowledged the negative effects that workload had on the quality of their own communication practices.

> *"It* [workload demand] *is eroding into my ability to just say hello properly to a patient without thinking about the 10 ECGs that are on my desk and my phone ringing, "where are you and what are you doing", and by the same token with the staff"* (15/D/E).

And beyond this, another participant felt that courtesy and gratitude was an important part of the communication between the CIC and the person escalating care. The CIC expressed that there was a *"…need to say thank you for someone who escalates because if you say "No," they won't come back and do that*" (25/N/AB). And further to this *"…because I'm managing some unseen risk through someone else, so if I keep that sort of family welcoming environment and make them feel free to come back"* (25/N/AB).

Mitigating Strategies

When discussing strategies that they use to ameliorate potential missed patient deterioration participants modify their practices, the configuration of team roles and the frequency of rounding. Many of the modifications to practice and team configuration were implemented by CICs, NICs[3] and nurse team leaders.

As was described under the communication section, team leaders described increasing the frequency of team huddles, especially in times of high workload demands. They (team leaders) also increase their efforts to familiarise themselves with their team's clinical competence levels and rounding of the patients in their care area. When describing her approach to assessing the team's competency at the beginning of the shift, one participant described how she clarified her expectations to "*junior or just staff who I'm not familiar with, I like to start the shift with* [describing] *my expectations"* (19/N/E). The same participant also increased the frequency of patient rounding based upon the competency levels of her team.

The strategy of increasing the frequency of rounding was not unique to the team leaders. The practice was also consistently described by CICs and NICs alike. Many of the NIC interview participants described similar efforts to increase the frequency of rounding while considering the skill-mix of the teams.

> *"I probably just made sure I was a bit more present walking around the department. Popping in checking on teams, just making sure that everyone was okay and happy with how things were going. Especially the [other] team, because they were quite junior"* (21/N/C).

The CIC interview participants described a similar approach they had taken with their own team of doctors by reviewing the patients who had been seen by novices and advanced beginners.

[3] The pleural abbreviation of consultants in charge and nurses in charge are represented as CICs and NICs respectively.

> *"I'll always go and see the patients that the interns have seen, and the medical students as well, and HMOs"* (20/D/E).

The same participant expressed that returning to a practice of rounding with the NIC would be an effective way to mitigate missed deterioration at times of high workload demand.

> *"I mean I'm sure it would be a good idea to have a little ward round* [with the NIC]*, but most of the time it doesn't seem to happen"* (20/D/E).

When pressed on why the CIC and NIC rounding did not happen, the participant cited leadership commitments and interruptions as barriers "*…because we both get called away and we're both busy*" (20/D/E).

Mitigating strategies were not isolated to team leaders, NICs and CICs but were also voiced by participants in their day-to-day care of patients. An example of changes to care practices included "cycling" automated non-invasive blood pressure machines to activate intermittently providing a continuous and convenient way to assess the patients' blood pressure.

Patient location

Participants described the impact that the patients' care location had on the recognition and management of patient deterioration. Some areas were perceived to provide a higher standard of safety and some a lesser level of safety. The geography of certain cubicles were identified as prone to being overlooked and less frequently visited.

> *"it's just not visual in that area, and people tend to forget about that room and it's usually the last priority going into that room"* (3/N/C).

The perception that certain cubicles may be more prone to being overlooked was perceived as an area of concern in regard to recognising patient deterioration.

Beyond single cubicles, participants repeatedly referred to three ED care areas that were likely to impact upon the recognition of deterioration and management of patients whose care had been escalated. The care areas included the resuscitation cubicles, the waiting room and the short stay unit (SSU).

The feasibility of safely observing patients in the waiting room was described by one participant:

> "*Patients in a waiting room, for example, are a big problem, even with rounding - if you've got 10 patients out in the waiting room to see each one, do their obs, say, 'hello, how are you doing', document it all down, …you could be spending the whole hour just circling the waiting room and then starting again*" (31/D/E).

The participant acknowledged that the issue of rounding in the waiting room was one focus of an imminent change to the ED's model of care.

The next care area that participants reported as having a perceivable impact upon the management of patient deterioration was the resuscitation cubicle area. There were several features and perceptions about the resuscitation area that participants described. There was a shared perception that the act of moving a patient to a resuscitation cubicle alleviated uneasiness felt by staff caring for the patient. Participant 18 articulated the effect of moving an ill patient saying "*when I first saw him in the triage chair I was a bit nervous. I was happy once we got a resus bed*". Further to this the staff to patient ratios and expertise of resuscitation staff were both recognised as features that provided higher quality care. Participants described these advantages frequently during the interviews. For example, participant 7 stated "*If they're in resus you feel a lot more comfortable spending more time*" (7/N/E), and participant 14 stated when you "*take them to resus, they've got more skilled nurses there…*".

Beyond this, participants described that the act of moving patients to the resuscitation area validated their concerns and their judgement about escalating the patient.

The SSU was an extensively discussed ED care area from the perspective of recognising deterioration as well as the events that followed escalation of care. The staffing levels, clinical skill-mix and physical geographic location of the SSU were perceived to have potential to impact upon the recognition of patient deterioration. When describing her experience as a NIC managing patients with potential to deteriorate in the SSU, a participant (NIC) stated that she can become "*…very frustrated. More so when they're down in short stay and you haven't got fantastic skill mix. That concerns me, especially overnight. Because obviously the skill mix drops*" (16/N/E).

There was also a perception that the care of patients in the SSU was impacted by cognitive bias that could ultimately influence care decisions.

> *"…in an area like a short stay unit where you're already cognitively biased as to what you think the diagnosis is and what the management plan is and then tiny steps along the way, it's not appreciated the actual significance of the change, and you then become aware of it when it's gone above that threshold and it's all catastrophic"* (15/D/E).

And,

"Because in our heads, those patients have been worked up as safe to move down there, so you assume they're safe to move to a ward. So, you do tend to not keep an eye on it as closely as what's going on in the main department". (19/N/E)

Participants also described frustration at the responses they received when escalating the care of patients in the SSU.

"*So, yes, resus is easier. Short stay's a whole different ball game. You escalate and nothing changes*".

"*A lot of the time you're down in short stay you're just like, "This patient shouldn't be in short stay. They should be in mains at least" and nothing changes, no matter how much you escalate*" (7/N/E).

Another issue for patients who were deteriorating in the SSU which was described throughout many of the interviews was the events that followed escalation of care from that particular area. The issue was connected to the perceived appropriateness of the outcomes once care was escalated. There was an expectation that the deteriorating patient should be moved out of the SSU and re-admitted to the main ED, and while this sometimes happened, many participants described a reluctance to move the patient back out of the SSU. This factor is reported in greater detail later in this section under the last theme.

Workload Demands

The perceived influence of dynamic factors such as workload to impact upon practice (e.g. communication) have been touched on throughout several of the previous sub-themes. The perceived direct impact of increased workload on recognising and responding to deteriorating patients is the focus of this section.

Increased workload was cited by the majority of interview participants as one of the most prominent variables to negatively impact upon patient monitoring and escalation practices. The participants were sometimes unable specify why practice was negatively impacted but generally agreed that "…*when the demand is high, that's when the cracks in any system appear*" (17/N/E). There was also concern expressed that when there were increases in the number of patients with intensive care requirements, that *"…the patients that are perhaps less unwell don't get as much attention as - because you have to focus on this person that's unwell*" (17/N/E).

However, increased workload was not perceived by all participants as having the potential to negatively impact upon escalation practices, but may only impact on the response to that patient's escalation. As one participant put it:

> *"I don't think it* [workload] *impacts how I go about escalation, because I'll still go and hover at a curtain and go, this is happening up there. It probably more impacts on the delay to respond to it"* (19/N/E) *.*

And while not stopping the escalation from taking place, many participants acknowledged that a busier department climate did affect their feelings about escalating a patient's care. There was a persistent concern expressed in many of the discussions about interrupting or creating more work for the person in charge. When asked about anything that may impact upon their decision to escalate one participant responded:

> *"Yeah. Probably like how busy it is, and like if the nurse in charge looks like they're being attacked by multiple, not attacked, but like you know, coming from multiple angles by everyone? You just kind of like, oh God, I don't want to add this to the pile"* (21/N/C)*.*

Similar concerns were verbalised by nurses about the burdening the CIC.

> "*I feel like if a consultant or all the senior doctors who can sign things are up in resus, I feel like I can't go up there and bother them with an ECG*". (25/N/AB)

And also, by junior doctors.

> *"Yep, definitely. If there's a resuscitation going on that makes it really difficult because you don't want to go in and interrupt and steal people from things that are going on, so you try and manage it by yourself a bit"*. (18/D/N)

The negative impact of higher workload demands was also felt by the person/s in charge of busier shifts. As one participant (a CIC) stated:

> *"…what I also have to do is mitigate the number of interruptions that I have. I don't think that we go two or three minutes without somebody interrupting us, and then to attach the same significance to the interruption each time. I find this a challenge sometimes, and the busier I am the less likely I am to react completely objectively in that situation"* (15/D/E).

And another revealed that in times of higher workload demand that *"sometimes you're not paying as much attention or you can see someone else is standing there wanting to talk to you"* (19/N/E).

Theme 4 - The influence of the staff

There were staff characteristics, traits and attributes that were perceived to influence escalation practices of patients with signs of physiological deterioration. The theme was found to be comprised of several sub-themes that included the characteristics of the CICs and NICs, the experience and expertise of staff, impact of trust in self and others, staffs' intuition and the impact of training/education on escalation practices in the ED. These subthemes formed the next theme called *the influence of the staff.*

In-charge characteristics

The participants in each semi-structured interview were asked to discuss any factors that may impact upon escalating patient deterioration. The participants consistently indicated that the personal characteristics of the person in charge of the shift may negatively influence their disposition toward escalating care. The influence of the personal characteristics of the in charge ranged from extreme:

> *"…sometimes they* [staff] *dread going to some consultants*" (1/N/E) or,
>
> *"…there's some people that I will still approach and tell them if there is something wrong but I'll be sitting there going, "Oh, I really don't want to have this conversation,"* (4/D/P).

to subtle:

> "*probably certain doctors and certain in charges* [NIC] *are more approachable. But it wouldn't really stop me from telling them"* (7/N/E).

The notion that in-charge personal characteristics would not completely prevent the escalation was also a persistent feature that accompanied unease about escalating care. As one junior doctor put it:

> *"There'd probably be one or two consultants who I have to word it right or just pick the moment but I wouldn't hesitate"* (13/D/P).

Participants who were CICs also acknowledged that they were aware of the role that personal and professional characteristics can play in the staffs' apprehension about escalating care.

CICs indicated that this same apprehension can lead to avoidance of one CIC in preference to informing a more approachable CIC. As one participant put it:

> *"What if the responsible adult's* [CIC] *not being an adult, what do you do then? Go to the other adult, I'm sure that's what happens. Because I've been the other* [approachable] *one a few times. I think that's okay, what I'd worry about is if there was no alert at all, so shit just happens in the dark"* (6/D/E).

Consultants also accept that they are aware that the level of workload can influence their own approachability in regard to escalating care.

> "*…the busier I become and the more I have to do, the more I'm consciously telling myself to be patient with the next person who comes to interrupt me with something*" (15/D/E).

Experience and expertise

Staffs' experience (time working in ED) and expertise (level of clinical competence) were seen as factors that influenced staff escalations, as well as how the escalation was discerned by the person in-charge. The relationship between escalation, experience and expertise was perceived to be highly strongly associated. That is, the longer a staff member has worked in ED and the more expertise they possessed was perceived to be better aligned with appropriate escalation of care.

> *"It's not so much the credibility but I do have a value system, …for example, if a very experienced senior nurse were to come up to me, I would pretty much get up off my seat and respond to that straight away. If somebody more junior were to come I'd be more concerned because I wouldn't know for certain whether it was genuine or not"* (15/D/E).

Conversely, staff with less experience or expertise were perceived to be uneasy about escalating care. As one participant stated "*I think it depends on the staff. A comfort level, so a lot of new staff I find are uncomfortable to escalate care*" (5/N/E). The reasons for this unease was thought to be because "*it's such a daunting place to start, ED. Especially for some of them, it's their first rotation. I think it can get a little bit by the wayside. They get a bit panicky and just forget to escalate*" (19/N/E).

However, the junior staff themselves felt that they were "*not scared to say something about it to the nurse in charge*" and "*…if the nurse in charge can't do something then go straight to the doctor in charge, if you have to*" (7/N/E).

The empowerment that junior nursing staff may feel about escalating care was thought to be, in part, due to an often reinforced early educational message to escalate care early.

> *"you're taught that you must escalate to the nurse in charge or the consultant or whoever. So, I think we do it really well, to be honest. And even a lot of the junior staff I'm noticing are becoming really good at it, particularly the ones that are here from the beginning"* (8/N/E).

This notion was echoed by the junior doctors who also cited the support and close supervision they receive as having a positive impact upon their escalation practices.

> *"I think as interns, as junior medical staff are always quite well supervised especially in the emergency department. They're very well supported and supervised by the senior staff*" (10/D/N).

The expertise and experience of the team members (skill-mix) also impacted on the team leaders' watchfulness for signs of deterioration and stewardship of escalating care.

> *"because I'm the team leader of that group, I'm supposed to be looking out for them and knowing if they're in trouble. If they've got something that needs to be done, I'll take it on board to do it myself"* (21/N/C).

This heightened awareness was also acknowledged by the CICs. As well as modifying their leadership strategies, the CICs recognised a lack of critical analysis amongst junior staff. As one CIC participant put it:

> *"probably the more junior, less experienced ones probably just go "oh, it's low blood pressure. We'll give fluid." But not thinking about why has that occurred"* (31/D/E).

Intuition

Intuition was another characteristic of the carer that was perceived to play a role in the decision-making process of escalating care. Intuition was discussed during several interviews and was referred to in several different ways. For example, participant 12 said "*you know how you get that feeling in your tummy when something's not right?*" and participant 20 described their intuition as "*…when you get like the little nursing tingles*". Referred to as "*enteric medicine*" by participant 6, the idea of carers using intuition was thought to be a valid reason to escalate care and was actively encouraged by senior doctors.

> *"so even if the numbers aren't normal and they're worried they can still come and alert you to the fact"* (31/D/E).

However, the junior participants still felt that sense checking their concerns before formally escalating care was an important step in the decision to escalate.

> "*Then you escalate it to your team leader and then collaboratively as a team we take it to the docs. Sort of a good thing, you're not alone. I feel like you're not alone. So, if you feel like you've got gut instinct, you're not alone*" (14/N/N)

It should be noted that the EDMAC does in fact include a criterion for staff to escalate care when they have "*any other concerns".*

Trust in self and trust in others

A sub theme that related to participants' perceptions of the confidence they placed in their own judgement, as well as the confidence they placed in their colleagues was identified as a factor that contributed to escalation practices. Trust in self and trust in others was described from several vantage points throughout the interviews.

Trust, or confidence, in one's own judgement was sometimes influenced by experience working in the ED.

> *"Maybe at the start when I was still finding my feet, I probably second guessed myself. Like, I didn't really trust myself in recognising that that patient's deteriorating"* (25/N/AB).

Confidence, in one's own judgement was also influenced by how participants' thought they were perceived by their colleagues "*…because if you are wrong, people don't talk to you nicely about being wrong*" (4/D/P). This was thought to lead to potential delays in escalation while the participants confirmed their findings.

> "*So, I try to work those things before I make a big hoo ha out of it*" (12/N/N).

Delayed escalation due to self-doubt were also acknowledged by doctors. When describing a delayed escalation event, participant 13 described her perceptions of why the delay occurred.

> "*I took the wrong advice from the wrong people and that was my fault, …I don't think I was proactive enough in this guy*" and "*I think it was me stalling things*" (13/D/P)

However, participants agreed that despite any potential anxiety that came from lack of confidence in one's own judgement, escalating care was the safest course of action if deterioration was suspected.

> *"I think you just have confidence that your instincts are usually right. And if you're wrong, you're better off just escalating it anyway because then the doctors can come in and find out that you're wrong"* (7/N/E).

The trust placed in individual team members, and teams as a whole, was perceived to impact on the CIC's prioritisation when faced with responding to escalated care.

> *"…there's a huge component of what you're trusting other people to tell you, and you're hoping that the two extremes - the really good and the really bad - is going to be accurate. It's the stuff in between that's harder to work out…"* (15/D/E)

Trust in individual team members was seen to be influenced by the experience and expertise of the team members, but there were other personal traits about the staff that participants factored in when a patient's care was escalated to them. These traits included how composed a team member was perceived to be in the workplace.

> "*I know I've got to calibrate the staff as well, some are more alarmist than others*" and when a "*…senior detached specialist nurse grabs me, it means can't get out of it, you've got to do it* [respond]" (6/N/E).

The personal traits, regardless of expertise, that endorsed trust in individual team members were also described by one participant as:

"They're confident. They're knowledgeable. They go out and they seek information. And they're good advocates for their patients. You know, they're just - I don't know, dynamic personalities maybe" (16/N/E)

Trust in individual team members was also perceived to strengthen the aggregated trust that a leader may place in any given team.

"…the fact that we do that nice teamwork, I know I've always got at least one senior person in that team that should be on top of it" (19/N/E).

Training or education

As discussed earlier in this chapter, understanding and knowledge about the principles of deteriorating patients and escalation were well understood by the participants. However, the impact of education or training upon escalation practices was not discussed in that section. Though not a significant sub-theme, there were several opinions voiced about the impact of education upon escalation practices.

One repeated concern acknowledged that when new staff are inducted into the workplace there is an overwhelming amount of information in which the message about escalation may be lost. As participant 19 reflected "*I know they're told, but they get told so much information*" (19/N/E). There was, however, a general perception that junior medical and nursing staff were very well supported educationally in regard to escalation of deterioration. The intensity of the work in the ED was cited as the main reason for the level of support.

"I think interns are pretty well-supported in EDs where they work everywhere because it's a high-intensity, early decision-making position" (31/D/E).

Apart from the practical aspects and processes involved in recognising and managing deterioration, there was evidence that attitudinal and behavioural instruction was provided in the workplace. When describing the key message that doctors need to know about recognising and managing deterioration in the ED, one participant explained:

> "*I teach the juniors that you learn how to get in to trouble, then you learn how to get out of trouble, and then you learn how to avoid trouble*" (6/D/E).

Theme 5 - The influence of the organisation

The last overarching theme that was perceived to influence escalation practices consisted of factors that related directly to the health service's processes, performance indicators and policy. Though the frequency of references to the constituent elements of this theme were significantly less than those of other themes, the features of this theme were distinctly different in nature which necessitated a discrete theme called *the influence of the organisation.*

Policy and process

Interview participants described their perceptions of the impact that performance indicators, such as the National Emergency Access Targets (NEAT), had upon the decisions concerning escalation and responses to deterioration. Team members expressed frustration when faced with impact of performance indicators on their concerns about patient safety. As one participant put it:

> I feel *"annoyed, because you're like, "Oh, I'm telling you and I'm worried about this patient. And you're not listening or you're worried about your KPIs over a patient's safety"* (21/N/C).

Other participants eluded to a situation, that was perceived to be delicate in nature, brought about when the appropriate response to escalation required the patient being moved from the SSU back to the main ED for more intense care.

> *"It's* [moving the patient] *awkward. No one's very happy about doing it but it goes okay"* (18/D/N).

The impact of performance metrics upon the management of deteriorating patients was also described by CICs.

> *"you have the sense that there's a lot of administrative management-style stuff going on. Not only supervision of junior staff but it's really the flow and the times and the numbers that you are - that's a superimposed task, it's a huge task, and I've had the awareness that it is changing me in terms of my personality and my actions"* (15/D/E).

Human resources

Finally, the availability of staff throughout the shift cycle was perceived as a factor that negatively impacted upon care of deteriorating patients. Participant 27 proposed that "*maybe not having enough senior staff, medical staff overnight potentially*" (27/N/C) impacted on timely and appropriate responses to escalation. This same perception was voiced about the impact of nurse-to-patient ratios overnight.

> *"So, the ratio is like one to six or it could be one to seven at night whereas during the day it's like one to four"* (29/N/E).

6.4. Conclusion

The results of a comprehensive framework analysis of the qualitative data derived from staff interviews has been reported largely as descriptive text with tables and descriptive figures where appropriate. The majority of interview participants were nurses (71%). Participants' roles, experience and level of competence have been presented in a table to provide an easy to interpret overview of each interview and participant.

Framework analysis of 31 interviews revealed that there were five themes that became evident from the interview transcripts. The first theme, *understanding deterioration and the escalation process,* was quite distinct from the remaining four themes. *Understanding deterioration and the escalation process* was a descriptive theme that synthesised participants knowledge of, and thoughts about what is meant by recognising and responding to the deteriorating patient in the context of the emergency department. The theme also highlighted participants' understanding and knowledge of what policies currently exist to support the recognition and management of deterioration in the ED.

Overall participants viewed the issue of recognising and managing ED patients who exhibit signs of physiological deterioration to be an important quality of care and patient safety matter. Patient deterioration was generally interpreted in alignment with definitions in the current literature regarding the afferent limb (the calling criteria) for deteriorating patients (Hillman & Chen, 2014). The fundamental principles of the escalation process were also well understood and the EDMAC was accurately described as a modified version of the health service MET calling criteria. However, detail about the policy and procedure was largely imprecise and, in several cases, unknown.

The escalation process was well known to the participants, but implementation of the process varied in the timing that of escalating, the persons to which escalation should be reported and the threshold of tolerance for physiological deterioration before escalation was initiated.

Participants also described their thoughts on the effectiveness of the afferent and efferent arms of the alert criteria. The EDMAC was generally perceived as an important and effective system that was not always well implemented. A consistent message about flawed implementation of the calling criteria was the uniform failure to notify the nurse in charge.

The remaining themes describe a large number of factors that were perceived to exert influence on the escalation practices of the participants. The themes, and their constituent sub-themes, were reported as descriptive text that included direct quotes which exemplify the meaning associated with the participants' perceptions, opinions and experience of escalating care of the deteriorating patient.

The first of these themes was called *The influence of the patient factors* and refers to the deteriorating patient's history of presenting complaint, their status/condition, their fellow patients' status/condition, their medical history and background and the effect that ED treatment or care might have on escalation practices.

The next theme was called *The influence of the environment.* This theme included factors that were perceived to influence escalation practices that are part of the ED's physical environment (e.g. care locations, vital sign observation charts), workflow practices (e.g. communication, teamwork) and patient care processes. *The influence of the environment* has been reported under several sub-themes including constant environmental variables (i.e. tools and instruments, automated prompts and alerts, assessment and documentation and patient care locations) as well as variables that are influenced by dynamic changes day-to-day and shift-to-shift (i.e. communication and team interaction, mitigating strategies and workload demands).

There were also staff characteristics, traits and attributes that were perceived to influence escalation practices of patients with signs of physiological deterioration. This theme was called *The influence of the staff* and was reported by describing several sub-themes that included the characteristics of the CIC and NICs, the experience and expertise of staff, impact of trust in self and others, staffs' intuition and the impact of training/education on escalation practices in the ED.

The final theme consisted of factors that were perceived to be directly related to the impact of the health service's processes, performance indicators and policy on escalation practices. The theme was called *The influence of the organisation* and comprised substantially less subthemes. These subthemes were *policy and process*, and *Human resources.*

Key findings

In summary, the key findings from the staff interviews indicate that escalating the care of deteriorating ED patients is perceived to be influenced by:

- staffs' understanding of the physiological deterioration and escalation process,
- patient factors such as the deteriorating patient's condition and comorbidities, responses to treatment as well as the status of other patients in the ED,
- ED working environment factors which can be constant (e.g. electronic medical record system) or dynamic (e.g. team interaction),
- Staffs' experience, expertise, personal traits and characteristics.

The findings reported in this chapter provide a valuable insight into the complexity of escalating the care of deteriorating ED patients. The results presented in this and the previous two chapters will be merged in the next chapter. The next chapter is an integrated discussion of the organisational climate, culture and structures that are associated with the recognition and management of patient deterioration by health care professionals in an emergency department.

Chapter 7. Discussion

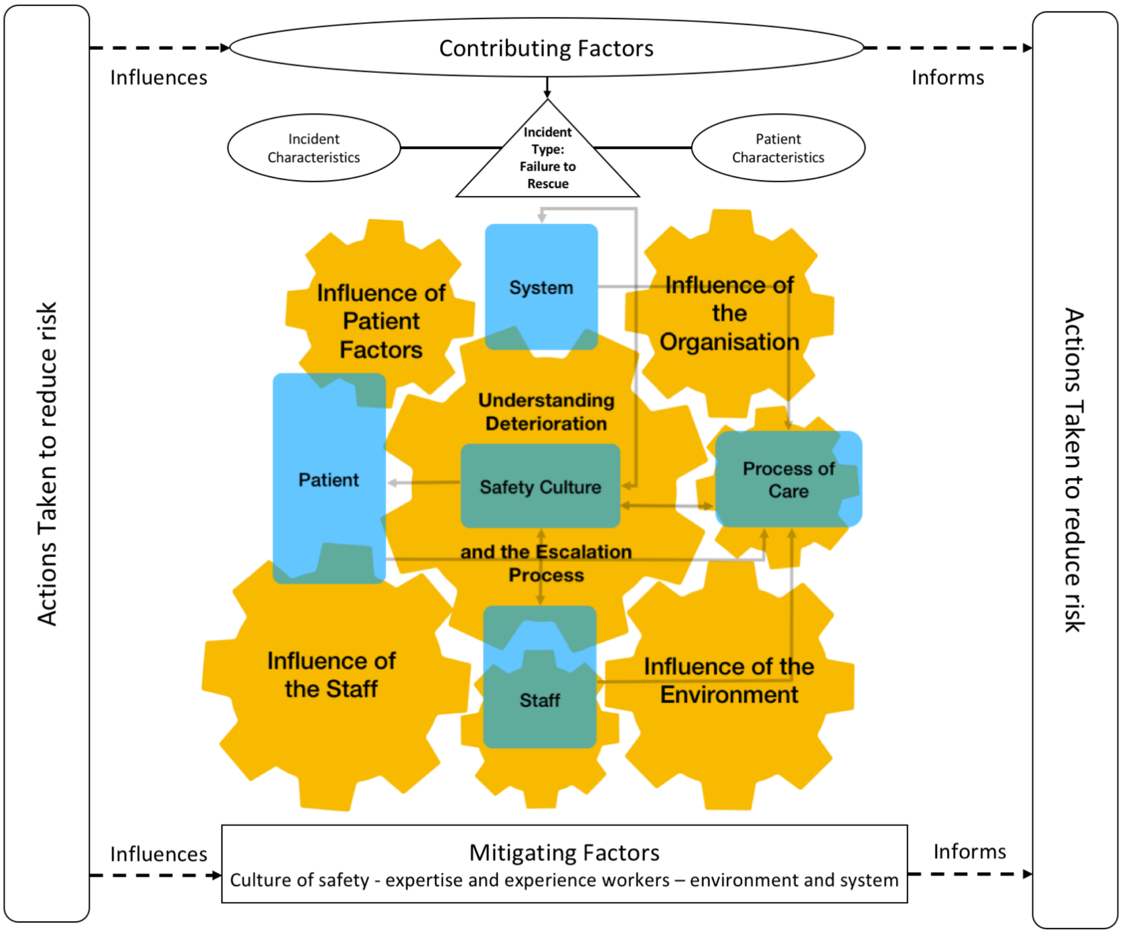
7.1. Introduction

In an attempt to understand the risk posed by physiological deterioration to ED patient safety and the factors that exert influence on that risk, the current study was designed to examine the relationships between dynamic ED characteristics (workload, skillmix and casemix), organisational culture (safety climate) and the care of the deteriorating ED patient.

The study aims were addressed in a mixed methods design comprising three periods of data collection across two phases. Phase One comprised of a safety climate survey (SCS) which was completed by medical and nursing staff (n = 127) working in the ED at the time of the study. The SCS was carried out to measure the staff perceptions of the culture of patient safety in the ED. Phase 2 comprised a retrospective medical record review (MRR) of episodes of ED care (n = 2668), and semi-structured interviews with ED doctors and nurses (n = 31). The MMR was designed to examine i) the period prevalence and characteristics of care escalation for deteriorating patients in a metropolitan ED, and ii) relationships between organisational factors (staffing levels, staff skillmix, patient casemix, occupancy) and escalation of care following patient deterioration. The semi-structured interviews enabled exploration of insider perceptions, opinions and experience of escalating care of the deteriorating patient and the factors associated with escalation practices.

The results of the three studies have been reported in chapters 4, 5 and 6. These results reveal a number of outcomes about the ED culture of safety, the magnitude of patient deterioration in the ED and its characteristics, as well as the factors that influence appropriate management of deteriorating ED patients. As was discussed in section 1.3, the cyclical nature of the International Classification for Patient Safety (ICPS) has been used to provide a theoretical framework and process for i) exploring the actions taken to reduce FTR, ii) generating understanding about what influences FTR, and iii) how this new understanding informs actions and change in practice to reduce FTR (i.e. risk/harm). Therefore, the outcomes from this research are likely to inform future policy, practice and education related to the recognition and management of deterioration in the ED. To illustrate the relationships between the findings of this study, the organisational and human factors, errors and safety outcomes described in section 1.2.8, the study findings are overlayed on the ICPS framework in figure 7.1. The diagram is intended to provide the reader with a visual representation and point of reference for the integrative discussion in this chapter. The diagram may be helpful as an aide-mémoire to how the theoretical framework, factors influencing FTR and the themes which were reported in Chapter 7, inform and relate to the discussion points. For example, while reading the discussion about the culture of safety (see section 7.2), the reader may find it helpful to imagine a vertical line down the middle of the 'Contributing Factors' oval. This will help to form a mental image about how safety culture is a contributing factor to the incident type (i.e. FTR), while also being influenced by staff factors such as team interaction and communication, leadership and their understanding of the escalation process, as well as system factors such as the model of care and ED performance indicators (i.e. NEAT).

Figure 7.1 Failure to Rescue and the International Patient Safety Framework



The aim of this chapter is to synthesise and discuss the key findings of the research in the context of the current literature and their relevance to improving safe, effective and high-quality patient care. In keeping with the tenets of a mixed method study design, this chapter presents an integrated discussion of the key findings from the quantitative and qualitative strands of the study.

This chapter is structured around three of the main elements that were observed to determine the effectiveness of recognising and managing physiological deterioration in the ED. These are the culture of safety, the expertise and experience of the frontline workers and the environment and system in which care is provided. These main elements are discussed in relation to answering the question: are organisational climate and structure associated with the recognition and management of patient deterioration by health care professionals in an emergency department?

7.2. The culture of safety

Safety climate is a measure of frontline healthcare workers' shared perceptions, behaviours, beliefs and attitudes towards the organisation's culture of safety (Zohar et al., 2007). Safety climate scores are also closely associated with the frequency of errors and adverse events in the healthcare setting (Flin et al., 2006; Flin et al., 2009; Singer, Lin, et al., 2009; Weaver et al., 2013). Safety climate scores are also a valuable indicator of health care workers' resolve to maximise behaviour and actions that ameliorates harm during the process of patient care (Vogus & Sutcliffe, 2007). The broader results of this study show that ED staff perceive that there is not a strong organisational commitment to patient safety. This finding is consistent with safety climate ratings in 92 hospitals in the USA which showed that ED staff rate the safety climate substantially lower than those in other acute care wards (Singer, Gaba, et al., 2009). Nurses in this study did, however, rate the safety climate higher than doctors across all domains except for stress recognition. This suggests that doctors are more circumspect about the adequacy of the system's safety processes, but remain equally as aware as their nursing colleagues of the workplace stressors that impact on their practice. The inferences that can be drawn from this aspect of the SCS results are better discussed by first examining the magnitude of the risk generated by deterioration and how that risk is being managed.

7.3. Period prevalence of deterioration

The results of this study show that the period prevalence of first episode late signs of physiological deterioration in the ED is 10.08% (n = 269). This is consistent with the range of prevalence demonstrated in Europe (Marquet et al., 2015; Zegers et al., 2009), Australia

(Harrison et al., 2005), the UK (Garry et al., 2014) and North America (Runciman et al., 2000) (10 – 27%). However, recent studies in Australian EDs have reported slightly higher prevalence (12.9-14.8%) (Considine et al., 2015a; Scott et al., 2015). The results vary from the current study's results and may, in part, be attributed to the different study designs used in each study. Scott et al. (2015) used a prospective point prevalence study design which reported on the point prevalence of adult ED patients only. Their findings of adult patients experiencing deterioration ranged from 5.8% to 21.7%. Furthermore, the cross-sectional design of the study by Considine et al. (2015) was limited to a sample of adult patients with shortness of breath, chest pain or abdominal pain. The results of the current study originate from a sample that included all adult and paediatric patients (*n* = 2668) that were cared for in the ED over a period of 14 days.

The demographic data of patients exhibiting the first episode of deterioration showed that half were male (51.8%) and the mean age was 48 years. Deterioration was seen in adult patients four times more than in paediatric patients (see table 5.2). This was not an unexpected result given that, although the site is a mixed ED (care provided to adults and children), it does not receive a large number of critically ill paediatric presentations when compared to other EDs in the health service.

The casemix of deteriorating patients also revealed findings that were not unexpected. Patients with signs of deterioration were represented by 33 different ED presenting problems that were allocated at the time they were triaged into care. The top three presenting complaints were *shortness of breath* (20%), *febrile/pyrexia of unknown origin (PUO)* (10%) and *abdominal pain* (9.1%) (see appendix M). With the exception of the *febrile/PUO* presenting complaint, this finding is the similar to the findings of Scott et al. (2015).

The urgency with which the deteriorating patients needed to be seen by a doctor (Australian Triage Scale) was also consistent with other ED specific studies (Considine, Charlesworth, & Currey, 2014; Hosking et al., 2014; Scott et al., 2015). The majority (58%) of deteriorating patients had been assigned a triage category of 3 (urgent – maximum waiting time 30-minutes). However, it must be noted that patients who received an ATS category 1 or 2, and had not experienced normalisation of their condition for at least 1 hour, were excluded during step two of the audit process (see section 3.10.4). Therefore, this result may have been different had all category 1 and 2 patients been included in the analysis.

Triage flagging of patients who may need ICU admission showed that this was not associated with patients who exhibited first episode signs of deterioration. However, this flag is not used as a predictor of the patient's potential to deteriorate, but rather as an indicator of potential to require an intensive care bed.

There was also little variation in the prevalence of deterioration across the three main shifts (AM, PM and night duty) with deterioration slightly less prevalent during the PM shift (27.3%). This result is consistent with results of a study examining clinical instability events and their management at different times of the day (Hravnak, Chen, Dubrawski, Bose, & Pinsky, 2015). However, there is also evidence that the management of patients who deteriorate and ultimately experience sudden cardiac arrest (SCA) overnight is different from those experiencing SCA during the day. A longitudinal prospective case register study of 2121 patients indicated that fewer patients deteriorate to the point where SCA occurs between midnight and 07:00 am, but the risk of death was significantly greater if cardiac arrest occurred during this time of day (Cooper, Janghorbani, & Cooper, 2006). This may indicate that there are differences in managing clinical instability at different times of the day.

7.4. Managing the risk

It is important to note that, in literature, failure to escalate is often referred to as 'failure to rescue' (Winters & DeVita, 2017). However, 'failure to rescue' also refers to mortality that has been caused by failure to recognise, escalate and appropriately manage surgical complications (Silber et al., 2007). Although both terms are similar, the important distinction is that failure to rescue is often measured by mortality rates, whereas failure to escalate does not.

The prevalence of documented first episodes of deterioration, that were not escalated according to the health service's EDMAC, was 47.3%. This is a rate that is greater than the 10 – 30% which has been reported in acute medical surgical wards (Hillman et al., 2005; Johnston et al., 2015; Kause et al., 2004) and in the limited ED literature (Scott et al., 2015). This may, in part, be due to reasons that were identified in the interviews and is highlighted as one of the limitations of the audit design. That is, there is a distinct possibility that care was, in fact, escalated in a proportion of the cases but there was insufficient documented evidence to indicate that the escalation took place.

The interview findings revealed many indicators that participants do actually escalate care while neglecting to document the escalation. However, participants also consistently acknowledged that they rarely escalate to the NIC, a factor that was echoed by participants who were NICs. Furthermore, there were interesting inconsistencies in the interviews (see section 6.3) that may have been influenced by the interview participant's eagerness for their actions to be viewed in a positive way (Hannabuss, 1996; Noble & Smith, 2015). Given the sensitive nature of the study and potential perception that the interview questions constituted a judgement of the quality of their care, there is a possibility that some participants may have found it difficult to acknowledge that they did not escalate care appropriately. Despite reassurance by the interviewer to the contrary, such an acknowledgement could be perceived by participants as an admission that the quality of their care was sub-optimal.

7.5. Team culture and communication

Despite the limitations of the retrospective nature of the audit, the prevalence of failure to escalate is high during the study period and is reflected in other results to emerge from both phases of the research. As discussed earlier, the results of this study show that overall ED staff perceive that there is not a strong organisational commitment to patient safety. As with most of the attitudinal domains in the survey, *team climate* and *perception of management* were not rated highly and indicate that there is a perception of poor quality of collaboration within the team and do not approve of the organisation's actions in responding to patient safety issues. Though the SCS results indicated that team climate was poor, the depth of data from the interviews provided a more detailed and temperate impression of team collaboration and interaction which was impacted by several intrinsic and extrinsic factors.

Team interaction featured heavily as a sub-theme in the *Influence of environmental factor*s theme. Seen as a variable that was affected by dynamic variables in the ED (such as workload), *communication and team interaction* were perceived to impact upon escalation practices and as one of the factors that contributed to the fabric of the ED's safety culture.

In their review of the culture of safety literature, Sammer, Lykens, Singh, Mains, and Lackan (2010) identified communication as one of seven subcultures that impact upon the culture of safety in the healthcare setting. In the current study ED communication practices were, i) structured (e.g. ISBAR), ii) perceived to be of high quality by newcomers to the ED workforce, and iii) were heavily influenced and supported by education. Communication was also perceived to be impacted by fluctuations in workload. This was not a surprising result and has been reported elsewhere. In a study designed to examine organisational-level factors that influence patient perceptions of physician communication using patient ratings of physician communication, Al-Amin & Makarem retrieved patient ratings of care from patient survey databases of from 2,756 hospitals. The findings from the study revealed that increased workload was associated with a reduction in patients' satisfaction and experience of quality communication from the physician (Al-Amin & Makarem, 2016). In this study, increased workload also appeared to bring about interesting modifications to the EDMAC process such as micro-escalations and an increased frequency of huddles (patient care updates within the team) as shown in interview findings, section 6.3 (*team interaction and communication*). These communication adaptations to a busier environment are likely to be necessary to enable the team to collaborate effectively in a highly dynamic environment with uncertain workload demands.

Increased workload was also seen to negatively impact communication practices in a way that eroded support for a positive culture of safety. This was evident in the self-acknowledgement by CICs and NICs that their fundamental approachability and standard of interpersonal courtesy had been negatively affected by the frequency of interruptions associated with increasing workload demands. Interview participants thought this to be especially true for interruptions that were perceived to be of less importance (e.g. reviewing normal ECGs) and consequently detracting from more serious patient issues. El-Sherif et al. (El-Sherif et al., 2017) showed that the duration of face-to-face interruptions to ED physicians' workflow were correlated with fluctuations in workload demands and are likely to contribute to physicians' cognitive load and the potential for medical errors. While the potential for medical errors was not discussed in the interviews, there was a sense that the frequency of interruptions did, in fact, impact on the CIC's cognitive load and their capacity for effective communication.

The inference that communication is both affected by competing workload demands as well as influencing the culture of safety has also been described in previous studies (Blake, Kohler, Rask, Davis, & Naylor, 2006; Farrell & Davies, 2006). The results of the open-ended questions in the Phase 1 survey indicates that participants feel that effective communication and debrief are important elements that require improvement if the ED is to enhance patient safety. When the individual survey items are scrutinised more closely (e.g. items 9 & 20) it is apparent that effective communication not only refers to communication between frontline workers, but also vertical communication between management and staff. Survey participants indicated in open-ended responses that these types of vertical communications should include acknowledgement of staff performance, their concerns about safety issues, and should promote a positive climate for feedback. These findings are consistent with studies reporting on the relationships between leadership and safety climate, (Fischer, Jones, & Verran, 2018).

The findings from this study support expert consensus opinion form nurse leaders in Australia, Colombia, Hong Kong, The Netherlands, Pakistan, and USA (Buckner et al., 2014). That is, leaders, both on the frontline and in administrative positions, are obligated to listen, acknowledge and act upon real or perceived safety problems whether they are practical operational factors or cultural in nature.

7.6. Leadership and the culture of safety

The personal and professional characteristics of the person in charge of each shift were consistently perceived to impact upon the decision-making processes necessary for escalation practices. However, before discussing the part that leadership characteristics play in forming the culture of safety, it is important to highlight two important aspects of these findings. Firstly, the interview participants in Phase 2 of the study were very clear that any difficulty in approaching the person in charge was not a universal experience that applied to all those in charge. On the contrary, the experience was seen to be the exception rather than the rule. Secondly, any hesitance felt by the participants did not translate into a failure to escalate care, but rather caused some anxiety and possible delays in escalating the care of the patient.

Despite these two caveats, it is quite likely that the perceived characteristics of the person in charge have a pervasive effect on the overall culture of safety, and are consistent with findings reported elsewhere (Fischer et al., 2018). Leadership that consistently commits to, and actively telegraphs the importance of a culture of safety has been described as one of the top facilitators of a healthy safety culture (Blake et al., 2006). Moreover, the relationship between a strong culture of patient safety and leadership has also been directly linked to leaders who exhibit a transformational leadership style (i.e. promotes pride in team members achievements and high-quality performance (Merrill, 2015)). Similar links have also been demonstrated in high risk industries beyond healthcare (Flin & Yule, 2004; Mohr, Abelson, & Barach, 2002).

The interaction between the person escalating the care of a deteriorating patient and the NIC or CIC was reported to be a predominantly positive experience. However, there was a pervasive and conspicuous acknowledgement that some leaders were less receptive to escalating care than others. This perception was not unique to team members responsible for escalating care, but was also reported by CICs and NICs. Again, though there was uneasiness associated with escalating to some ‘in charge’ persons, this discomfort was not reported to translate into failure to escalate. However, the existence of supportive leadership has been identified as a factor that enables escalation, and unsupportive leadership as a barrier (Massey et al., 2014). There was a sense from the interview data that, rather than avoid escalating, staff applied workarounds that circumvented any discomfort that may arise from escalating to an unsupportive leader. One example of this was escalating to a consultant who was perceived to be more approachable (see section 6.3, *Theme 4 - The influence of the staff*).

Though this study was not designed to explore the relationships between leadership and patient safety culture, there was a noticeable interface between the interviewee's perceptions about the characteristics of some leaders and the safety climate status.

7.7. Performance indicators and the culture of safety

In response to ED overcrowding and a need to improve patient access to emergency care, the Australian government introduced the National Emergency Access Target (NEAT) in 2012 (Baggoley et al., 2011) following a staggered adoption in Australia of the UK's "four-hour rule". In line with many Australian EDs, the study site management team modified their existing model of care to help meet the targets and create greater access for new patients presenting to the ED. One of the modifications included the process of moving patients that were stable, and had an agreed management plan, from the main ED treatment area to the Short Stay Unit (SSU), thus creating space to assess new arrivals. The SSU is physically located in the ED and patients who are moved to the unit are discharged from the main ED care streams.

The medical record review results indicated that patients who were being cared for in the SSU at the time of their initial episode of deterioration were significantly less likely to have their care escalated appropriately ($p < 0.05$). An extensive review of the extant literature revealed no studies that indicate an association between escalation practices and specific ED care locations. There is however, evidence that nurses on acute surgical wards are more likely to follow the correct escalation practices than those in acute medical wards (Radeschi et al., 2015). In order to better understand some of the reasons that underpin any association between escalation practices and the SSU, it is important to consider the experiences and perspectives of frontline ED workers.

Important data emerged from the semi-structured interviews which provided greater depth to the cultural reasons behind failure to escalate SSU patients. Interview participants described barriers to escalation that centred around the implementation of the health care service performance indicators to fulfil the four-hour targets. Respondents to the open-ended survey section also indicated that adherence to the health service's performance indicators negatively impacted upon patient safety. The main barrier to appropriate SSU escalation was a perceived cultural reluctance to act on escalations in a way that was thought to better support patient safety. For example, staff who escalated SSU patients with signs of deterioration were either asked to manage them in situ, or described a cultural reluctance associated with the process of bringing the patient back the main ED.

The persons in charge of shifts acknowledged that there was also a cognitive bias associated with caring for patients located in the SSU. Patients in the SSU were considered to be less at risk because they had been diagnosed and they had an agreed plan of care. This perception was described to result in a somewhat diminished vigilance by the in-charge persons when monitoring for acute deterioration in the patient's status.

There is little evidence to describe the safety of patients who are cared for in ED short stay units (Galipeau et al., 2015). Most studies tend to focus on distinct outcomes which are specific to various patient types. For example, physiological respiratory outcomes for asthma patients (McDermott et al., 1997) or length of stay for patients with chest pain (Roberts et al., 1997). As a result, there are no available studies for comparison purposes.

The evidence presented here suggests that all ED SSU patients are placed at additional risk by virtue of a culture of safety that is negatively influenced by performance indicators, as well as a perception that the watchfulness for deteriorating SSU patients is blunted. It is, however, unlikely that these are the only two factors associated with sub-optimal escalation practices in SSUs, and as such, would benefit from further research to investigate the quality of care practices in this specific area of emergency care.

7.8. Experience and Expertise

The impact of experience and expertise on real and perceived escalation practices and patient safety has been a key feature in the results of each strand of the current research. Clinical competence (expertise) was represented throughout based upon the Benner's five stages of clinical competence (Benner, 1982). The model provided a convenient and relevant tool to describe the participants level of clinical competence as it was the model that was used throughout the health service and the study site. As described in sections 3.8.3, 3.8.4 and 3.8.5 accurate and up to date records of all staff members' level of clinical competence are maintained by the ED's management and education team, and the data in each of the three studies was presented in such a way to allow meaningful comparison for each dataset. Therefore, the staff expertise has been grouped differently in the results of each strand (see sections 3.9.5 and 3.11.1).

7.8.1. Expertise and escalation

There are several significant findings that emerged from the study that demonstrate strong relationships between patient safety climate, escalation practices and expertise. Safety climate scores indicate that staff become less optimistic about the culture of safety at what appears to be a pivotal point of their professional development. Results from the MRR also indicate that there are significant changes in staff practice as they transition from advanced beginner to intermediate (competent and proficient) competency level at, or around, the two-year point in their ED career (see figure 3.2).

Staff who documented the first episode of deterioration are significantly more likely to escalate appropriately when they are at an intermediate competence level ($p < 0.05$) (see table 5.9). Regression analysis further showed that this same group was nine times more likely to escalate care appropriately compared to beginners (novice and advanced beginners) and experts ($p < 0.05$) (see table 5.10). However, the odds ratio had a wide confidence interval (95%, 1.148 – 70.636) which indicates that intermediate expertise is an imprecise, albeit strong, predictor of appropriate escalation practice.

The association between intermediate expertise and appropriate escalation practice is both surprising and of great importance to efforts to improve escalation practices in the ED. When the relationship between intermediate expertise is considered together with of the group's corresponding experience, it is likely that they have experienced many episodes of deterioration and, potentially, a large number of episodes of failure to escalate. Bearing in mind that this is also a group that does not perceive of a positive patient safety culture, it is likely that they possess attitudes, motivations and beliefs that may augment current efforts to improve escalation practices. Carers who have experienced prior exposure to deterioration and escalation practices have been reported to experience improved escalation practices

(Galhotra et al., 2006; Salamonson, van Heere, Everett, & Davidson, 2006). Considering the positive predictive value of intermediately competent staff to escalate care in the current study, closer exploration of their attitudes, beliefs and behaviours regarding patient safety and escalation may unearth valuable insights into ameliorating FTR.

There are also relationships between poor escalation practices and staff at the novice and expert extremes of the expertise and experience continuum (see table 5.9 and figure 3.2). Appraising the meaning of these relationships requires closer consideration of the richer data that came from the interviews and the cultural attitudes of safety climate survey participants at various competency levels. This is the focus of the following section.

7.8.2. The impact of expertise and expertise

As staff transition along the expertise and experience continuum (see figure 3.2) their attitudes and beliefs about team climate, safety climate, job satisfaction perception of management and working conditions became less positive. Further, when comparing those at the top end of the expertise and experience continuum (expert and proficient) with the lower end (novice, advanced beginner and competent), participants at the lower end were significantly more positive about the climate of safety for patients. Interestingly the perceptions of how performance is influenced by stressors (stress recognition) was consistently high, and was largely unchanged during the transition from novice to expert. This is a finding that is consistent with a large body of evidence which demonstrates clear links between clinicians' wellbeing and poor patient safety (Hall, Johnson, Watt, Tsipa, & O'Connor, 2016). In their systematic review, designed to determine whether there is an association between healthcare professionals' wellbeing and burnout, with patient safety, Hall et al. found that 16 (16/27) of their included studies reported significant correlation between poor wellbeing and worse patient safety. Given the risk averse nature of the ED's management approach to patient safety, understanding the factors that influence stress recognition (excessive workload, workplace hostility or tension and fatigue) are likely to be benefit staff and patients alike.

When synthesising the MRR findings related to the escalation practices of beginners, intermediates and experts with changes in perceptions of the climate of patient safety, it was apparent that there is a negative shift in mindset during intermediate level of competency that translates to a positive change in escalation practice. That is, intermediate level nurses are nine time more likely to escalate appropriately while novices and experts are more likely to miss the chance to escalate care (see section 5.5.7). Strong associations between poor escalation practices and nurses with greater than 15 years of experience have been demonstrated in a study examining the relationship between nurse (n = 94) demographics and MET activation (Pantazopoulos et al., 2012). Pantazopoulos et al. also found that nurses with less than 5 years of experience were more likely to escalate care appropriately. However, the association between expertise and escalation was not examined in their study.

This study is not the first to demonstrate the relationship between expertise and escalation practices. Though often used interchangeably, expertise and experience have been shown to have demonstrable relationships with escalation practices throughout the FTR literature. In their literature review of 15 studies which examined the factors that impacted on decisions to escalate care, Jones et al. (Jones, King, & Wilson, 2009a) identified expertise as a theme strongly associated with escalation practices in 95% (n = 14) of the included studies. These studies described the positive effects of increased expertise on escalation practices as well as negative effects identified in carers with less expertise. Unfortunately, the term 'expertise' was used quite broadly to describe several different characteristics of the study participants in each paper. These included the participants' previous experience of deterioration, their years of clinical experience or their theoretical knowledge. As such, the influence of expertise on escalation practices has not been accurately addressed in the literature to date.

One of the strengths of this study is a consistent and detailed stratification of the participants' expertise throughout each study as well as congruent findings in respect to their experience. As seen in the MRR results (section 5.5.7), escalation practices are poor for novice ED nurses and improve as they transition through the intermediate level of competence, declining again at the expert level.

In contrast, there was a consistent perception among interview participants that appropriate escalation was less likely to take place when staff were relatively junior and more likely to be appropriately escalated by expert staff. Nurses and consultants in charge of a shift were also more likely to be at ease with escalations that originated from experienced staff with a higher level of expertise. This is not a surprising finding and may indicate that the staff with more expertise and experience are simply afforded greater scope in their decisions to escalate or not. The reasons for the confidence that NICs and CICs have in expert staff decision making is implicit in the terminology used to describe them – they are experts. As such, expert staff are considered highly competent and able to provide safe, high quality care. Therefore, it is reasonable to assume that the NICs and CICs are not only confident the clinical judgement of their more experienced staff, but also the site's clinical competence progression strategy (education).

Leaders also felt less concerned about patient safety when a team included at least one expert staff member. This relaxed disposition relative to the skillmix of the team was not surprising, and despite the focus of the interviews, it is likely that their equanimity was influenced by the many of the other benefits that are attributed to having expert team members in each team. That is, leaders have many other competing performance and safety outcomes to achieve throughout each shift, of which surveillance for deteriorating patients is just one. Having at least one expert in each team may mean that the leaders perceive that they need to exercise a lower level of supervision with that team and can rely upon the experts to ensure the quality of the team's performance as well as the safety of the patients.

The factors that influence the escalation practices of more experienced nurses and doctors have been described elsewhere (Cioffi, 2000c; Kielpikowska, 2006). These factors include previous exposure to deterioration, knowledge, clinical reasoning, intuition and confidence to make decisions and were reported to have improved escalation practices in acute medical and surgical wards (Jones et al., 2009a). In contrast, the current study indicates that expert ED nurses are less likely to escalate appropriately 60% of the time. There are several reasons for this, some of which were described in the interview data.

Less experienced nurses described intuition as a factor that supported their decision to escalate care of deteriorating patients in this study. Whereas, clinical reasoning was attributed to the decision practices of more experienced participants. Clinical reasoning was seen as reliable skill, and a practice that was also endorsed by management, CICs and NICs in the current study (interviews). Clinical reasoning has been the focus of many educational interventions designed to improve escalation practices in undergraduate medical students (Chua et al., 2017; Liaw, Zhou, Lau, Siau, & Chan, 2013), nursing students (Endacott et al., 2010; Levett-Jones, Lapkin, Hoffman, Arthur, & Roche, 2011) as well as registered doctors and nurses (Connell et al., 2016). Furthermore, clinical reasoning was identified by an expert clinical nurse specialist as a factor which contributed to their failure to escalate in the current study. Again, this is not a surprising result, given that experts are likely use their clinical judgement to rationalise deterioration within the context of any number of benign causes (e.g. self-limiting tachycardia in a patient who has recently exerted themselves). Decisions such as these may be defensible and would likely help reduce the frequency with which the CIC and NIC are required to review unwarranted escalations. Given the evidence that the triggering arm of RRS can place an addition burden on the workload of those responsible for the efferent arm of these systems (Jarvis et al., 2015a; Jones et al., 2015; Winters, 2017), the utility and role of clinical reasoning in responding to deterioration calls for further evaluation.

The role of intuition as it relates to escalation has, to some degree, been built in to the EDMAC and is evident in the “any other concerns” criterion of the alert criteria. However, both intuition and clinical reasoning are largely informal factors that are not integrated into the clinical competence development that ED staff are exposed to during their journey from novice to expert.

Clinical competence development is managed both programmatically and informally at the study site and is described in section 3.8.3. In brief, while many nursing staff complete a number of programs designed to formally develop their expertise, others are required to engage in a less programmatically designed progression model. The programmatic nursing development model is a sequence of structured learning programs that may include a graduate year program (GYP), transition to specialty practice (TSP) program and postgraduate emergency nursing qualifications (e.g. ED critical care certificate or master of emergency nursing). Doctors also may enrol in a formal progression that includes internships and advanced 5-year ED physician training program. On the other hand, clinical competence training is also provided for those nurses and doctors not enrolled in a formal program, these include a series of clinical competence modules and workplace assessments designed to develop specialised ED skills and knowledge.

The role and effectiveness of clinical reasoning as it relates to appropriate escalation of physiological deterioration has been demonstrated elsewhere (Cant & Cooper, 2017; Lapkin, Levett-Jones, Bellchambers, & Fernandez, 2010; Levett-Jones et al., 2009).

7.9. Trust

There was a sense that trust in one's own judgement and the judgement of others were directly associated with escalation practices and how escalations were responded to. Interviewees largely related their perceptions of trust in themselves and others to expertise or experience. That is, there was a perception that greater expertise was associated with confidence in self and others. There was also evidence from the SCS that survey participants trusted the quality of care and safety provided by their colleagues. For example, 85% of survey participants agreed or strongly agreed that the would feel safe being treated as a patient in the ED (see appendix L, item 1).

7.9.1. Trust in self

Though not always related to experience or expertise, the idea of trust in self and in the clinical judgement of others has been shown to influence practice elsewhere (Peters et al., 2017). The data from the interviews indicate that expertise and experience played a role in trusting others. Participants described the relationship between trust and escalation in several ways. Although uncertainty about the validity of one's judgement was seen to cause some anxiety among less experienced participants, these doubts were not described as being powerful enough to translate into failure to escalate. Participants, did however, describe delayed escalation and the need to confirm their findings with their colleagues or team leaders as a type of sense-checking exercise. Cioffi (2000a) identified the same type of sense-checking practices when she interviewed 32 nurses to explore their experiences of activating a MET call. In her study, registered nurses reported that they checked their assessment findings with colleagues to confirm they were "doing the right thing" (Cioffi, 2000a). The notion that one might be blamed or castigated for incorrectly activating a MET call is a recurrent theme that has been described as a significant barrier to escalating care of deteriorating patients throughout the RRS literature (Davies, DeVita, & Hillman, 2017). In this study, sense checking appeared to fulfil two roles. First it seemed to be a way to avoid ridicule that was perceived could arise from unwarranted escalation, and secondly as a learning opportunity. Whether any such derision does, in fact, stem from unwarranted escalation is irrelevant. The fact that participants perceived that it was possible is indicative of a teamwork culture that requires improvement and is consistent with the teamwork climate findings in the SCS.

7.9.2. Trust in others

This study also showed that ED doctors and nurses trusted each other's professional competence. Survey participants felt they would trust their colleagues with their care if they were admitted to the ED (appendix L, item 1). They also felt well supported by other personnel to care for patients and agreed that co-workers followed safety rules and policies (appendix L, items 26 and 35). Despite the generally poor safety climate rating, it would appear that the ED doctors and nurses did, in fact, trust in the care being provided by their colleagues. However, trust was not seen to be automatic, nor was it based solely on their competence level. Rather, trust was established based on a combination of the staff members' competence level as well as familiarity with their clinical practice. This type of "earned" trust has previously been attributed to a sequence of interpersonal developments between healthcare workers (Calnan & Rowe, 2008; Pullon, 2008). In her study designed to explore the relationships between doctors and nurses (n = 18), Pullon found that trust was earned between carers when individuals developed an understanding of each other's roles and respect for the individual's professional competence. Furthermore, interprofessional trust is no longer seen as a function of professional hierarchy, but rather formed through shared values and goals of care (Calnan & Rowe, 2008).

The ED team is good example of a team that shares common values and goals to ensure the safety of its patients. But simply describing the principles and procedures for ensuring patient safety is unlikely to be enough. The collegial trust within, and effectiveness of the team is likely to require familiarising the team members with each other's clinical practice and fostering respect for each individual's level of competence. These team outcomes can be achieved through the implementation of interprofessional training and interventions designed to improve teamwork and the culture of safety (Friberg, Husebø, Olsen, & Sætre Hansen, 2016; Husebø & Olsen, 2016; Jones & Jones, 2011).

Further to this, trust was a factor that CICs included in their evaluation of the credibility of escalations from staff with varying expertise. The personal characteristics of staff were also seen to influence the CIC's interpretation of the escalation. For example, interview participants perceived that staff displaying greater composure in the workplace added to the veracity of their escalations. And while this stratification of trust seemed to be well understood by, and potentially helpful to, the CICs, there was also evidence that a grey area of trust existed which created uncertainty about the significance of an escalation. That is, the persons in charge perceived that they could gauge the seriousness of escalations from some staff, but not others. Uncertainty about the substance of an escalation was perceived to generate increased workload for the CIC and/or NIC. That is, the person/s in charge would feel obligated to re-assess patients that were escalated by staff who were inexperienced, unsure or perceived to be alarmist. Therefore, adding to the workload of the person/s in charge.

It is reasonable to speculate about the potential benefits to ED staffs' trust in oneself and others that might come from an intervention designed to improve the culture of safety. There are also likely to be several benefits to an ED workforce who possess sound and trusted clinical reasoning skills. Staff who are confident in their assessment of a patient's status may feel less inhibited to escalate in a timely manner, while leaders who are confident with that information may experience reductions in their workloads.

There are clear indications from this research that relate to ED staffs' clinical competence progression that are likely to benefit escalation practices and the implementation of the EDMAC. These include the utilisation of key characteristics and motivations that compel intermediately experienced staff to escalate appropriately and the integration of sound clinical reasoning throughout programs that support the clinical progression.

7.10. Education

Many of the themes and subthemes that emerged from the interview data, as well as inferences within this discussion and the evidence described in Chapter Two, relate directly and indirectly to the education and training that supports staff recognition and management of physiological deterioration in the ED. There were also many references to general and specific staff training, as well as the need for improved supervision and support of junior staff in the open-ended question of the survey. These were opinions that were repeated in the interviews and further expanded upon.

Though there was good understanding of patient deterioration and the processes for managing deteriorating patients, interview participants' knowledge of the existence and/or details of a formalised EDMAC was variable. This a consistent finding in the literature that explores frontline healthcare workers' impressions of RRS (Blake et al., 2006; Chua et al., 2017; Cioffi, 2000a; Davies et al., 2017; Johnston et al., 2015). Furthermore, interview participants acknowledged that the calling criteria was well defined and unambiguous, despite inconsistencies in escalation practice and responses to deterioration evident in the MRR data. Several opinions were offered about this including a sense that the details of the escalation process may get lost in an overwhelming amount of information made available to staff during their initial orientation to the ED workforce, and that ongoing educational support was lacking. The content of future ongoing educational interventions which would support staff to recognise and respond to deterioration are touched on throughout the discussion. However, the mode with which the education is delivered also warrants discussion here.

The systematic review published as part of the literature review to this study provided considerable evidence to support the positive impact of educational interventions that are designed to improve the recognition and management of the deteriorating patient (Connell et al., 2016) (see Chapter 2). While the inclusion of simulation in educational interventions is associated with improved learner, patient and health service outcomes (Connell et al., 2016) sustained long-term outcomes beyond the initial effect of education is an area that requires further investigation.

In situ simulation (simulation incorporated into the real-world clinical environment) is an educational technique that has demonstrated sustained long-term improvements in escalation practice (Harvey, Echols, Clark, & Lee, 2014; Theilen et al., 2017). Key findings in earlier work by Theilen et al. (2013), indicated that that the regularity of training (4 - 10 times per year) is an important element that contributed to sustained improvements in responses to physiological deterioration. In their single site study to evaluate the long-term (3-year) impact of a paediatric MET, the authors also highlighted the importance of training that includes both medical and nursing staff. This is not a surprising recommendation given that teams who manage complex clinical situations are impacted by interprofessional teamwork, communication and leadership as well as interprofessional cultural factors. Therefore, simulation that is designed to support ED staffs' efforts to better recognise and manage deteriorating patients is likely to be more effective if it regularly takes place in situ and involves doctors and nurses. However, it should be acknowledged that regular in situ simulation training can be more resource intensive than conventional simulation training (Orique & Phillips, 2018). The educational support of clinical competence development that currently exists at the study site already includes in situ training as well as workplace assessments of several competencies related to the specialised ED processes of care (see section 3.8.3). Therefore, incorporating regular interprofessional in situ simulation including technical and non-technical (communication, teamwork and leadership) skills training which highlights escalation and response processes would be an effective and feasible educational proposition.

7.11. Emergency Department structures and processes

In part, the aims of the research were to examine the relationships between escalation practices and staff skillmix, patient casemix and workload demands. Some of the elements of these dynamic factors have been discussed, either in full or in part in sections 7.2 and 7.3. This section addresses the associations between escalation practices and factors that were related to the ED care processes (model of care), policies, procedures as well as the resources that support these.

As discussed earlier, though the objectives and application of a system for recognising and managing deterioration in the ED was broadly understood, participant's knowledge about the details of the EDMAC was limited. For example, the EDMAC procedure states that any response to an escalation by the NIC and CIC (i.e. review of the patient) should take place within two minutes. Interview participants consistently described this response time to be 10 minutes. Also, the person to whom an episode of deterioration should be reported to was often unclear to participants, or was reported to be dependent upon the circumstances of the episode. These circumstances included staff skillmix, workload demands and the area (or cubicle) in which the patient was being cared for.

7.11.1. Skillmix and staffing levels

The data from the MRR indicated that there was no appreciable difference between escalation practices when the ED was staffed at, above or below standard. This is an interesting finding when considered in the context of the qualitative findings from the interviews and open-ended responses to the SCS.

There was a strong sense in the interview data that staffing levels and the composition of the team's skill levels played a considerable role in the team's effectiveness to recognise and escalate care of deteriorating patients. Fluctuations in skillmix were also reported to impact upon the CICs, NICs and team leaders' proclivity for closer supervision of teams who were perceived to be less skilled. Further to this, there was evidence from responses to the open-ended survey questions that participants believed the safety of patients would be improved by ensuring that the staffing levels and skillmix were at standard.

Studies have shown that increases in hospital ward patient to nurse ratios by a single patient is associated with a 5 – 7% reduction in survival from an in-hospital cardiac arrest (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; McHugh et al., 2016). Furthermore, higher numbers of nursing care hours (larger nurse-patient ratios) were associated with lower rates of "failure to rescue" in hospital administrative data from 799 hospital in the USA (Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002). However, these results were reported in a study designed to examine relationships between nursing care hours and patient outcomes before the ubiquitous uptake of rapid response system principles in the acute healthcare setting. More recent studies have been unable to show any association between higher nursing staff levels and improvements in "failure to rescue" (Talsma, Jones, Guo, Wilson, & Campbell, 2014). It is important to note that the studies by Needleman et al. and Talsma et al. were both studying the impact of staffing levels on "failure to rescue". That is, mortality due to complications during acute care, and not failure to escalate the care of all patients with signs of physiological deterioration. To our knowledge, this study is the first to directly investigate the relationship between the appropriateness of escalation practices and varying staffing levels/skillmix in an ED.

There is an obvious disparity between the perceptions and experiences that were reported in the interviews and survey when compared to the evidence in the MRR. It is, however, interesting to note there was a significant improvement in appropriate escalations when deteriorating patients were cared for in the resuscitation area; an area where nurse patient ratios are at most 1:2 (overnight). On the other hand, the two ED areas with the lowest nurse-patient ratios (SSU and the waiting room) had the worst rates of failure to escalate. Though the sample numbers were small for these two care areas (see table 5.4), it would also be unwise to disregard the perceptions of frontline workers with first-hand experience of the complex influence that staffing and skillmix have upon recognising and escalating the care of deteriorating ED patients. However, the MRR data with regard to escalation practices should also be interpreted with a degree of caution (see section 7.11.3).

7.11.2. Workload demands

There was a consistent notion, from the interview data, that increased workload demands had a considerable influence upon escalation practices, and was identified as a subtheme (workload demands) that emerged under the *influence of environmental factors* theme. Participants, once again, acknowledged that increased workload would not influence their decision to escalate, but rather generated challenges for the escalation process, prioritisation of each escalation and subsequent response to the patient's deterioration. Certainly, the results of the MRR supported the participants' beliefs that actual escalation of deleterious vital signs was not affected by the real or perceived workload in the ED.

There were three measurable indicators of workload that were collected in the MRR and one qualitative estimation from the interviews. The quantitative measures of workload comprised of the ED occupancy at the time of the episode, the amount of new patient presentations in the two hours prior, and the amount of new patient presentations during the hour of the episode. The qualitative workload data was represented by interview participant responses about whether there had been any extra stressors placed on the ED's workload (e.g. managing extreme patient behaviour or equipment failure).

There was no significant association between escalation practices as workload demands fluctuate. However, though not statistically significant, patient care was more likely to be appropriately escalated when the ED was between 75 – 100% capacity. Though difficult to substantiate, it may be reasonable to surmise that, for this aspect of patient safety, staff performance peaks for to match workload demand as capacity approaches 100%. There was also very little difference in escalation practices as increased demands were placed on the staff due to the increasing numbers of patient arrivals.

Increased workload has been described as a powerful barrier to escalating care of deteriorating patients (Padilla, Urden, & Stacy, 2018; Purling & King, 2012). However, Jones et al. (2009b), in a comprehensive thematic literature review to identify factors that impact on nurses' effective use of MET, reported conflicting findings about the effect of workload on FTR from several studies. The themes to emerge from these seven studies indicated that increased workload can either be perceived as a barrier or an enabler to escalating care of deteriorating patients. In their study examining 15 studies published between 1994 - 2007, Jones et al. described barriers to escalating care caused by increased workload such as interference with the ability to effectively monitor patient vital signs, interruptions that caused delayed escalation and even the potential for the escalation to increase workload. They also found that there was evidence that higher levels of workload demand could enable escalation as study participants felt that the process would decrease their workload and enable them to provide greater quality of care for their other patients (Jones et al 2009).

Participants in the current study felt that the resources and time which was afforded to the patient with signs of deterioration had the potential to detract from the care of other patients in the ED. This is a result that is consistent with the findings from recent research designed to explore potential barriers to MET call activation in metropolitan and regional Australian hospitals (King, Belan, & Wilson, 2018). This is not a surprising assumption considering that all responses to deterioration at the study site were handled in-house by available ED staff, and the time that responses to deterioration can consume. Rapid response teams that respond to an acute ward often comprise of staff that are not responsible for the care of other patients in that ward (ANZICS-CORE MET dose Investigators, 2012). The duration of rapid responses have also been reported to last between 20 –53 minutes (Chamberlain, Donley, & Maddison, 2009; Rothberg, Belforti, Fitzgerald, Friderici, & Keyes, 2012; Scott & Elliott, 2009). Though there is no ED specific data to quantify the resources and time utilised responding to deterioration, it is likely to have a substantial impact on ED staff workload and the care of all ED patients.

There were several assertions from interview participants that increased workload may also negatively impact on the capacity of the person/s in charge to receive, process and act on each episode of escalation equally. This was a consequence of workload which also concerned to the CICs and NICs who were interviewed. Although the impact of responding to deterioration on CIC/NIC workload was not a quantified measure in this study, the perceptions of interview participants indicate that it would likely to be comparable to results reported elsewhere. In a multi-site UK study designed to compare the impact of two different EWS on workload from 45,678 episodes of care, escalations increased doctor workload by up to 40% (Jarvis et al., 2015a). At the time of data collection, the EDMAC procedure clearly stated that the "Patient must be reviewed by senior doctor and nurse within 2 minutes". It is not only unlikely that the persons in charge would be able to achieve this, especially as workload demands intensify, but it may also create a loop of reviewing patients which would reduce their capacity to see new patients.

Unlike the afferent limb at the study site ED, there is evidence that ward RRS efferent limb team membership rarely includes a consultant physician (ANZICS-CORE MET dose Investigators, 2012; Jacques, Harrison, & McLaws, 2008). This is an important and conspicuous difference between ED and ward RRTs. Not only are the ED CICs and NICs expected to respond to every episode of physiological deterioration, they are expected to do so within two minutes.

The efferent arm of the ED in this study has remained unchanged since its inception in 2012 (see section 3.8.2). On the other hand, the membership of RRTs responding to ward patients in smaller, regional hospitals or hospitals without full time intensivists is often tailored to the available resources and personnel (Mantoo, DeVita, Murray, & Schaefer, 2017). Data from this study's interviews indicate that subtle modifications to the efferent arm of the ED response system have organically manifested in the daily workflow of the study site staff. For example, nurses and doctors make decisions about who to escalate to depending on the patient's status and the perceived workload of the person/s in charge. That is, staff appear to be flexing the escalation process to meet the needs of the patient, themselves and dynamic characteristics of the ED (e.g. workload).

A factor which is closely related to workload is the profile of patients who were being cared for in the ED during a patient's initial episode of deterioration. The presenting problems/diagnoses, severity of illness as well as the complexity and intensity of the care required by patients has been referred to as patient acuity and used as a measure of the demands that are placed upon staff resources (Brennan, Krumlauf, Feigenbaum, Gartrell, & Cusack, 2018). Patients in the ED who are triaged as an ATS category 1 or 2 or those that have been referred to and accepted by the intensive care unit are considered to be high acuity ED patients who require urgent or complex care.

Interview participants perceived that an increase in high acuity patient numbers was likely to bring about higher demands on staff resources, as well as negatively impacting upon escalation practices. That there may be increased demands on staff resources was not a surprising outcome, nor was the notion that the presence of high acuity patients may impact on escalation practice. However, there was no evidence from the MRR that escalation, or failure to escalate, was significantly impacted by changes in the number of high acuity patients that were being cared for in the ED (see table 5.5). Again, much like dynamic fluctuations in ED occupancy or new patient presentations, it appears that the process of escalation (rather than the actual outcome) was most affected by variations in ED patient casemix (e.g. delayed escalations or compromised care of other patients).

7.11.3. Systems that support recognition and escalation

The instruments used to document patient data (e.g. vital signs) during the ED process of care include an electronic medical record (EMR) and observation and response charts (ORC). These documentation tools have been described in Chapter Three (see section 3.8.2). The efficacy of these resources as well as how the staff used them during their daily care was discussed during the interviews.

Interview participants described various preferences related to their assessment and documentation workflows which incorporated the various charts and alerts. There was an appreciable amount of variation in practice related to documentation, review of vital signs and perceptions that the EMR was an inefficient way to monitor for deterioration. The quality of data entry (documentation) also appeared to be negatively impacted by the intensity and complexity of patient care requirements. Interview participants reported that time limitations were likely to influence the completeness and quality of the information which they document. This is consistent with the findings by the Australian Commission on Safety and Quality in Healthcare. In their evaluation of the ORC implementation project, the report authors found that inconsistent documentation practices, imprecise data entry as well as poor compliance with documentation policy were impacted by increases to workload. These undesirable documentation practices were seen to give rise to visual clutter and potentially create undesirable added cognitive load which negatively affected escalation processes (National Safety and Quality Health Service Standards, 2012).

As previously mentioned, there were clear references in the data from the current study to suggest that care may have been escalated in some cases, but simply not documented. This was an outcome that interview participants accepted as a consequence of being busy, but one that they would also like to improve. There are limited options to consider when endeavouring to improve the quality of documentation. While educational interventions and quality control audits to check compliance are common strategies, they are also often fruitless (Prideaux, 2011). It is tempting to consider adding a 'check box' to the EMR in an attempt to document if care is appropriately escalated. Though this is technically trivial to implement, interview participants who were frequently burdened with new check boxes and alerts designed to satisfy the auditing requirements of quality initiatives and patient safety targets indicated that they were reluctant to introduce additional notifications and alerts to the EMR.

It remains unclear what strategy, if any, would be most appropriate to support the ED staff desire to improve the quality of documentation related to escalation practices. A similar finding was described in a report to the Victorian state government (Australia) on the effectiveness of education (face-to-face versus web-based) on 141 nurses' ability to detect and manage patient deterioration in four Australian hospitals (Cooper et al., 2016). There is, however, evidence that doctors and nurses should be furnished with an EMR interface that is perceived to be compatible with their preferred work practices, considered to be useful and positively impacts on the quality of their care processes (Maillet, Mathieu, & Sicotte, 2015).

7.11.4. Alert fatigue

The automated alerts generated by the EMR are based on unsophisticated algorithms which are triggered by a single point of data (i.e. a single deleterious vital sign), or single parameter track and trigger system (SPTTS). There are far more sophisticated electronic track and trigger systems using aggregated scores from different databases (e.g. vital signs and biochemistry results) that generate an early warning score for physiological deterioration (Green et al., 2018; Kipnis et al., 2016). These multiparameter track and trigger electronic systems (MPTTS) can improve the positive predictive value of the afferent arm of RSSs (Green et al., 2018). However, it has also been acknowledged that electronic triggering systems are not mature technologies that warrant further research to examine the effectiveness of their tracking capabilities as well as how this impacts human responses and translates to practice (Kipnis et al., 2016).

The results from this study indicate that participants' sensitivity to the automated "pop-up" alerts diminishes over time. That is, there was a sense from the interview findings that the electronic alerts were experienced by participants so often that they began to disregard and override the message without acting on the information. This is an interesting phenomenon that equates with concerns in the literature about alarm fatigue and its potential impact on patient safety (Ruskin & Hueske-Kraus, 2015; Sendelbach & Funk, 2013). Alarm fatigue occurs when clinicians become desensitised to potential safety risks by repeated exposure to clinical alarms and alerts from medical devices or technology used during patient monitoring and treatment. Alert fatigue is a well-documented patient safety risk with evidence that 49 – 96% of clinical alerts are overridden in clinical practice (van der Sijs, Aarts, Vulto, & Berg, 2006), and it has been linked to medication errors and serious adverse events (Ancker et al., 2017). Like many EDs, the study site ED has a large amount of equipment that has the ability to alarm. The noise and visual cues from the equipment alerts are a constant feature of the environment and may contribute to a form of alert fatigue which the ED staff may be experiencing.

Alert fatigue that is experienced due to mechanical alarms may also be somewhat analogous with frontline workers who are faced with frequent exposure to signs of deterioration and subsequent verbal escalation process. Acknowledgement of this type of alert fatigue emerged from the interviews. Considering the level of exposure, the diversity of patient problems and acuity in the ED, the sensitivity of the current EDMAC criteria does not appear to be specifically tailored to a care environment and a patient casemix profile that is more diverse than that which is found in general acute wards.

Put simply, the EDMAC is a combination of the health service adult and paediatric MET calling criteria. While these triggers are well suited to acute medical and surgical wards, there is evidence that ED specific alert criteria with modified parameters (reporting thresholds) and criterion (e.g. urine output, arterial blood gases) can effectively reduce unreported physiological deterioration (Considine, Rawet, & Currey, 2015b). There is also evidence that lowering the triggering thresholds in aggregated MPTTS early warning systems (EWS) improves the system's sensitivity, and therefore effectiveness, to identify physiological deterioration (Jarvis et al., 2015a). However, lowering the thresholds of reportable vital signs came with an associated increase in physician workload (Jarvis 2015).

There is evidence from this study that the process, vital signs and parameter boundaries that make up the current EDMAC may not be ideally suited to the ED environment. While some patient data are associated with better escalation practices, others are often overlooked. For example, evidence from regression analysis shows that a systolic blood pressure reading of less than 90mmHg has a significantly positive predictive value for staff to escalate appropriately (see section 5.5.8). Whereas, vital signs such as oxygen saturation were more often underreported (see sections 5.4 and 5.5.8).

Multiparameter track and trigger systems with aggregated weighted scoring, otherwise known as aggregated weighted track and trigger systems (AWTTS), have demonstrated robust capacity to identify patients with physiological instability (Alam et al., 2014) and discriminate patients at risk of cardiac arrest, unanticipated ICU admission or death within 24 hours (Smith et al., 2013). These AWTTSs have enjoyed moderate uptake in EDs internationally (Alam et al., 2015), and while their capacity to detect physiological instability has been demonstrated in this specialised setting (Griffiths & Kidney, 2012a; Keep et al., 2016), Australian EDs have primarily adopted SPTTSs that rely on a single abnormal parameter (Considine et al., 2012). This is also true of the system in place at the current ED study site.

Evidence from this study highlights the limitations of an ED EWS that relies upon a single parameter triggering system and appears to breed alert fatigue. Whether alert fatigue is attributed to cognitive overload or desensitisation due to repeated exposure to deteriorating patients, the EDMAC policy and procedure, and more specifically, the utility and sensitivity of automated EMR alerts require further evaluation. Furthermore, the suitability of a single parameter triggering system to a specialised critical care area such as the ED is questionable. Again, the feasibility and effectiveness of a track and trigger system that aggregates a combination of patient data is likely to provide a more balanced and comprehensive data point to support ED staff's decision-making processes when faced with recognising and escalating the care of the deteriorating ED patient.

7.11.5. Emergency Department Care area

There were relationships between the area in which a patient was being cared for when they experienced signs of deterioration and whether their care was escalated (see table 5.4). Patients being cared for in the resuscitation cubicles at the time that deterioration was documented were appropriately escalated 75% of the time. The resuscitation cubicles were the only ED care where substantial improvements in escalation practices were seen. Higher rates of failure to escalate were seen in other ED care areas. This has been partly discussed in section 7.1 as the findings relate to the SSU patients. There was, however, far greater prevalence of failure to escalate for patients who experienced signs of deterioration in the ED waiting room (84%) (see table 5.4). The potential for unreported deterioration in the waiting room comes as no surprise. The undifferentiated nature (no provisional diagnoses) of the patients in an ED waiting room is a well-known patient safety concern (Carter, Pouch, & Larson, 2014; Guttmann, Schull, Vermeulen, & Stukel, 2011) which has prompted EDs to modify the structure of their patient flow strategies (Paul & Lin, 2012), their triage and reassessment processes (Blank, Santoro, Maynard, Provost, & Keyes, 2007) as well as introducing clinical roles dedicated to waiting room patient care (Innes, Jackson, Plummer, & Elliott, 2015). This study site ED is no exception. In recent years the site management team has spearheaded changes to their model of care with a focus on reducing the time patients spend in the waiting room prior to a comprehensive assessment. The ED has also introduced additional staff whose role it is to specifically reassess and provide care waiting room patients (e.g. waiting room nurse).

The waiting room nurse role was originally a government funded role, and although several benefits were attributed to the waiting room nurse (see section 3.8.5), funding for the role ended in 2013. The results from the current study indicate that the ED's waiting room patients are, in fact, at risk of unreported deterioration. It is therefore very encouraging that the ED management have continued to modify the patient flow through the waiting room and support the safety of its patients with staff resources such as the waiting room nurse.

7.12. Conclusion

In summary, findings from this study indicates that patient safety in relation to the risk posed by physiological deterioration is consistent with that which has been reported in the literature. The two-week period prevalence of physiological deterioration was 10.8% (269/2668). The FTR rate in the study site ED was 47.3% (of these 269 patients), and was impacted by the culture of safety, the expertise and experience of the frontline workers and the environment and system in which ED care is provided.

The culture of safety was suboptimal and impacted by a number of factors that are related to workload, team interaction and communication, leadership and the indicators with which the ED's performance is measured (e.g. NEAT). Though FTR rates were not significantly affected by changes in workload, routine communication strategies and team interaction, and ultimately the culture of safety, were found to be impacted by these dynamic variations in demand for emergency care. The effect of workload on human interactions were also perceived to impact upon i) the quality and timeliness of escalation processes in a way that eroded support for a positive culture of safety, and ii) exacerbate interruptions to, and availability of the teams' leaders.

Leadership style and approachability were also linked to the culture of safety. When escalating the care of a patient experiencing physiological deterioration, the availability and approachability of the ED shift leadership was reported to be a largely positive experience. However, there was clear evidence that the perceived characteristics of the person in charge can have a pervasive effect on the overall culture of safety. This phenomenon was reported by both the persons charged with escalating care, as well as being acknowledged by the CICs and NICs themselves. That is, CICs and NICs recognised that their approachability and the standard of their interpersonal disposition was negatively affected by the frequency of interruptions associated with increasing workload demands. This was found to negatively impact on the timeliness of escalation practice and willingness to report deleterious vital signs.

A number of strategies and patient care processes (e.g. models of care) have been put into practice, both locally (at the study site) and nationally, which were designed to reduce risk to patient safety and ameliorate ED overcrowding. One of the strategies implemented nationally (and internationally) has been the implementation of performance indicator, the NEAT '4-hour rule'. The interpretation and implementation of this performance indicator, as well as local model of care processes, were found to impact the culture and care processes which supports patient safety. In particular, the factors associated with sub-optimal escalation practices in the SSU. As such, it is likely that further research to investigate the quality of care practices in this specific area of emergency care would inform future ED short stay patient care and to augment patient safety.

There was a significant relationship between FTR and the staff expertise and experience. Again, the escalation practices of novice ED nurses are poor and significantly improves as they transition through the intermediate level of competence, declining again at the expert level. The effect of expertise and experience on escalation practice is likely to be a case of the novice 'ought to' escalate care, the intermediates 'do' escalate care and, as function of their clinical judgement, the experts 'know when to' escalate. It is also important to highlight that, due to their experience of patient deterioration and scepticism about the culture of patient safety, there appears to be a negative shift in mindset during the intermediate level of competency that translates to a positive change in escalation practice. Therefore, research designed to examine intermediate ED doctors and nurses' attitudes, motivations and beliefs is likely yield important information to inform current efforts to improve escalation practices.

The ED environment and system factors have also been discussed in the context of their impact upon escalation of the deteriorating ED patient. In particular, the influence exerted by education, skillmix, staff roles and staffing levels, as well as the EWS currently used to track and trigger physiological instability on escalation decisions have been explored. Though the concept and importance of recognising and responding to a deteriorating patient was well understood, the details of the escalation process was not. The results of this, and other studies (e.g. Connell et al., 2016), indicate that the care of deteriorating patients in the ED can be improved through modifications to the current educational strategies. These strategies would ideally include regular interprofessional in situ simulation which incorporates technical and non-technical (communication, teamwork and leadership) skills training and expert feedback.

Though variations in the agreed staffing levels and skillmix of the entire ED did not (quantitatively) demonstrate a significant association with FTR rates, nurse-patient ratios between specific ED care areas did reach statistical significance. That is, higher nurse-patient ratios were associated with improved escalation rates, and lower nurse-patient ratios were associated with significantly worse escalations. Importantly, the data from the staff interviews indicate that the staff experience of escalation when ratios are reduced (i.e. During night duty) indicate that there are substantial barriers to adhering to the expected escalation process.

The ED RRS team roles are quite unique. Unlike general acute ward response teams, the ED response is handled in-house with a team comprised of the NIC and CIC who arguably bear the greatest cognitive and workload burden during each shift. Considering the importance and fundamental utility of the NIC and CIC's availability to the team, the structure and roles of the response team are likely to be better served by modifications that removes some of that burden from these shift leaders.

Finally, the appropriateness and goodness-of-fit of the tracking and triggering system (designed for use in the hospital's general wards) used in the ED were discussed. The ED EWS is based upon a SPTT system which is triggered by a single point of data (i.e. a single deranged vital sign), and highly sensitive to deviations from 'normal' vital sign parameters. The sensitive nature of a SPTT impacted on staff responsiveness to the automated alerts from the EMR and their attention to the alerts diminished over time. That is, there was a sense from the interview findings that the electronic alerts were experienced by participants so often that they began to disregard and override the message without acting on the information. This is a phenomenon known as alert fatigue, and has been described in the literature as a substantial patient safety risk.

Multiparameter track and trigger systems with aggregated weighted scoring have demonstrated reliable and powerful use in identifying patients with physiological instability and are less sensitive to subtle variation in the patient's condition. It has been discussed in this chapter that an MPTTS with an aggregated weighted scoring system may be better suited to discriminate ED patients at risk of cardiac arrest, unanticipated ICU admission or death within 24 hours. It has also been suggested in the discussion that the discriminatory value of an MPTTS may reduce alert fatigue as well as the workload and cognitive burden experienced by the ED's response arm of the response team members.

This chapter has provided a discussion of the study findings as they relate to the broader body of emergency and rapid response system literature. The discussion focussed on how FTR was impacted by the culture of safety, expertise and experience of the frontline workers and the environment and system in which care is provided. The next, and final chapter of the thesis outlines the conclusion which have been drawn from the study outcomes discussed in this chapter.

Chapter 8. Conclusion

8.1. Introduction

In this chapter, conclusions from the research question, study aims and key findings are presented. The study was designed to answer the question: Are organisational climate and structure associated with the recognition and management of patient deterioration by health care professionals in an emergency department? The aims of the study were to examine the relationships between dynamic ED characteristics (workload, skillmix and casemix), organisational culture (safety climate) and the care of the deteriorating ED patient. These aims have been addressed in a mixed methods research design comprising three periods of data collection across two phases. The outcomes of the data analysis have provided important insight into the magnitude of patient physiological deterioration, ED workers' responses to the problem, and the impact that dynamic ED variables and culture have upon recognising and responding to ED patients who are deteriorating.

There are also several limitations of the study which are described as well as the implications for emergency clinical practice and future research.

8.2. Summary of Key Findings

Fourteen-day period prevalence of ED patients exhibiting first episode signs of physiological deterioration was 10.8% and the FTR rate of patients requiring escalation was 47.3%. Escalation of deteriorating ED patient care was not significantly impacted by fluctuations in workload, staffing levels/skillmix or ED patient casemix.

Failure to rescue deteriorating ED patients was significantly impacted by the experience and expertise of the person documenting signs of deterioration, the ED area in which the patient is being cared for, and the patient's vital sign which indicated physiological deterioration.

Failure to rescue was also influenced by i) the safety culture within the ED, ii) staff self-confidence and confidence in others, iii) communication and team interaction, iv) the interpretation and implementation of care based on the health services and national performance indicators, and v) the education which is provided to support ED staff efforts to recognise and manage deteriorating patients.

The conclusions of this study contribute to the scarce evidence about the magnitude of the risk to ED patient safety related to physiological deterioration. The outcomes of the study also represent a unique contribution to the FTR literature by describing the complex relationships between dynamic ED characteristics, organisational culture and how these factors impact on the care of the deteriorating ED patient. This is the first study which provides i) sufficient evidence with the breadth (quantitative) and depth (qualitative) needed to explain FTR in the ED setting, and ii) a systematic means of measuring the effectiveness of the actions taken to detect and reduce risk to deteriorating ED patients which aligns with the International Patient Safety Framework uniform set of internationally standardised patient safety concepts (Sherman et al., 2009).

8.3. Safety Culture

The culture of safety inherent in a given healthcare setting is indicative of its capacity to provide safe high-quality patient care. By measuring the staff shared perception of the organisation's safety culture it was shown that ED doctors and nurses do not perceive of a strong culture of patient safety. Further to this, doctors are significantly less optimistic about the culture than nurses, and both become less confident about the cultural support for patient safety as they gain expertise and experience.

The downturn in staff perceptions of the safety climate over time were more easily understood after speaking with the staff during the interviews. The quality of team interaction, communication, leadership and the implementation of performance indicators became more transparent to staff over time by virtue of their exposure to, and understanding of the safety issues facing their patients. Put simply, when ED doctors and nurses gain experience and competence, they see the risk more clearly and flex their behaviour to ensure the safety of their patients.

8.4. Prevalence

By examining the period prevalence of physiological deterioration in the study site, the magnitude of the threat was found to be was consistent with the prevalence found in acute medical wards and EDs around the world (10.08%).

Examination of ED patients with signs of deterioration revealed that the afferent arm of the sites mandatory alert criteria underreports physiological deterioration at an unsatisfactory rate (47%). As an outcome endpoint, escalating deteriorating patients' care in the ED was not found to be significantly influenced by variations in staff skillmix, patient casemix or workload. However, deeper examination the staff experience and perceptions of escalating care revealed that the process of escalation (rather than the actual outcome) and the quality of ED care were affected by these three factors (staff skillmix, patient casemix and workload).

Overall, the synthesis of the study results indicates that the quality of escalation practices in the ED study site is influenced by any one, or combination of, the following factors:

- A safety culture which was found to be unsatisfactory.
- The experience and expertise of individual frontline ED nurses who document deteriorating vital signs.

- Frontline workers trust in self and others.
- Ineffective communication, especially in times of increased workload.
- The ED care area in which the deteriorating patient is cared for.
- Interpretation and implementation of care based on the health service's and national performance indicators.
- Education that is provided to support ED staffs' efforts to recognise and manage deteriorating patients.
- The patient's vital sign which indicates physiological deterioration.

8.5. Competence level and experience

This study also provides evidence that the individual skill level of ED workers is associated with escalation practices in deteriorating ED patients. Signs of physiological deterioration are significantly underreported by novice and expert ED nurses. Whereas, ED workers 'in the middle' of their journey from novice to expert are nine times more likely to escalate deteriorating patient care appropriately.

It is not surprising that novice ED workers are less likely to escalate care appropriately, a finding which has been reported throughout the failure to rescue literature. What is somewhat surprising is that expert ED nurses are also significantly less likely to escalate care appropriately when caring for a patient exhibiting signs of deterioration. The results of this study indicate that this expert group have exercised clinical reasoning in their decision-making approach to deteriorating patients. Clinical reasoning is a potent and professionally empowering skill. However, judicious clinical reasoning is not inherited by virtue of clinical experience. But when informed clinical reasoning is acquired and supported with evidence-based education, it may bring about defensible well-informed escalation choices for some patients with benign self-limiting signs of deterioration.

It is likely that the intermediately competent group who have between 2 – 5 years of ED work experience have encountered physiological deterioration in at least 10% of the patients they have cared for. It is also likely that they have been experienced enough variation in escalation practice to influence their decision-making processes when they are faced with a patient exhibiting signs of physiological instability. Given the predictive strength of these ED nurses to escalate patient care appropriately, it is likely that there are valuable lessons to learned from their beliefs and practice. Therefore, further research that is designed to explore the attitudes, motivations and behaviours of intermediately competent ED nurses' is likely to yield evidence that will improve the care of deteriorating ED patients.

8.6. Education

Emergency departments provide structured long term and robust educational support for many aspects of clinical competence in this specialised area of patient care. However, the efforts to support frontline ED carers recognise and manage patient deterioration are lacking ongoing evidence-based enhancements designed to nurture frontline workers' long-term knowledge and use of the ED's early warning system.

This study has shown that there is varied knowledge and implementation of an ED rapid response system. And while there are early foundational education efforts to incite the adoption of a consistent, safe and reliable process for escalating care, these efforts are not sustained throughout staff clinical competence development and work life cycle. The outcomes from this study indicate several key elements that, if included in the current education strategy, would enhance the quality of care for deteriorating ED patients. Some of these key educative elements are yet to be exposed while others have been identified in this study.

There is evidence that intermediately competent nurses with 2 – 5 years of experience possess important characteristics (attitudes, motivations and behaviours) that translate to safer and more effective escalation practices. These characteristics are not yet transparent in the results of this study. However, enhancements to the ED's education strategy are likely to be better informed by research that aims to explore this group's decisions and practices when faced with physiological deterioration in the ED.

There are also key educational elements that support ED doctors and nurses' efforts to provide sustained high-quality care for deteriorating patients which have been made more transparent by this study. These include regular (4 -10 times per year) interprofessional in situ simulation training that blend patient deterioration scenarios incorporating expert evaluation and feedback about the team's technical and non-technical (clinical reasoning, communication, teamwork and leadership) performance.

8.7. Staffing

Though no association was found between the prevalence or failure to escalate and overall staffing levels, there was however, a significant relationship between escalation practices and care areas that had different nurse-patient ratios and skillmix requirements. In short, ED care areas with smaller nurse-patient ratios are more likely to escalate the care of deteriorating patients more appropriately compared with ED care areas with higher nurse-patient ratios. While ED care areas such as resuscitation cubicles provide appropriate care 75% of the time, two care areas of concern include the ED short stay unit and waiting room. These two areas are prone to poor escalation processes at a rate of 63 – 84% respectively. The outcomes of this study indicate that the ED community should look to the efficacy of staffing levels provided in these two care areas as part any strategy to reduce risk to patients with signs of physiological deterioration.

8.8. ED Care area

As a specialised area of healthcare, EDs are uniquely structured providing emergency healthcare across several distinct care areas and streams including waiting rooms, resuscitation areas, acute emergency cubicles, fast track and short stay units. Each of these care areas implement a system for surveillance and management of deteriorating patients which is subtly adapted to the needs of each area.

There are other factors unique to specific ED care areas that impact upon escalation practices which transcend nurse-patient ratios. Indeed, the recognition and management of deteriorating ED patients was found to be directly linked to the nuanced care practices intrinsic to some care areas. In particular, the SSU and waiting room.

ED short stay units are faced with distinct challenges to patient safety which are exacerbated by the interpretation of, and compliance with national emergency health performance targets requiring ED patients to be seen, treated and admitted/discharged within 4 hours (i.e. NEAT). As a result, the care of deteriorating SSU patients may be unintentionally destabilised by best intentioned carers trying to cope with ED overcrowding. These policy related challenges were found to be further compounded by an unconscious cognitive bias about a patient group who are perceived to be less at risk than other ED patients.

While ED carers are obligated to create equal access to care for every person presenting, that same equality should not be achieved at the expense of deteriorating patients in ED short stay units. This study has highlighted potential gaps in the safety and quality of care which is provided to ED SSU patients. As an outcome of this study further research is recommended to investigate the quality of care practices in this specific area of emergency care.

Emergency department waiting room patients are also at risk of unreported deterioration. At the time of data collection, the study site ED management were, again, planning to change the patient flow model for waiting room patients later in that year. These changes the to the ED patient flow strategy should incorporate an evaluation of the new model of care which includes a repeated audit of the prevalence of unreported deterioration in the SSU and waiting rooms.

8.9. The emergency department rapid response team

The efferent arm of the ED rapid response system comprised of the consultant and nurse in charge of each shift. Though these leaders have the greatest oversight of the ED's status throughout the course of a shift, they were also perceived to be the most in demand and were cognitively overloaded. The results of this study indicate that deviations from the ED mandatory alert criteria procedure were influenced by staff's perceptions about the workload of the consultant and nurse in charge. And while they were eager to be informed about patients of concern, consultants acknowledged the negative effect that increased demand and cognitive load had upon their performance as a clinician, as well as their availability to consult on emergency care.

Unlike response teams that respond to deteriorating acute ward patients, the response in the study site ED was mounted largely by a CIC and NIC encumbered with ever increasing demands on their time and expertise. It may, therefore, be time to revaluate the feasibility and utility of the current ED rapid response team configuration in the wider ED community.

To our knowledge there is no published research findings describing the ideal composition and team roles of the efferent arm of ED specific response systems. The outcomes from this study suggests that research designed to describe the typical roles and responsibilities of the wider ED rapid response teams may be a valuable first step in realising more practical and efficient ED response teams.

8.10. The emergency department early warning system

The findings of this study also indicate that the current single parameter track and trigger system may be underpowered to address the safety needs of a diverse patient casemix with extremely variable acuity levels. This may, in part, be related to the limited data which the ED's early warning system relies upon to initiate automated alerts, as well as the system's inherent susceptibility to bring about alert fatigue in ED carers already exposed to a raft of alarms and patient safety alerts.

Single parameter track and trigger EWSs are an effective tracking and triggering model in acute medical and surgical wards. And while emergency care has embraced similar systems, the ideal ED track and trigger model has not yet been described in the literature.

The findings from this research indicate that patients with hypotension are significantly more likely to have their care appropriately escalated than patients with other deleterious vital signs (e.g. hypoxaemia). That is, the EDMAC may be sensitive to some patient data, but not all. As such, it may be necessary to evaluate the efficacy of ED track and trigger systems that are less sensitive to a single patient data point, but rather synthesise all relevant patient data and provide a more complete picture of the patient's physiological status. There is, however, limited published evidence that describes the type and effectiveness of EWSs used in the ED setting. Therefore, the final recommendation of this study suggests that the wider ED community prioritise research that aims to describe the ideal ED EWS.

8.11. Limitations of the research

There are several limitations to this research some of which have been touched on throughout the discussion. These limitations were, in part, due to ensuring the study design was feasible.

The safety climate survey, and indeed the MRR and interviews, were limited to a single ED, and as such the generalisability of the results may be limited by this. However, the study site ED provided an ideal environment to explore the aims of the research in great detail. This was largely due to the site's RN professional development framework and the meticulous attention to keeping up to date live records of every staff member's clinical competence standing. Without this stratified competency level data, many of the outcomes and conclusions related to experience and expertise would not have been possible. It was considered unlikely that different EDs would have competency level strategies and records that were similar enough to limit the heterogeneity of competence levels.

The period prevalence of deterioration was also limited to a distinct two-week period that did not control for seasonal fluctuations in ED presentations. And though the MRR was conducted during winter months (a time when ED presentation numbers are higher), scheduling data collection during winter and summer may have yielded a different, and perhaps more representative result.

Due to the retrospective nature of the MRR, there was also a possibility that care was, in fact, appropriately escalated for some of the episodes of deterioration but there was insufficient evidence of this in the documentation. Though all care was taken to identify any evidence that a doctor had been informed (e.g. administration of treatment that can only be ordered by a doctor), it is quite possible that some episodes may have been escalated.

The benefits of conducting a prospective investigation was considered early in the research method planning stage. The decision to move ahead with a retrospective approach was based on to two factors. Firstly, a prospective design would require the researcher to make ethically consequential decisions about what should be done if they identified signs of deterioration in real time. That is, if the staff member who recorded vital sign that indicated deterioration did not immediately escalate care, it would be ethically inappropriate for the researcher to wait before intervening. The second reason for selecting a retrospective approach over a prospective design was to do with the sampling of potential interview participants. It was considered crucial to invite potential interviewees to discuss the episode as quickly as possible so as to minimise any degradation of their memory of the episode. A prospective data collection method would render it impractical to collect deterioration and escalation data, as well as interview the relevant staff members.

The fidelity of the responses from the interviewees was also considered to be a limitation. Interview participants were often asked about circumstances and clinical decisions that could easily be perceived as an assessment of the quality of the care they provided. And to some degree, these concerns may have been somewhat justified. Therefore, any acknowledgement by participants that they failed to escalate could have been perceived as an admission that their care was substandard. In an attempt to mitigate these concerns, the interviewer reassured the participants that the focus of the interview was to explore their experience, not to judge. The interviewer also observed for verbal and non-verbal cues of participant discomfort when talking about their actions during the episode. If the participant appeared to be uncomfortable with the conversation, the interviewer would acknowledge this and move on to another topic if the participant agreed.

Though all efforts were made to interview participants as soon as possible after an episode of caring for a deteriorating patient, some staff were interviewed up to 10 days later. These delays were mostly a result of the individuals leave entitlements, participants' roster commitments and scheduling clashes. Where able, the researcher would offer a memory prompt about the deteriorating patient or other significant events that may have taken place during the shift. However, sometimes the participant's detailed memory of the events was diminished regardless of the prompts.

A result of interviewing staff as soon as possible after an episode of caring for a deteriorating patient presented another disappointing limitation. There was insufficient time to analyse the data in detail prior to each interview. As such, only preliminary findings related to the relationship between competence level and escalation practices were available at the time that the interviews took place. However, this was seen as a necessary trade-off to ensure interviews were conducted as close as possible to the time when the patient deteriorated.

Finally, the specialised nature of the emergency care setting poses a barrier to transferability of the outcomes and recommendations to other acute care area settings (e.g. general wards). The FTR literature has largely ignored exploring the factors and characteristics which are distinctly endemic to emergency care. This is, in part, due to the relevantly recent uptake of RRS in the ED. As such, the need to describe the relationships between dynamic ED specific factors and FTR were considered to be a priority for improving the safety of deteriorating ED patients.

8.12. Recommendations for Practice and Future Research

This study has established several implications for ED practice and future research priorities as they relate to the care of deteriorating ED patients. These recommendations include a need for cultural change, learning from the expertise of frontline ED doctors and nurses, targeted ED specific education, as well as adapting staff deployment and the ED rapid response system. The following recommendations have been informed by mixing the results from the three study strands and framed by how these results sit within the theoretical model outlined in the International Patient Safety Framework (see figure 7.1). The recommendations are based upon the actions which are currently taken to reduce harm and their influence upon the factors which contribute to FTR (incident type). Synthesis of these results has provided substantial theoretical support for several mitigating factors which are likely to inform future actions which can be taken to reduce risk to the deteriorating ED patient.

The study design also provides a systematic means of measuring the effectiveness of the actions taken to detect and reduce risk to deteriorating ED patients. This is done in a way that i) capitalises on the cyclical nature of the IPSF framework, and ii) aligns with a uniform set of internationally standardised patient safety concepts to systematically evaluate and improve current ED policy and practice.

8.12.1. Cultural change

Cultural improvement, as it relates to patient safety, is complex and potentially abstract. The factors that require change can be subtle elements related to beliefs and attitudes, or tangible and measurable such as patterns of behaviour (Parker, Lawrie, & Hudson, 2006). Regardless of the complex nature of improving the culture of safety, there is substantial evidence regarding the association between a strong culture of patient safety and improved patient outcomes (Singer, Lin, et al., 2009). Therefore, once there is evidence that the culture of safety is undermined, failing to act is commensurate with supporting a poor safety culture.

The results from the current study indicates an association with the culture of safety that negatively impacts on escalation practices when a patient with signs of deterioration is identified. This is evident in the areas of communication, leadership, teamwork and the organisation's actions in responding to patient safety. Though it is very unlikely that the culture of safety is the only factor associated with sub-optimal escalation, it is encouraging that this is one area of emergency care that can be improved through interventions designed to address the culture of safety. However, cultural change is difficult, and while there are many "off the shelf" interventions designed to help improve the patient safety culture, tailored interventions based upon an evaluation of endemic cultural norms are likely to yield far greater safety culture improvements (Morello et al., 2013). Furthermore, findings from previous studies show that attempts to improve safety culture have a greater impact when the frontline workers, who are actively involved in the day-to-day processes of care, are involved in the evaluation of the culture of safety and the actions required to improve it (Benning et al., 2011; Frankel et al., 2005; Thomas, Sexton, Neilands, Frankel, & Helmreich, 2005).

The outcomes of the current research suggest that further research is needed to evaluate the quality of safe and effective care as it relates to specific aspects of ED care (e.g. associations between SSUs and quality of care). There is also an urgent need to address the culture of safety in EDs with targeted interventions that address local issues which are designed and implemented by frontline workers, and are fully supported by a management structure committed to cultural improvement.

8.12.2. The Implications of Expertise

It would appear that there are valuable practices, beliefs and motivations to be learned from ED staff who have 2-5 years of experience and/or intermediate level competence. This group have likely experienced many episodes of deterioration and escalations, an exposure which seems to be associated with i) a scepticism about the safety culture, ii) the resolve to advocate for their patients' safety, and iii) significantly healthier escalation practices.

Further research designed to evaluate this intermediate group's motivations, attitudes, beliefs and behaviour is recommended. The outcomes from this would be key to the development and focus of any interventions (e.g. education) to support better escalation practices in all ED staff from novice through to expert.

Clinical reasoning was also identified as a powerful influence on escalation practices, but one which was not formally included in any of the clinical progression strategies. The clinical reasoning skills of ED expert staff are likely to greatly benefit both the staff with less expertise and the workload of the person/s in charge of each shift. Further research is recommended to explore the cognitive processes and clinical decision-making practices employed by expert ED staff. Furthermore, expert ED staff in this study failed to escalate 60% of the time, indicating that there is a need to develop ongoing and effective educational support throughout the whole work life cycle of frontline ED staff. The outcomes of this could be included more formally in educational interventions that are designed to support ED staffs' efforts to recognise and respond to physiological deterioration.

8.12.3. Implications for Education

As a specialist area that enjoys robust long-term educational support for its staff, the ED's current education structure would benefit from some minor modifications to its delivery and content.

The outcomes from the current research also suggest that modifications to the staff clinical competence progression should include EDMAC policy refreshers, clinical reasoning skills and any other evidence that comes from an evaluation of the intermediate staff attitudes and behaviours.

There is evidence that intermediately competent nurses with 2 – 5 years of experience possess important characteristics (attitudes, motivations and behaviours) that translate to safer and more effective escalation practices. These characteristics are not yet transparent in the results of this study. However, enhancements to the ED's education strategy are likely to be better informed by research that aims to explore this group's decisions and practices when faced with physiological deterioration in the ED.

There are also key educational elements that support ED doctors and nurses' efforts to provide sustained high-quality care for deteriorating patients which have been made more transparent by this study. These include regular (4 -10 times per year) interprofessional in situ simulation training that blend patient deterioration scenarios incorporating expert evaluation and feedback about the team's technical and non-technical (clinical reasoning, communication, teamwork and leadership) performance.

8.12.4. Staffing levels

Despite evidence that increased nursing hours can reduce mortality, reduce errors improve patient satisfaction and worker satisfaction (Aiken et al., 2017), there was no evidence in the current research that overall appropriate escalation practice was impacted by changes in staffing levels. However, there was evidence that there was a relationship between ED care areas with different nurse-patient ratios and escalation practices. That is, deterioration went unreported in areas with high ratios and were more reliably escalated with lower nurse-patient ratios. To our knowledge, this is the first study to evaluate the effect of staffing levels and mix on escalating the care of deteriorating ED patients. And though it would pose an economic challenge, it is recommended that the impact of increasing ED nursing hours on patient safety issues (such as escalation) should be trialled and evaluated.

8.12.5. Evaluate the safety of each emergency care area

There were imminent plans for changes to the study site's patient flow structure and model of care at the time of data collection. Given the evidence from the current study that ED waiting room patients are deteriorating without appropriate escalations, it is recommended that any evaluation of the new model includes a repeated audit of the prevalence of unreported deterioration in the waiting room.

The SSU was an ED area that was also identified as an ED care area where over 63% of deterioration was not escalated. And when escalation did take place in this care area, there was a perception that appropriate responses were impeded by hesitation to transfer the patient back to the ED. The use of SSUs are becoming widely used globally but there is little research that describes general patient safety and the quality of care provided in these specialised care areas (Damiani et al., 2011). Therefore, further research to investigate the quality of care for all patients in Emergency SSUs is recommended.

8.12.6. A new ED response team

The outcomes of this study suggest that the person/s responsible for responding to deteriorating patients are heavily in demand and overburdened with workload tasks and cognitive load. A subtle variation to the team roles that includes an ED doctor and/or nurse deterioration response team, and not the CIC or NIC, may provide a feasible alternative to the current system.

There are many variations on response team membership that are based upon the availability of human resources. As is the case for most Australian MET response teams (ANZICS-CORE MET dose Investigators, 2012), there is no additional funding provided to support the EDs efforts to respond to deterioration. As such, lean redeployment of the ED's staff resources may be a practical and economically viable alternative.

To date there are no published findings describing the composition and team roles of the efferent arm of ED response systems, and as such it is difficult to generalise to the broader ED community. However, allocating an ED doctor and/or nurse deterioration response team, that does not include the ED CIC, may be a practical and economically viable strategy to help improve the ED's response to physiological deterioration, as well as ease the workload of the CIC and NIC.

8.13. A new Early Warning System

There are several other elements of the EDMAC process and ED model of care that, if modified, may reduce the prevalence of failure to escalate. The automated deteriorating patient alerts generated from the EMR are often overridden and disregarded due to overexposure. It is possible that modifying the alert's sensitivity to data may address alert fatigue. But it is also highly likely that any such changes would also shift the safety net for patients experiencing deterioration and expose them to greater risk. The impact of an ED specific multiparameter track and trigger system on the recognition and management of physiological deterioration is recommended for a specialist care area with a diverse patient casemix such as the ED.

8.14. Conclusion

This study provides evidence that escalating deteriorating patients' care in the ED is substandard. In a risk averse specialised healthcare setting, this is a significant concern that places the safety of ED patients in a precarious position. However, this study also delivers clear evidence about why the problem exists and suggests practical strategies about how to ameliorate it with feasible evidence-based modifications to ED practices and cultural change. These strategies include recommendations for emergency practice and research priorities related to cultural change, the expertise and experience of staff, effective education and adapting the systems for recognising and responding to deterioration.

Emergency departments can provide a safer environment for deteriorating patients through genuine commitment to cultural improvement which addresses site-specific safety culture issues reported by frontline ED workers. Capitalising on the intrinsic strengths and behaviours, characteristic of the ED team's expertise and experience, can also positively influence the effectiveness of actions taken to reduce risk to the deteriorating patient.

Furthermore, staff can be better supported to recognise and respond to deterioration in the ED through evidence-based education. This includes adapting current educational strategies to incorporate regular interprofessional in situ simulation based on ED specific deteriorating patient scenarios, as well as expert evaluation and feedback about the team's technical and non-technical performance.

Finally, risk to deteriorating ED patients can be reduced by providing a consistent, evidence-based and ED specific approach to recognising and responding to patient deterioration. This should include evaluation of, and recommendations for i) the roles and responsibilities of ED response teams, and ii) an ED specific track and trigger system befitting the diversity and complexity of emergency care.

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Appendix A. Emergency Department Mandatory Alert Criteria

Who must comply with this procedure? All [redacted] emergency department clinical staff (medical, nursing and allied health staff) Other [redacted] clinical staff managing patients in ED (pharmacy, mental health, medical staff)
This procedure applies in the following setting: This procedure is applicable to all [redacted] patients under the care of the emergency department.
Precautions and Contraindications This document describes criteria to identify potentially unstable patients in the Emergency Department, the requirement to alert senior clinical staff of patients meeting the alert criteria, and the response required when alert criteria are met. In all cases of suspected cardiac or respiratory arrest, immediate help should be summoned by calling for help and pressing the nearest emergency buzzer.
Equipment Pulse oximeter Non-invasive blood pressure cuff

Procedure

1. Determine whether determine if any of the physiological and clinical mandatory alert signs in the implementation tool *(link)* are present.
2. If any mandatory alert criteria are present, the most senior Emergency Department Doctor (Emergency Department consultant or senior registrar overnight) *and* nurse in charge **must** be notified.
3. Staff are to clearly state that “<<*patient name*>>” & “<<*location*>>” fits ED mandatory alert criteria.
4. If necessary, use the staff assist or emergency buzzers to seek urgent assistance.
5. Inform patient’s treating Emergency Department doctor and nurse.
6. Senior Emergency Department Doctor / nurse in charge must review the patient within 2 minutes and directly supervise management of patient.
7. Management may include:
    - Implementation of appropriate diagnostic and therapeutic interventions
    - moving patient to an appropriate location
    - allocation of additional senior staff to assist
    - Specialty referrals
    - Setting variations to the criteria.
8. Senior Emergency Department Doctor and nurse in charge are to document interventions & outcomes in e-notes.
9. Emergency Department senior doctor to notify treating inpatient team/after-hours covering staff for admitted patients.
10. **Patients are not to be moved to ward beds, transferred to other hospitals, or discharged from the Emergency Department if warning signs are present unless one of the following apply:**
    - patient is being transferred to a critical care area (eg theatre, cath lab)
    - there is a medical escort (ICU transfer)
    - patient is for palliative management and this is documented in the medical record
    - limitations to resuscitation/ MET call status are in place and clearly documented.

Adult Warning Signs

Airway	Respiratory distress Concern about airway
Breathing	Respiratory rate > 30 / min Respiratory rate < 6 / min Oxygen Sats < 90% on 02
Circulation	Systolic BP < 90 mmHg Heart rate > 130 bpm
Neurology	Decrease in conscious state Fitting
Other	Concern about patient

Paediatric Warning Signs

Airway		Respiratory distress Concern about airway		
Breathing		Cyanosis Oxygen Sats < 90% on 02 (< 60 % on any O2 in cyanotic heart disease)		
		Respiratory rate too fast	**Respiratory rate too slow**	
	Term – 12 months	> 70	< 20	
	1 – 4 years	> 56	< 16	
	5 – 12 years	> 46	< 13	
	> 12 years	> 34	< 10	
		BP systolic too low	**Heart rate too fast**	**Heart rate too slow**
	Term – 12 months	< 65 mmHg	> 180	< 95
	1 – 4 years	< 70 mmHg	> 165	< 75
	5 – 12 years	< 80 mmHg	> 150	< 60
	> 12 years	< 95 mmHg	> 135	< 50
Neurology		Decrease in conscious state Fitting		
Other		Concern about patient		

Appendix B. Interview Schedule

Interview Schedule

Opening

1. (Establish Rapport) My name is Cliff Connell and I am an ED nurse, lecturer and PhD candidate. As part of my PhD research I am trying to answer some questions about the assessment and management of ED patients that show signs of physiological deterioration. Following on from previous research about organisational climate and structure associated with the recognition and management of patient deterioration in an emergency department. The aims of this interview are to explore the staff experience and perceptions of escalating care of the deteriorating Emergency Department patient.

2. (Purpose) I would like to start by asking you some questions about your work background, ED experience etc. before moving on to discuss details about your experience of assessing and caring for deteriorating ED patient/s, including how patient information was communicated (e.g. ISBAR handover). The interview discussion may also include your preferences and insights into the assessment and care of the patient as well as communication about the clinical situation.

3. (Motivation) I hope to use this information to help provide evidence to inform policy design, clinical governance and ED practice development related to patient safety and ED clinicians with evidence to improve the quality and effectiveness of the care they provide.

4. (Time Line) The interview should take about 30 minutes. Are you available to respond to some questions at this time?

5. (Documentation) Reading explanatory statement and signing consent forms.

We are collecting some demographic information; however, we will ensure that no individual is identified and all responses are treated confidentially. All reporting will be on de-identified data at the aggregate level only.

Demographic Data

What is your gender?

- ☐ Female
- ☐ Male

Are you employed by this health service?

- ☐ Yes
- ☐ No (e.g. agency)

What is your employment status?

- ☐ Full time
- ☐ Part time
- ☐ Casual / temporary

How is your job level best described?
(please mark one only)

- ☐ Consultant
- ☐ Registrar
- ☐ Resident
- ☐ ANUM
- ☐ Clinical Nurse Specialist
- ☐ Registered Nurse
- ☐ Enrolled Nurse

What is your age range?

- ☐ Less than 24 years
- ☐ 25 to 29 years
- ☐ 30 to 34 years
- ☐ 35 to 39 years
- ☐ 40 to 44 years
- ☐ 45 to 49 years
- ☐ 50 to 54 years
- ☐ 55 to 59 years
- ☐ 60 to 65 years
- ☐ More than 65 years

How is your current role best described?
(please mark one only)

- ☐ Doctor
- ☐ Nurse
- ☐ Nurse Practitioner
- ☐ Other (please specify): ____________

What health emergency department area do you work in most?

(please mark one only)

☐ In charge	☐ General cubicles	☐ Waiting Room
☐ Triage	☐ Fast Track	☐ All areas
☐ Resuscitation	☐ Short Stay Unit	☐ Other (please specify): ______________________________
☐ Monitored area	☐ Rover	

.... **How long have you worked in this health service?**

☐ Less than 3 months	☐ 6 to 9 years
☐ 4 to 11 months	☐ 10 to 19 years
☐ 1 to 2 years	☐ 20 to 29 years
☐ 3 to 5 years	☐ 30 or more years

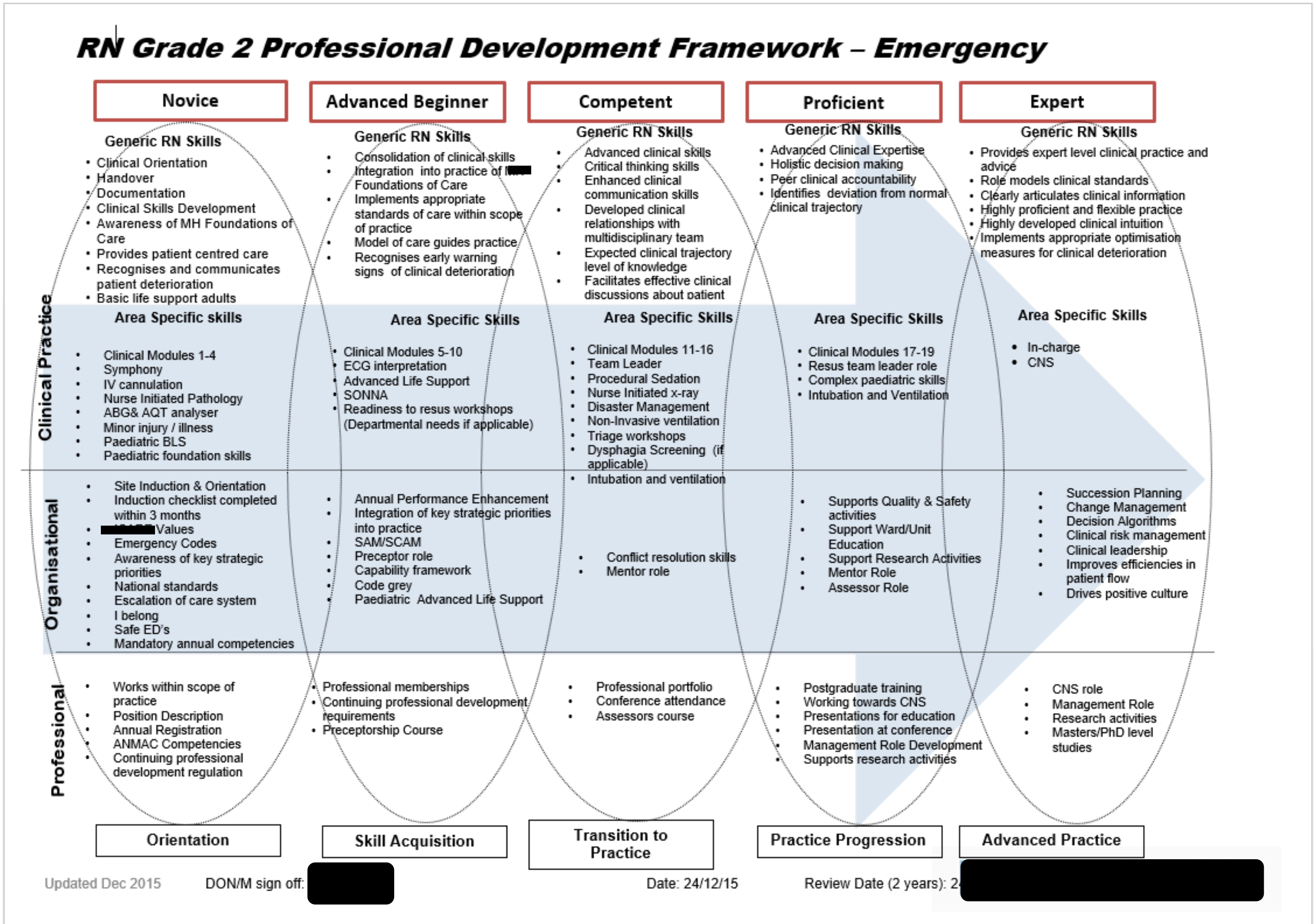
How long have you worked in your current role?

☐ Less than 3 months	☐ 6 to 9 years
☐ 4 to 11 months	☐ 10 to 19 years
☐ 1 to 2 years	☐ 20 to 29 years
☐ 3 to 5 years	☐ 30 or more years

Interview questions and prompts

1. Can you describe what you believe recognising and responding to the deteriorating ED patient involves?
   → Possible prompt: Types of patients, EDMA criteria.
2. Can you tell me of your experiences with patients who exhibit signs of deterioration in the ED?
   →Possible prompt: positive, negative, eventful.
3. (Describe deteriorating patient identified in chart audit) Can you remember caring for this patient?
   → Possible prompt: date, shift, patient history etc.
4. Can you describe the events surrounding the patient's care, how patient information was communicated, what happened (e.g. who was the patient's condition escalated to) and the state of the ED?
   → Possible prompt: ISBAR used? EDMAC considered.
5. Do you have any preferences about the assessment and management of potential deteriorating patients in the ED?
6. Do you have any preferences about how information should be communicated regarding patients who are deteriorating?
7. Do you have any suggestions for changing the practice of recognising and managing deteriorating patients in the ED?

Appendix C. Emergency Department Professional Development Frameworks



RN Grade 2 Professional Development Framework – Emergency

	Novice	Advanced Beginner	Competent	Proficient	Expert
Clinical Practice – Generic RN Skills	• Clinical Orientation • Handover • Documentation • Clinical Skills Development • Awareness of MH Foundations of Care • Provides patient centred care • Recognises and communicates patient deterioration • Basic life support adults	• Consolidation of clinical skills • Integration into practice of [redacted] Foundations of Care • Implements appropriate standards of care within scope of practice • Model of care guides practice • Recognises early warning signs of clinical deterioration	• Advanced clinical skills • Critical thinking skills • Enhanced clinical communication skills • Developed clinical relationships with multidisciplinary team • Expected clinical trajectory level of knowledge • Facilitates effective clinical discussions about patient	• Advanced Clinical Expertise • Holistic decision making • Peer clinical accountability • Identifies deviation from normal clinical trajectory	• Provides expert level clinical practice and advice • Role models clinical standards • Clearly articulates clinical information • Highly proficient and flexible practice • Highly developed clinical intuition • Implements appropriate optimisation measures for clinical deterioration
Clinical Practice – Area Specific Skills	• Clinical Modules 1-4 • Symphony • IV cannulation • Nurse Initiated Pathology • ABG& AQT analyser • Minor injury / illness • Paediatric BLS • Paediatric foundation skills	• Clinical Modules 5-10 • ECG interpretation • Advanced Life Support • SONNA • Readiness to resus workshops (Departmental needs if applicable)	• Clinical Modules 11-16 • Team Leader • Procedural Sedation • Nurse Initiated x-ray • Disaster Management • Non-Invasive ventilation • Triage workshops • Dysphagia Screening (if applicable) • Intubation and ventilation	• Clinical Modules 17-19 • Resus team leader role • Complex paediatric skills • Intubation and Ventilation	• In-charge • CNS
Organisational	• Site Induction & Orientation • Induction checklist completed within 3 months • [redacted] Values • Emergency Codes • Awareness of key strategic priorities • National standards • Escalation of care system • I belong • Safe ED's • Mandatory annual competencies	• Annual Performance Enhancement • Integration of key strategic priorities into practice • SAM/SCAM • Preceptor role • Capability framework • Code grey • Paediatric Advanced Life Support	• Conflict resolution skills • Mentor role	• Supports Quality & Safety activities • Support Ward/Unit Education • Support Research Activities • Mentor Role • Assessor Role	• Succession Planning • Change Management • Decision Algorithms • Clinical risk management • Clinical leadership • Improves efficiencies in patient flow • Drives positive culture
Professional	• Works within scope of practice • Position Description • Annual Registration • ANMAC Competencies • Continuing professional development regulation	• Professional memberships • Continuing professional development requirements • Preceptorship Course	• Professional portfolio • Conference attendance • Assessors course	• Postgraduate training • Working towards CNS • Presentations for education • Presentation at conference • Management Role Development • Supports research activities	• CNS role • Management Role • Research activities • Masters/PhD level studies
	Orientation	Skill Acquisition	Transition to Practice	Practice Progression	Advanced Practice

Updated Dec 2015 DON/M sign off: [redacted] Date: 24/12/15 Review Date (2 years): 2[redacted]

EN Professional Development Framework - Emergency

	Novice	Advanced Beginner	Competent	Proficient	Expert – EN3
Clinical Practice – Generic EN Skills	• Clinical Orientation • Handover • Documentation • Clinical Skills Development • Awareness of MH Foundations of Care • Provides patient centred care • Recognises and escalates patient deterioration • Basic Life support adult	• Consolidation of clinical skills • Integration into practice of [redacted] Foundations of Care • Implements appropriate standards of care within scope of practice • Area model of care guides practice • Competent in area specific clinical skills	• Demonstrates sound critical thinking skills in clinical care • Enhanced clinical communication skills • Developed clinical relationships with multidisciplinary team • Familiar with expected patterns of patients' clinical progress • Sound contribution to care planning	• Advanced Clinical Expertise • Holistic care delivery • Peer clinical accountability • Contributes to effective clinical discussions about patient management • Identifies deviations from expected patterns of patient clinical progress • Recognises early warning signs of clinical deterioration	•Provides expert level clinical practice and advice •Role models clinical standards •Clearly articulates clinical information •Highly proficient and flexible practice •Highly developed clinical intuition and identifies deviations from expected patient clinical progress •Highly developed critical thinking skills
Clinical Practice – Area Specific Skills	• Clinical Modules 1-2 • Symphony • Emergency nurse role & responsibilities • Infection control awareness • Pathology result checking • Incident reporting • Paediatric BLS • Paediatric foundation skills workshop	• Clinical Modules 3-4 • Venepuncture • NGT insertion • IDC insertion • Attend a minor trauma workshop	• Clinical Modules 4-5 • Attend a basic ECG workshop	• Recognises early signs of clinical deterioration and respond within scope of practice	• Consolidation of clinical expertise • Displays high proficient & flexible practice within scope of practice • Holds a portfolio
Organisational	• Site Induction & Orientation • Induction checklist completed within 3 months • [redacted] Values • Emergency Codes • Awareness of key strategic priorities • National standards • Escalation of care system • Completion of MH Medication • Competency of Medication Endorsement • I belong • Safe ED's • Manual annual competencies	• Annual Performance Enhancement • Mandatory Annual Competencies • Integration of key strategic priorities into practice • Capability framework • Code Grey	• Committee Membership • Conflict resolution skills • Mentee role • EN Preceptor role	• Supports Quality & Safety activities • Support Ward/Unit Education • Support Research Activities • EN Mentor Role • Assessor role	• Coordination of quality and safety activities • Change Management • Clinical risk management • Clinical leadership • Improves efficiencies in patient flow • Drives positive culture
Professional	• Works within Scope of Practice • Position Description • Annual Registration • ANMAC Competencies • Continuing professional development regulation	• Professional memberships • Continuing professional development requirements • Education Courses on caring for unwell patients: • VITALS (site based) • SOUP (SIM Centre)	• Professional Portfolio • Conference attendance • Preceptorship Course	• Assessor's course • Working towards EN3 • Presentations for education • Presentation at conference • Portfolio involvement	• EN3 role • Management Role • Research activities • Coordinating portfolio
	Orientation	Skill Acquisition	Transition to Practice	Practice Progression	Advanced Practice
	EN 1 & EN 2				

Updated April 2015 DON/M sign off: [redacted] Date: 24/12/15 Review Date (2 years): [redacted]

Appendix D. Staffing and Skillmix Requirements

Shift by shift staffing requirements

ED area staffed by nurses	Skillmix minimum standard across all areas in a 24-hour period
In-charge	1 x in charge nurse (all shifts)
Triage	AM - 1 x triage nurse PM – 2 x triage nurses ND – 1 x triage nurse
R1	AM - 1 x R1 nurse PM - 1 x R1 nurse ND - 1 x R1 nurse
R2 – R3	AM - 2 x R2 nurses PM - 2 x R2 nurses ND - 1 x R2 nurse
G1 and Y1	AM – 3 x RNs PM – 3 x RNs ND – 3 x RNs
G2 and Y2	AM – 8 x RNs PM – 8 x RNs ND – 6 x RNs
Fast Track	AM – 1 x RN PM – 1 x RN
AV offload	AM – 1 x RN PM – 1 x RN
Rover	AM – 1 x Triage nurse PM – 1 x Triage nurse ND – 1 x Triage nurse
X-Ray Nurse	PM – 1 x RN

Minimum standard skillmix for each ED nursed area.

ED area	Minimum standard skillmix and staff numbers		
	AM	PM	ND
In-charge	1 x In-charge nurse (ANUM/CNS)	1 x In-charge nurse (ANUM/CNS)	1 x In-charge nurse (ANUM/CNS)
Triage	1 x triage nurse	2 x triage nurse 1 x WR nurse	1 x triage nurse
Resuscitation Cubicles	1 x R1 2 x R2	1 x R1 2 x R2	1 x R1 1 x R2
General cubicles	2 x G1/Y1 4 x G2/Y2	2 x G1/Y1 4 x G2/Y2	2 x G1/Y1 4 x G2/Y2
Fast Track	1 x G1	1 x G1	NA
SSU	1 x G1/Y1 4 x G2/Y2	1 x G1/Y1 4 x G2/Y2	1 x G1/Y1 2 x G2/Y2
AV offload	1 x G2/Y2	1 x G2/Y2	NA*
Rover	1 x triage nurse	1 x triage nurse	1 x triage nurse
X-Ray Nurse	NA	1 x G1	NA

NA – Not applicable
*AV offload nurse staffed 10:00hrs – 02:30hrs

Safety Climate Survey

A Staff Survey for Measuring Patient Safety

This survey asks about your perceptions and experiences of patient safety in your health service. There are no right or wrong answers; it is your opinion that counts. The survey is anonymous. All responses will be treated confidentially and no individual will be identified.

This survey is designed to be completed by selected staff members who work in, or for, this health service. This includes medical and nursing staff. All views and opinions regarding patient safety are important, even if you are not involved in direct patient care.

Some definitions:

- **Patient**: client, resident or consumer in the health system;
- **Safety**: condition of being safe, free from danger, risk or injury;
- **Error**: any mistake in the delivery of care by any staff member regardless of the outcome.

Please respond to each statement by placing a cross **(not a tick)** in the appropriate box.

Think about the health service area or unit you work in most when rating your level of agreement with the following statements. **Place a cross in the appropriate box.**	Strongly Disagree 1	Disagree 2	Neither Agree Nor Disagree 3	Agree 4	Strongly Agree 5	Not Applicable 6
1. I would feel safe being treated here as a patient.	☐	☐	☐	☐	☐	☐
2. I like my job.	☐	☐	☐	☐	☐	☐
3. Errors are handled appropriately in my work area.	☐	☐	☐	☐	☐	☐
4. This health service does a good job of training new personnel.	☐	☐	☐	☐	☐	☐
5. All the necessary information for important decisions is routinely available to me.	☐	☐	☐	☐	☐	☐
6. Working in this health service is like being part of a large family.	☐	☐	☐	☐	☐	☐
7. Nurse input is well received in my work area.	☐	☐	☐	☐	☐	☐
8. Health service management supports my daily efforts.	☐	☐	☐	☐	☐	☐
9. I receive appropriate feedback about my performance.	☐	☐	☐	☐	☐	☐
10. In my work area, it is difficult to discuss errors.	☐	☐	☐	☐	☐	☐
11. Clinical handover is common in my work area.	☐	☐	☐	☐	☐	☐
12. This health service is a good place to work.	☐	☐	☐	☐	☐	☐
13. The levels of staffing in my work area are sufficient to handle the number of patients.	☐	☐	☐	☐	☐	☐
14. Decision making in my work area frequently utilises input from relevant personnel.	☐	☐	☐	☐	☐	☐
15. I am encouraged by my colleagues to report any patient safety concerns I may have.	☐	☐	☐	☐	☐	☐

Think about the health service area or unit you work in most when rating your level of agreement with the following statements. Place a cross in the appropriate box.	Strongly Disagree 1	Disagree 2	Neither Agree Nor Disagree 3	Agree 4	Strongly Agree 5	Not Applicable 6
16. The culture in my work area makes it easy to learn from the errors of others.	☐	☐	☐	☐	☐	☐
17. This health service deals constructively with problem staff/personnel.	☐	☐	☐	☐	☐	☐
18. In my work area, it is difficult to speak up if I perceive a problem with patient care.	☐	☐	☐	☐	☐	☐
19. When my workload becomes excessive, my performance is impaired.	☐	☐	☐	☐	☐	☐
20. I am provided with adequate, timely information about events in the health service that might affect my work.	☐	☐	☐	☐	☐	☐
21. I know the proper channels to direct questions regarding patient safety.	☐	☐	☐	☐	☐	☐
22. I am proud to work at this health service.	☐	☐	☐	☐	☐	☐
23. Disagreements in my work area are resolved appropriately (i.e. not who is right, but what is best for the patient).	☐	☐	☐	☐	☐	☐
24. I am less effective at work when fatigued.	☐	☐	☐	☐	☐	☐
25. I am more likely to make errors in hostile or tense situations.	☐	☐	☐	☐	☐	☐
26. I have the support I need from other personnel to care for patients.	☐	☐	☐	☐	☐	☐
27. It is easy for personnel in my work area to ask questions when there is something that they do not understand.	☐	☐	☐	☐	☐	☐
28. The doctors and nurses in this health service work together as a well-coordinated team.	☐	☐	☐	☐	☐	☐
29. I am frequently unable to express disagreement with doctors.	☐	☐	☐	☐	☐	☐
30. Morale in my work area is high.	☐	☐	☐	☐	☐	☐
31. Trainees in my discipline are adequately supervised.	☐	☐	☐	☐	☐	☐
32. I know the first and last names of all the personnel I worked with during my last shift.	☐	☐	☐	☐	☐	☐
33. Fatigue impairs my performance during emergency situations.	☐	☐	☐	☐	☐	☐
34. Important issues are well communicated at shift changes/handovers.	☐	☐	☐	☐	☐	☐
35. Personnel frequently disregard rules or policies (e.g. treatment protocols/clinical pathways, sterile field, etc.) that are established for my work area.	☐	☐	☐	☐	☐	☐
36. My suggestions about safety would be acted upon if I expressed them to management.	☐	☐	☐	☐	☐	☐
37. This health service is doing more for patient safety now, than it did one year ago.	☐	☐	☐	☐	☐	☐
38. I am satisfied with the quality of collaboration that I experience with nurses in my work area.	☐	☐	☐	☐	☐	☐
39. Briefing other personnel before the start of a shift or before a procedure is an important part of patient safety.	☐	☐	☐	☐	☐	☐
40. Leadership is driving us to be a safety-centred organisation.	☐	☐	☐	☐	☐	☐
41. Executive management does not knowingly compromise the safety of patients.	☐	☐	☐	☐	☐	☐
42. Line managers in my work area do not knowingly compromise the safety of patients.	☐	☐	☐	☐	☐	☐
ß43. What are three (3) ways in which your health service can improve patient safety?						

Demographic Survey

We are collecting some demographic information; however, we will ensure that no individual is identified and all responses are treated confidentially. All reporting will be on de-identified data at the aggregate level only.

What is your gender?

☐ Female ☐ Male

Are you employed by this health service?

☐ Yes ☐ No (e.g. agency)

What is your employment status?

☐ Full time

☐ Part time

☐ Casual / temporary

How is your job level best described?
(please mark one only)

☐ Consultant ☐ ANUM

☐ Registrar ☐ Clinical Nurse Specialist

☐ Resident ☐ Registered Nurse

☐ Enrolled Nurse

What is your age range?

☐ Less than 24 years ☐ 45 to 49 years

☐ 25 to 29 years ☐ 50 to 54 years

☐ 30 to 34 years ☐ 55 to 59 years

☐ 35 to 39 years ☐ 60 to 65 years

☐ 40 to 44 years ☐ More than 65 years

How is your current role best described?
(please mark one only)

☐ Doctor ☐ Other (please specify): ____________________

☐ Nurse

☐ Nurse Practitioner

What health emergency department area do you work in most?
(please mark one only)

☐ In charge ☐ General cubicles ☐ Waiting Room

☐ Triage ☐ Fast Track ☐ All areas

☐ Resuscitation ☐ Short Stay Unit ☐ Other (please specify): ____________________

☐ Monitored area ☐ Rover

How long have you worked in this health service?

- Less than 3 months
- 4 to 11 months
- 1 to 2 years
- 3 to 5 years
- 6 to 9 years
- 10 to 19 years
- 20 to 29 years
- 30 or more years

How long have you worked in your current role?

- Less than 3 months
- 4 to 11 months
- 1 to 2 years
- 3 to 5 years
- 6 to 9 years
- 10 to 19 years
- 20 to 29 years
- 30 or more

Please return to survey collection box in the Emergency Department.

Appendix F. Safety Climate Survey Items by Domain

SCS Factor	Item number and item
Job Satisfaction	2. I like my job.
	6. Working in this health service is like being part of a large family.
	12. This health service is a good place to work.
	22. I am proud to work at this health service.
	30. Morale in my work area is high.
	8. Health service management supports my daily efforts.
	20. I am provided with adequate, timely information about events in the health service that might affect my work.
	41. Executive management does not knowingly compromise the safety of patients.
Perceptions of management	41. Executive management does not knowingly compromise the safety of patients.
	20. I am provided with adequate, timely information about events in the health service that might affect my work.
Safety Climate	21. I know the proper channels to direct questions regarding patient safety.
	15. I am encouraged by my colleagues to report any patient safety concerns I may have.
	3. Errors are handled appropriately in my work area.
	42. Line managers in my work area do not knowingly compromise the safety of patients.
	1. I would feel safe being treated here as a patient.
	35. Personnel frequently disregard rules or policies (e.g. treatment protocols/clinical pathways, sterile field, etc.) that are established for my work area.
	16. The culture in my work area makes it easy to learn from the errors of others.
	9. I receive appropriate feedback about my performance.
	40. Leadership is driving us to be a safety-centred organisation.
	37. This health service is doing more for patient safety now, than it did one year ago.
	36. My suggestions about safety would be acted upon if I expressed them to management.
	10. In my work area, it is difficult to discuss errors.
	13. The levels of staffing in my work area are sufficient to handle the number of patients.
Stress Recognition	24. I am less effective at work when fatigued.
	19. When my workload becomes excessive, my performance is impaired.
	25. I am more likely to make errors in hostile or tense situations.
	33. Fatigue impairs my performance during emergency situations.

SCS Factor	Item number and item
Teamwork Climate	39. Briefing other personnel before the start of a shift or before a procedure is an important part of patient safety.
	27. It is easy for personnel in my work area to ask questions when there is something that they do not understand.
	11. Clinical handover is common in my work area.
	38. I am satisfied with the quality of collaboration that I experience with nurses in my work area.
	26. I have the support I need from other personnel to care for patients.
	7. Nurse input is well received in my work area.
	14. Decision making in my work area frequently utilises input from relevant personnel.
	32. I know the first and last names of all the personnel I worked with during my last shift.
	34. Important issues are well communicated at shift changes/handovers.
	28. The doctors and nurses in this health service work together as a well-coordinated team.
	23. Disagreements in my work area are resolved appropriately (i.e. not who is right, but what is best for the patient).
	18. In my work area, it is difficult to speak up if I perceive a problem with patient care.
	29. I am frequently unable to express disagreement with doctors.
Working conditions	31. Trainees in my discipline are adequately supervised.
	5. All the necessary information for important decisions is routinely available to me.
	4. This health service does a good job of training new personnel.
	17. This health service deals constructively with problem staff/personnel.

Appendix G. Safety Climate Survey Cover Letter

Safety Climate Survey

Thank you for taking the time to complete this important staff survey. Participation in the survey is voluntary; there is no obligation for you to complete this survey and non-participation will not affect your employment or relationship with the health service. At the completion of the project a report will be provided to us, and arrangements made for feedback to staff. The survey will take approximately 8-10 minutes to complete.

The central purpose of the survey is to identify patient/client safety issues so that concerted efforts to tackle them can be made. A key objective of the survey is to provide information on your attitudes towards training, teamwork and cooperation amongst staff. This will help determine priority areas for safety climate improvement across our system including at the regional, service, division and professional group levels.

The survey is anonymous so you do not need to place your name on this questionnaire. We are collecting information including age, position, years of service and experience; however, we will ensure that no individual is identified and all responses are treated confidentially. All reporting will be on de-identified data at the aggregate level only. This means that groups under ten will not be separately reported.

This survey is designed for completion by selected staff members working in or for our health services. This includes medical and nursing staff. Please answer all questions – knowledge and opinions on patient safety are important, even if you are not involved in direct patient care.

Please note, only one survey per employee is to be completed. If you should choose to complete the survey online then please do not complete this hardcopy version.

This research has received ethics approval. If you have any questions about this research please contact:

Prof. Ruth Endacott
Monash University
Monash Nursing and Midwifery
Tel: +61 3 9904 4282
email: ruth.endacott@monash.edu

Prof. Simon Cooper
Federation University
School of Nursing, Midwifery and Healthcare
Phone: +61 3 5122 8032
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Mr. Cliff Connell
Monash University
Monash Nursing and Midwifery
Phone : +61 422 461 100
email: clifford.connell@monash.edu

I would like to personally thank you for your participation in this important research.

Yours sincerely

Cliff Connell

Appendix H. Interview Explanatory Statement

EXPLANATORY STATEMENT

Project: Escalating deteriorating patients' care in the ED: Characteristics and safety culture.

Prof. Ruth Endacott
Monash University
Monash Nursing and Midwifery
Tel: +61 3 9904 4282
email: ruth.endacott@monash.edu

Prof. Simon Cooper
Federation University
School of Nursing, Midwifery and Healthcare
Tel: +61 3 5122 8032
email: s.cooper@federation.edu.au

Cliff Connell
Monash University
Monash Nursing and Midwifery
Tel: +61 422 461 100
email: clifford.connell@monash.edu

[redacted]
Tel: XXXX | email:XXX@XXXX

You are invited to take part in this study. Please read this Explanatory Statement in full before deciding whether or not to participate in this research. If you would like further information regarding any aspect of this project, you are encouraged to contact the researchers via the phone numbers or email addresses listed above.

What does the research involve?

The proposed research will address the research question: Are organisational climate and structure associated with the recognition and management of patient deterioration by health care professionals in an emergency department? The aims of the research are to explore the staff experience and perceptions of escalating care of the deteriorating Emergency Department patient. As a participant, you will be asked to take part in a semi-structured interview. The subject of the interview will be about the processes that were followed when faced with the recognition and management of the deteriorating emergency department patient. The interviewer will ask questions that relate to details about your experience of assessing and caring for the patient including how patient information was communicated (e.g. ISBAR handover). You may also be asked questions about your preferences and insights into the assessment and care of the patient as well as communication about the clinical situation. The interviews are expected to take 30-40 minutes and will be audio recorded for accurate data collection.

Why were you chosen for this research?

You were asked to participate in this research because you are an emergency doctor or nurse who has taken part in patient care in the ED within the last two (2) months and you have cared for at least one ED patient who showed signs of physiological deterioration while in the ED. You have been identified and contacted by [redacted] employee/s on behalf of the research team and who have not disclosed your details to the research team.

Consenting to participate in the project and withdrawing from the research

Participation in this study is completely voluntary. Informed consent for every participant will be obtained. The consent process involves signing and returning the consent form. Participants have the right to withdraw from further participation at any stage of the data collection process (the duration of the interview), and there will be no repercussions/implications of withdrawal at this stage. However, it will NOT be possible to withdraw data once collected, as data will be de-identified for analysis.

Possible benefits and risks to participants

The results and conclusions of the research will provide evidence to inform policy design, clinical governance and practice development related to patient safety and provide participants (ED clinicians) with evidence to improve the quality and effectiveness of the care they provide.
Minor interruption to work schedules may be experienced by interview participants due to the time taken to conduct the interview. To minimise this, the interviews will be conducted during double staffing time, or at a time best suited to the interviewee. There is also a small risk that interview participants may experience minor emotional discomfort when discussing experiences and perceptions of escalating the care of deteriorating patients. Participants can ask to stop the interview at any time and debriefing sessions to address any concerns will be provided if required.

Confidentiality

At the commencement of each interview, participants will be assigned a unique code by the researcher. This code will be used when transcribing the audio recording to text, de-identifying the participants. These codes will also be used in the publication of the findings if required.

Storage of data

The recordings and transcripts of the interviews will also be stored in an encrypted folder on a password protected computer and kept in a locked office of the primary researcher. It will be held at Monash University for seven years, and then destroyed.

Results

The results of this study will be reported/submitted as part of a PhD research thesis. The results of the research will be disseminated in the final thesis submitted for examination by the PhD candidate (C. Connell), by publication/s in peer-reviewed academic journals and through presentation at relevant conferences. The ED Medical Director and Nurse Unit Manager will be updated with the progress and conclusions of the research.

Complaints

XXX XXXX - Manager
XXXX Human Research Ethics Committee

Tel: XXXXX   Email: XXX@XXXXXXXX

[redacted]
Executive Officer
Monash University Human Research Ethics Committee (MUHREC)
Room 111, Chancellery Building E,
24 Sports Walk, Clayton Campus
Research Office
Monash University VIC 3800
Tel: +61 3 9905 2052   Email: muhrec@monash.edu   Fax: +61 3 9905 3831

Thank you,

Professor Ruth Endacott
Professor Simon Cooper
[redacted]

Appendix I. Participant Information and Consent Forms

CONSENT FORM

Project: Escalating deteriorating patients' care in the ED: Characteristics and safety culture.

Chief Investigators:

Monash University - Professor Ruth Endacott and Professor Simon Cooper

I have been asked to take part in the Monash University research project specified above. I have read and understood the Explanatory Statement and I hereby consent to participate in this project.

I consent to the following:	Yes	No
Audio recording during the interview	☐	☐
Taking part in a semi-structured interview	☐	☐

Name of Participant - _________________________

Participant Signature Date ___/____ /________

Appendix J. Safety Climate Survey Respondent Details

Table 1. Respondent age range, time working in health service and current role

		age range	Time worked in health service	Time worked in current role
N	Valid responses	123	122	100
	Missing	4	5	27
Mode		25 – 29 years	3 – 5 years	3 – 5 years
Skewness		.810	-.220	.000

Figure 1 Respondent age ranges

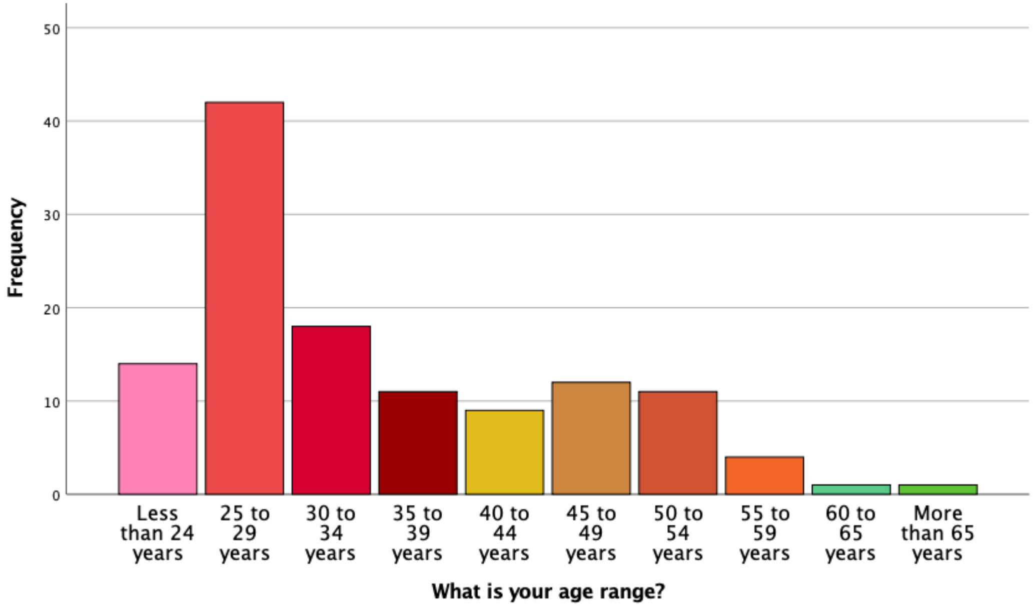


Figure 2 Respondent time in current role

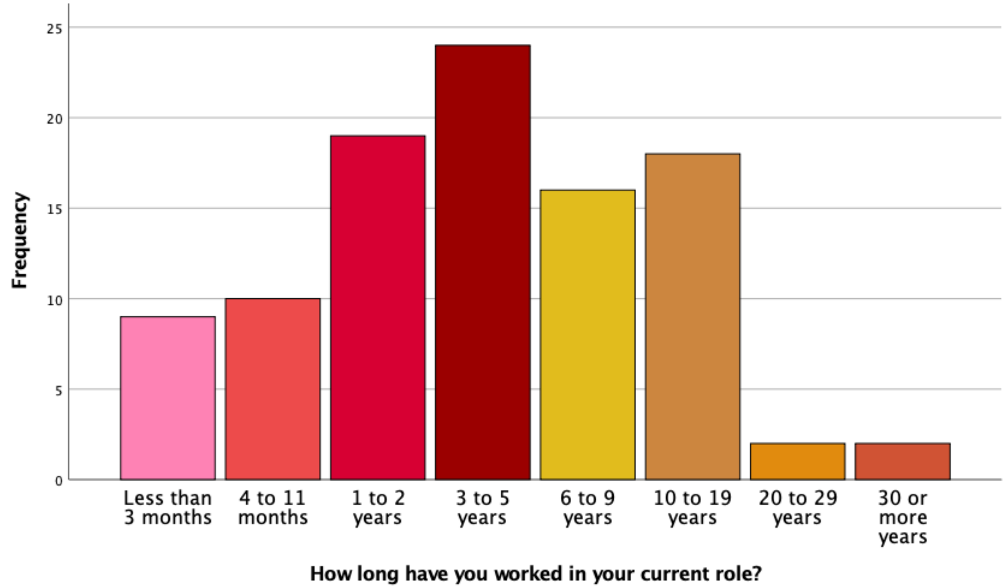
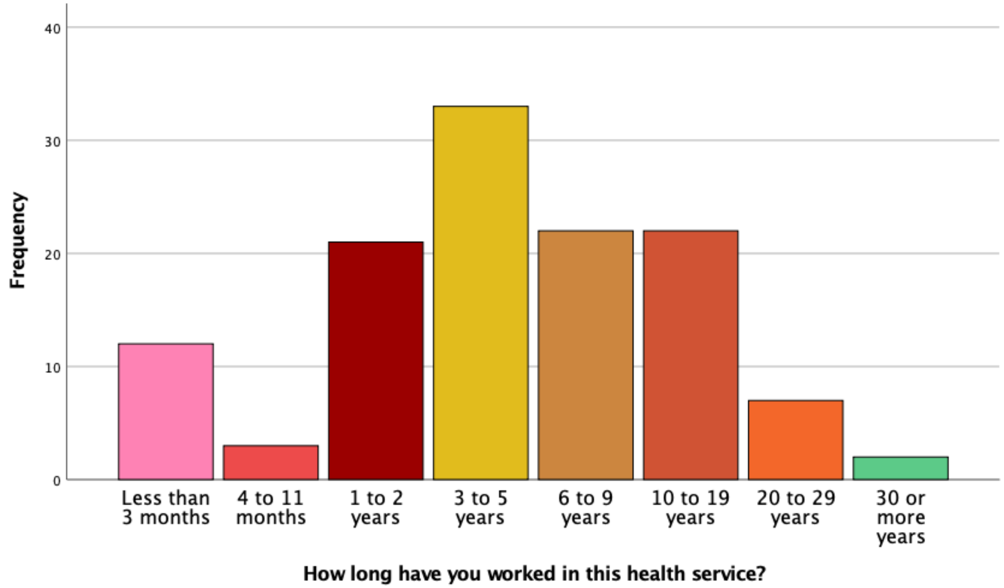


Figure 3 Respondent time in health service



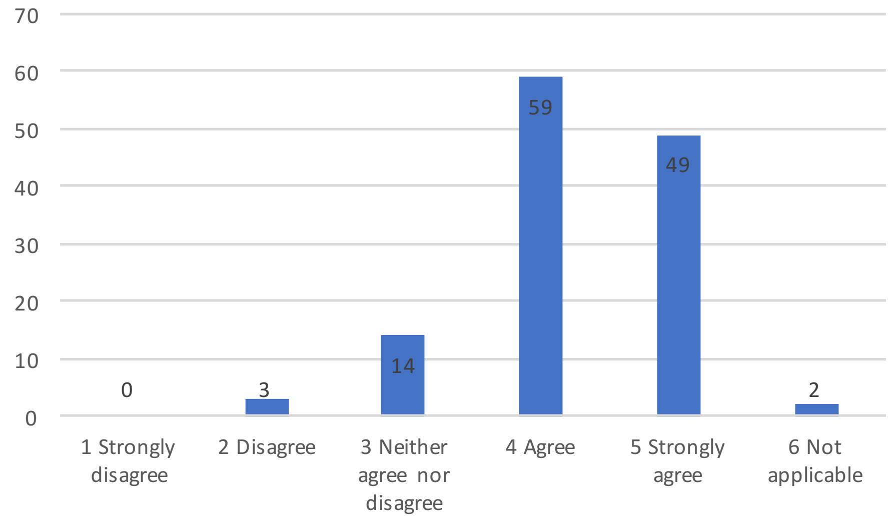
Appendix K. Individual Survey Response Analysis

Table 1. Survey item central tendency and distribution

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
Valid	127	127	127	127	125	127
Missing	0	0	0	0	2	0
Mode	4	5	4	4	4	4
Skewness	-.591	-1.227	-.599	-.616	-.750	-.849
	Item 7	Item 8	Item 9	Item 10	Item 11	Item12
Valid	127	127	127	127	126	127
Missing	0	0	0	0	1	0
Mode	4	4	4	2	5	4
Skewness	-.992	-.493	-.421	.790	-.483	-.878
	Item 13	Item 14	Item 15	Item 16	Item 17	Item 18
Valid	127	127	127	127	127	126
Missing	0	0	0	0	0	1
Mode	2	4	4	4	4	2
Skewness	.320	-.890	-1.028	-.583	.017	.649
	Item 19	Item 20	Item 21	Item 22	Item 23	Item 24
Valid	125	127	127	127	126	125
Missing	2	0	0	0	1	2
Mode	5	4	4	4	4	5
Skewness	-1.156	-.239	-.966	-.817	-.193	-1.186
	Item 25	Item 26	Item 27	Item 28	Item 29	Item 30
Valid	126	127	127	127	123	127
Missing	1	0	0	0	4	0
Mode	4	4	4	4	2	4
Skewness	-.655	-.709	-.786	-1.013	.410	-.164
	Item 31	Item 32	Item 33	Item 34	Item 35	Item 36
Valid	127	127	125	126	127	127
Missing	0	0	2	1	0	0
Mode	4	2	4	4	2	4
Skewness	-.395	.439	-.697	-.358	.460	-.324
	Item 37	Item 38	Item 39	Item 40	Item 41	Item 42
Valid	124	127	127	127	127	126
Missing	3	0	0	0	0	1
Mode	3	4	4	4	3	4
Skewness	.299	-.702	-1.100	-.495	-.232	-.392

Item 1. I would feel safe being treated here as a patient.

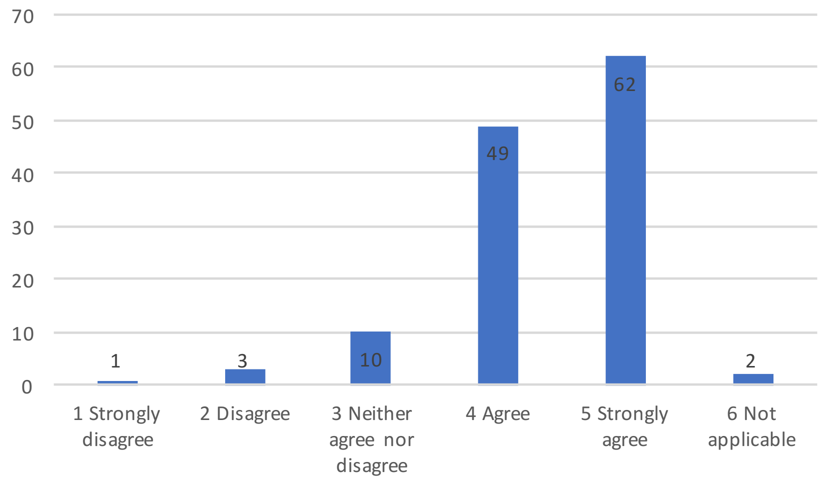
Figure 1 I would feel safe being treated here as a patient



When asked if they would feel safe being treated in the ED the majority either agreed (n = 59) or strongly agreed (n = 49). The remaining 19 participants either disagreed (n = 3), neither agreed or disagreed (n = 14) or did not see the question as applicable (n = 2). There were no missing data for this item. (see figure 1)

Item 2. I like my job.

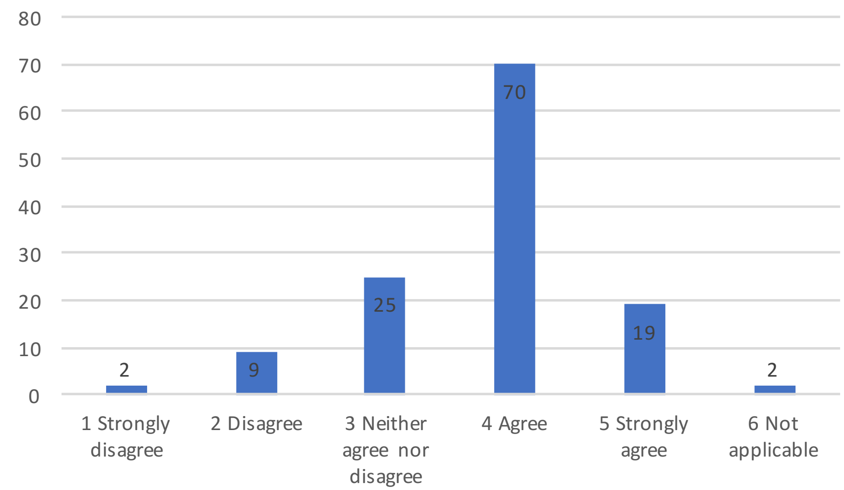
Figure 2 I like my job



In response to whether they liked their job, respondents mostly either agreed (n = 49) or strongly agreed (n = 62). The remaining 16 participants either strongly disagreed (n=1), disagreed (n = 3), neither agreed or disagreed (n = 10) or did not see the question as applicable (n = 2). There were no missing data for this item. (see figure 2)

Item 3. Errors are handled appropriately in my work area.

Figure 3 Errors are handled appropriately in my work area



Eighty nine of the 127 respondents that answered whether errors were handled appropriately either agreed (n = 70) or strongly agreed (n = 19) with the statement. However, 25 were neutral in their response. The remaining 11 respondents strongly disagreed (n= 2), disagreed (n = 9) or did not see the item as applicable. There were no missing data for this item. (see figure 3)

Item 4. This health service does a good job of training new personnel.

Figure 4 This health service does a good job of training new personnel

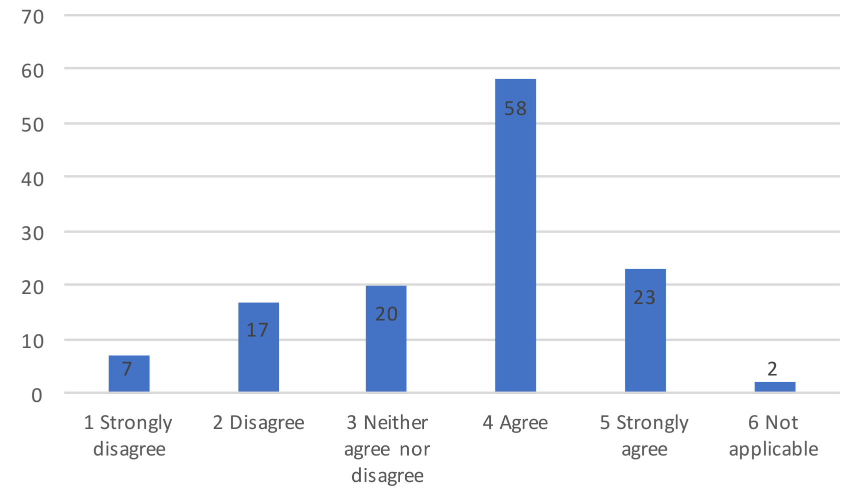
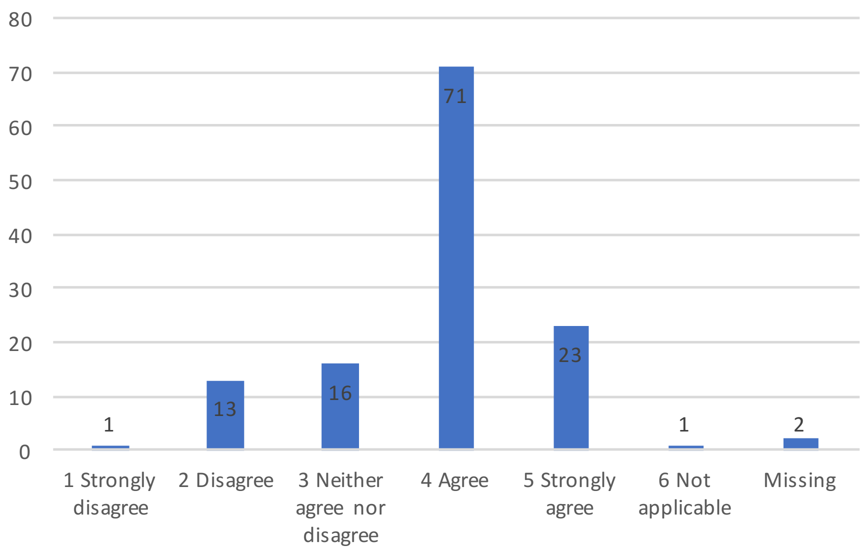


Figure 4 demonstrates that the majority of respondents either agreed (n = 58) or strongly agreed (n = 23) that the health service does a good job of training new personnel. Twenty neither agreed nor disagreed, while the remaining 26 either strongly agreed (n = 7), disagreed (n = 17) or did not see the statement as being applicable. There were no missing data for this item.

Item 5. All the necessary information for important decisions is routinely available to me.

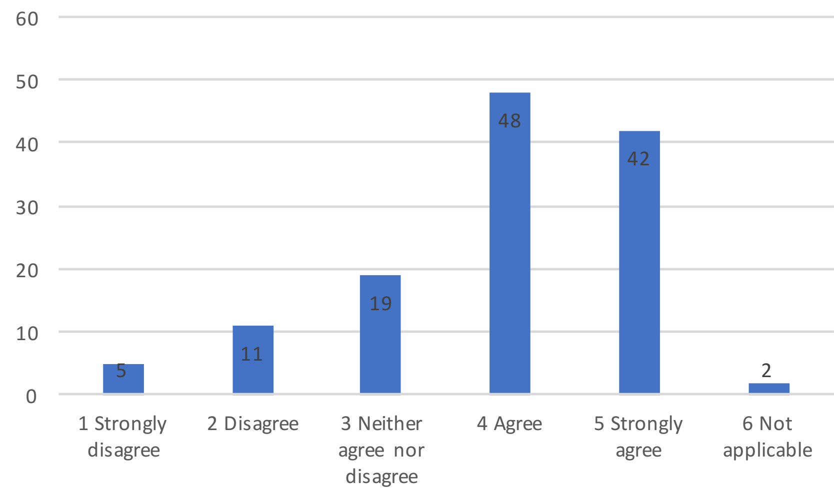
Figure 5 All the necessary information for important decisions is routinely available to me



Item 5 refers to whether all the necessary information for important decisions is routinely available to them. Again, the majority of respondents either agreed (n = 71) or strongly agreed (n = 23). Sixteen respondents responded neutrally and the remaining 15 respondents strongly disagreed (n = 1), disagreed (n = 13) or did not see the statement as applicable. There were 2 respondents that did not answer this item (see figure 5).

Item 6. Working in this health service is like being part of a large family.

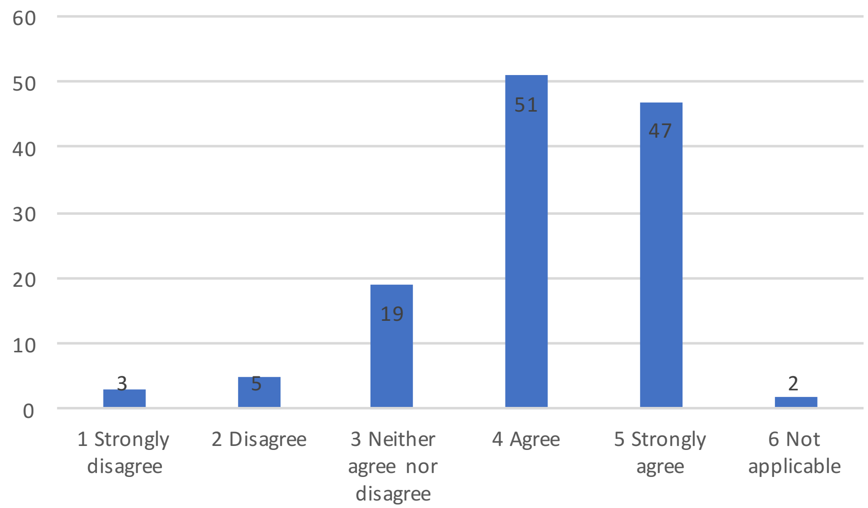
Figure 6 Working in this health service is like being part of a large family



When asked if working in the health service is like being part of a large family the majority either agreed (n = 48) or strongly agreed (n = 42). The remaining 37 participants either strongly disagreed (n = 5) disagreed (n = 11), neither agreed or disagreed (n = 19) or did not see the question as applicable (n = 2). There were no missing data for this item. (see figure 6)

Item 7. Nurse input is well received in my work area.

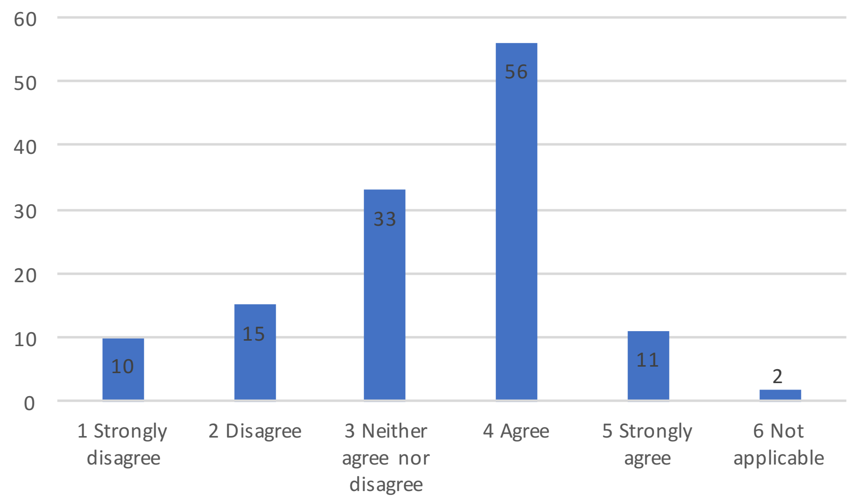
Figure 7 Nurse input is well received in my work area



As shown in figure 8, most of the respondents either agreed (n = 51) or strongly agreed (n = 47) that nurse input is well received in the work area. Nineteen respondents were neutral in their response and the remaining 10 respondents either strongly disagreed (n = 3), disagreed (n = 5) or did not rate the item as applicable to them. There were no missing data for this item.

Item 8. Health service management supports my daily efforts.

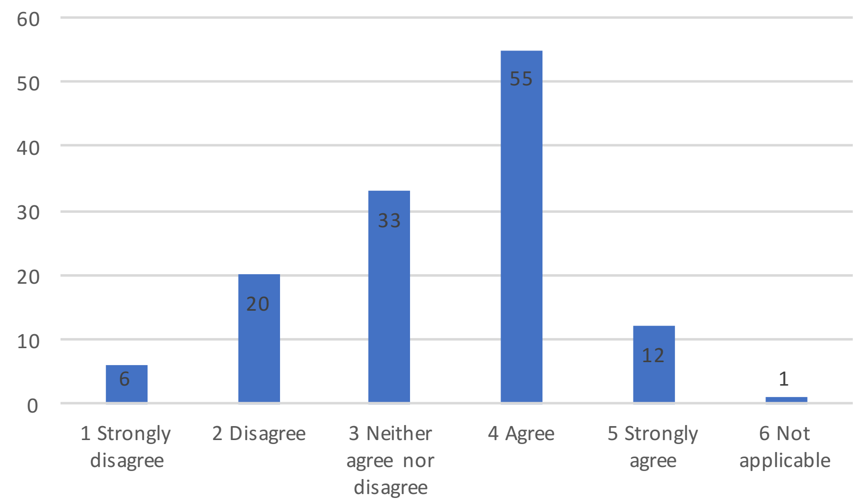
Figure 8 Health service management supports my daily efforts



When asked if the health service management supports their daily efforts, 56 respondents agreed and 33 neither agreed nor disagreed. Unlike previous items, only 11 respondents strongly agreed with the statement. The remaining 27 either strongly disagreed (n = 10), disagreed (n = 15) or responded that the item was not applicable. There were no missing data for this item.

Item 9. I receive appropriate feedback about my performance.

Figure 9 I receive appropriate feedback about my performance



Fifty-five respondents agreed that they received appropriate feedback about their performance. Whereas a large proportion of the respondents (n = 60) either strongly disagreed (n = 6), disagreed (n = 20) or were neutral (n = 33). Twelve participants strongly agreed that they received appropriate feedback and one indicated that the item was not applicable. There were no missing data for this item (see figure 9).

Item 10. In my work area, it is difficult to discuss errors.

Figure 10 In my work area, it is difficult to discuss errors

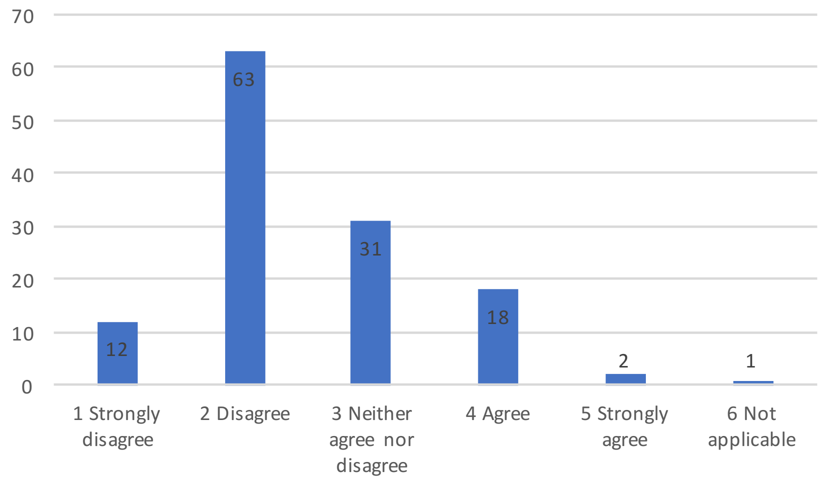
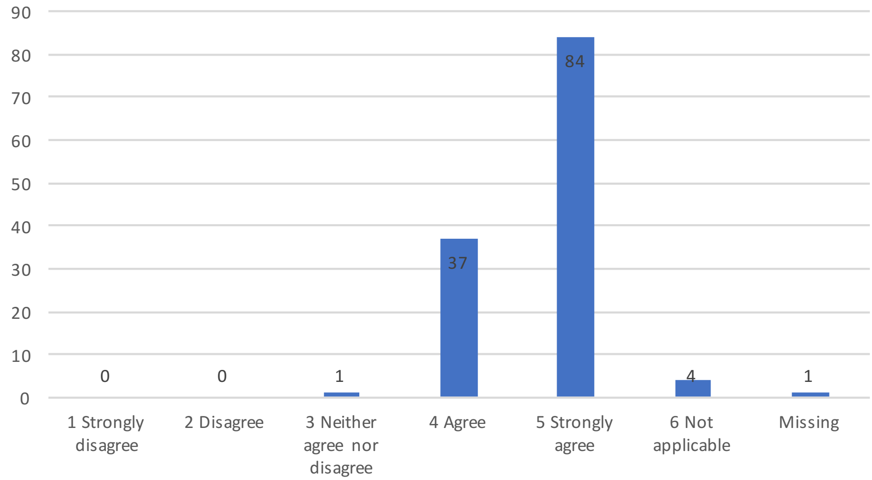


Figure 10 shows that the majority of respondents either strongly disagreed (n = 12) or disagreed (n = 63) that it was difficult to discuss errors in the work area. Thirty-one respondents neither agreed nor disagreed with the statement. The remaining 21 respondents either agreed (n = 18), strongly agreed (n = 2). The item was considered to be not applicable by a single respondent and there were no missing data for this item.

Item 11. Clinical handover is common in my work area.

Figure 11 Clinical handover is common in my work area.



None of the respondents disagreed that clinical handover is common in the work area, and the majority either agreed (n = 37) or strongly agreed (n = 84) with the statement. Four participants ranked the statement as not applicable and one participant did not respond to the question (see figure 11).

Item 12. This health service is a good place to work.

Figure 12 This health service is a good place to work.

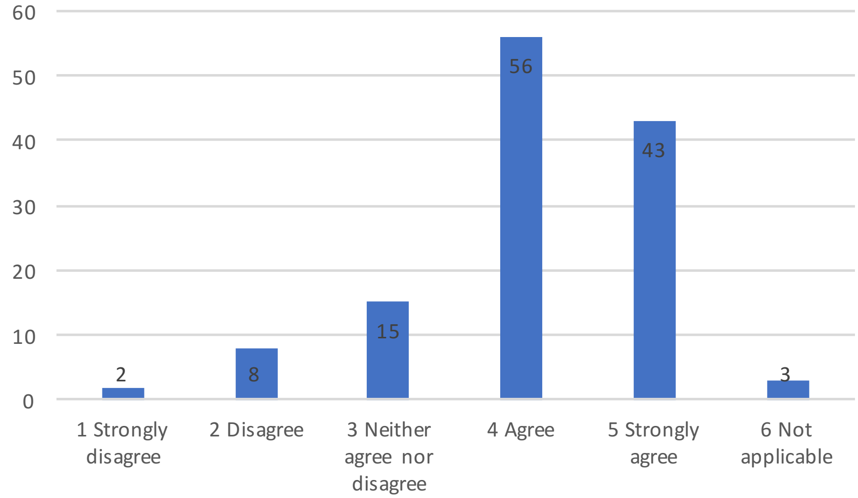
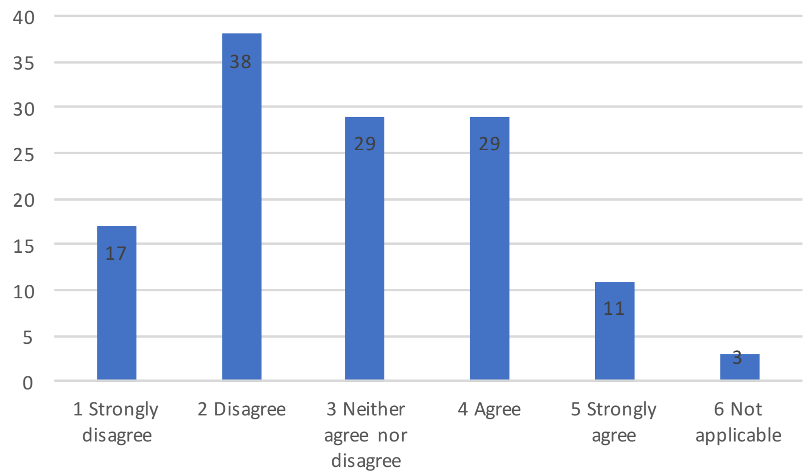


Figure 12 shows that the majority of respondents either agreed (n = 56) or strongly agreed that the health service is a good place to work. The remaining 28 respondents either strongly disagreed (n = 2), disagreed (n = 8), were neutral about the health service as a good place to work. The item was considered not applicable to three of the respondents. All 127 participants responded to the question.

Item 13. The levels of staffing in my work area are sufficient to handle the number of patients.

Figure 13 The levels of staffing in my work area are sufficient to handle the number of patients



When asked about whether the levels of staffing in their work area are sufficient to handle the number of patients, there was a strong shift towards respondents who either strongly disagreed (n = 17), disagreed (n = 38) or were neither in agreement nor disagreement (n = 29). Those who remained either agreed (n = 29) or strongly agreed (n = 11) that staffing was sufficient. Three participants did not think the item was applicable and there were no missing data.

Item 14. Decision making in my work area frequently utilises input from relevant personnel.

Figure 14 Decision making in my work area frequently utilises input from relevant personnel

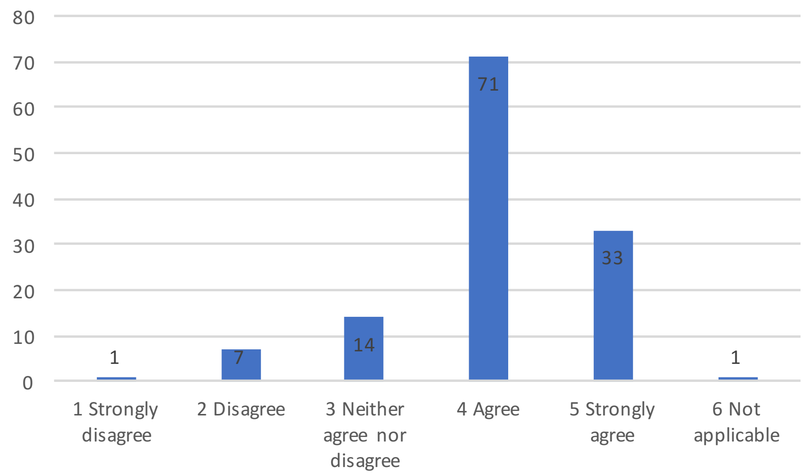
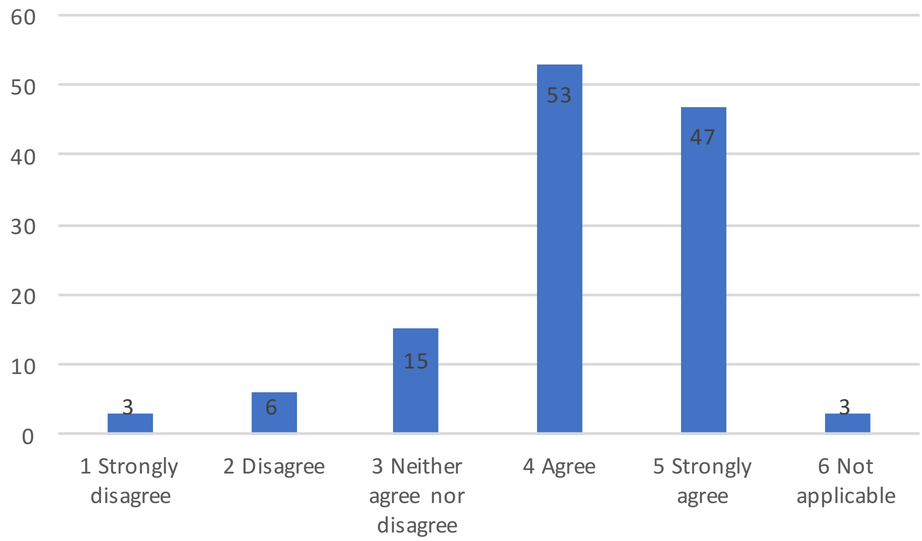


Figure 14 highlights that there was strong agreement the decision making in the work area frequently utilises input from relevant personnel. The majority either agreed (n = 71) or strongly agreed (n = 33) with the statement and the remaining 23 respondents either strongly disagreed (n = 1), disagreed (n = 7), neither agreed nor disagreed (n = 14) or considered the item not applicable. There were no missing data for this item.

Item 15. I am encouraged by my colleagues to report any patient safety concerns I may have.

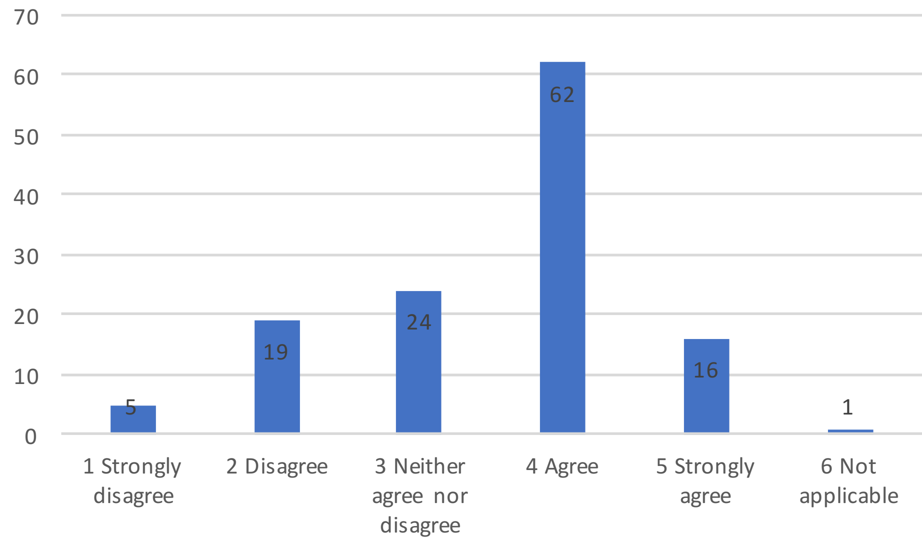
Figure 15 I am encouraged by my colleagues to report any patient safety concerns I may have



One hundred of the respondents indicated that they strongly agreed (n = 53) or agreed (n = 47) that they are encouraged by their colleagues to report any patient safety concerns they may have. Fifteen respondents were neutral about the statement and the remaining respondents either strongly disagreed (n = 3), disagreed (n = 6) or did not regard the statement as applicable. There were no missing data for this item.

Item 16. The culture in my work area makes it easy to learn from the errors of others.

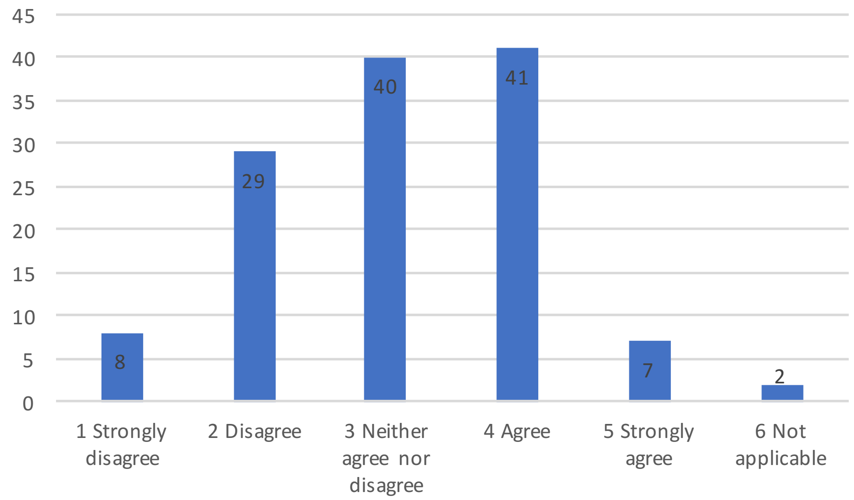
Figure 16 The culture in my work area makes it easy to learn from the errors of others



When asked if the culture in their work area makes it easy to learn from the errors of others, 62 agreed, 16 strongly agreed and there were 24 respondents who neither agreed nor disagreed with the statement. The remaining 25 respondents strongly disagreed (n = 5), disagreed (n = 19). There was one respondent that considered the statement to be not applicable. There were no missing data for this item (see figure 16).

Item 17. This health service deals constructively with problem staff/personnel.

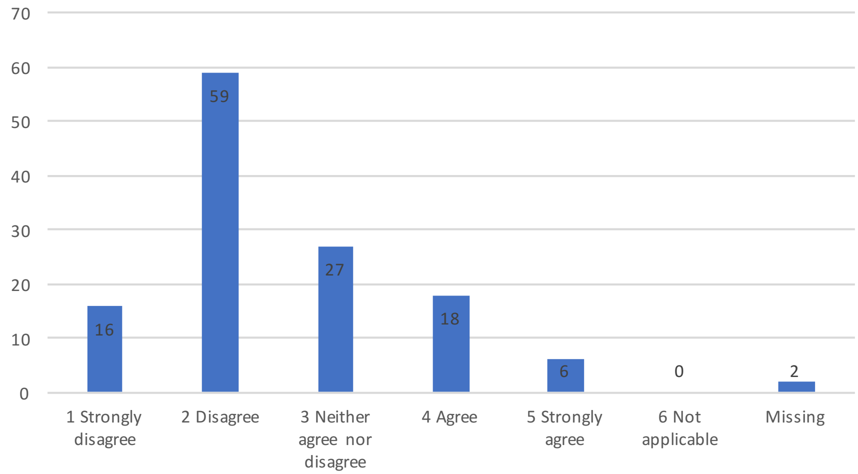
Figure 17 This health service deals constructively with problem staff/personnel.



when asked if the health service deals constructively with problem staff/personnel 41 participants agreed and an almost equal amount (n = 40) were neutral. The remaining respondents either strongly disagreed (n = 8), disagreed (n = 29), strongly agreed (n = 7) or indicated that the statement was not applicable (n = 2). There were no missing data for this item (see figure 17).

Item 18. In my work area, it is difficult to speak up if I perceive a problem with patient care.

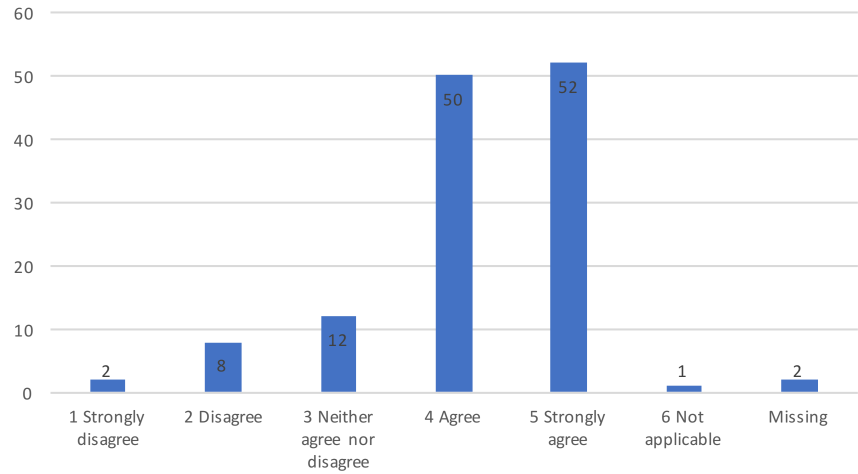
Figure 18 In my work area, it is difficult to speak up if I perceive a problem with patient care



The results of the negatively worded item in figure 18 enquires if it is difficult to speak up if respondents perceive a problem with patient care. The majority of participants either strongly disagreed (n = 16) or disagreed (n = 59). The remaining respondents were neutral (n = 27), agreed (n = 18) or strongly agreed (n = 6). There were 2 participants that did not respond to this item.

Item 19. When my workload becomes excessive, my performance is impaired.

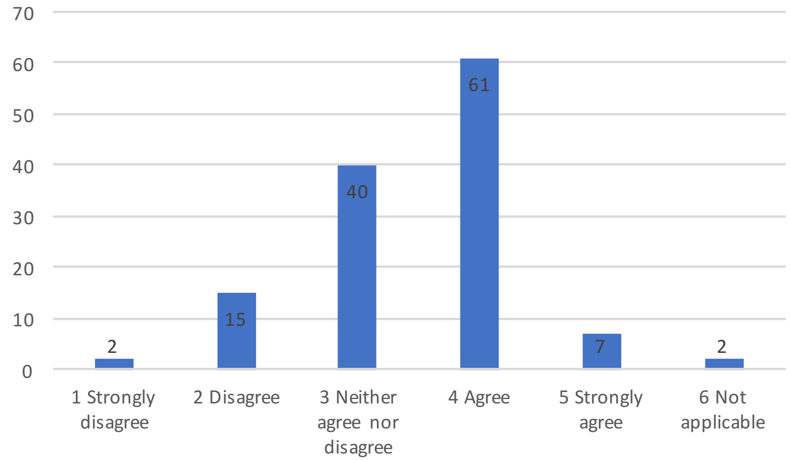
Figure 19 When my workload becomes excessive, my performance is impaired



Item 19 asked about as workload becomes excessive, respondent performance is impaired. The large majority of participants agreed (n = 50) or strongly agreed (n = 52) and 12 participants neither agreed nor disagreed. The remaining strongly disagreed (n = 2), disagreed (n = 8) or rated the item as not applicable (n = 1). Two respondents did not complete this item (see figure 19).

Item 20. I am provided with adequate, timely information about events in the health service that might affect my work.

Figure 20 I am provided with adequate, timely information about events in the health service that might affect my work



When asked if they were provided with adequate, timely information about events in the health service that might affect my work 61 respondents agreed and 40 remained neutral. The remaining either strongly disagreed (n = 2), disagreed (n = 15) or strongly disagreed (n = 7). There were two respondents that did not consider the item to be applicable. There were no missing data for this item (see figure 20).

Item 21. I know the proper channels to direct questions regarding patient safety.

Figure 21 I know the proper channels to direct questions regarding patient safety

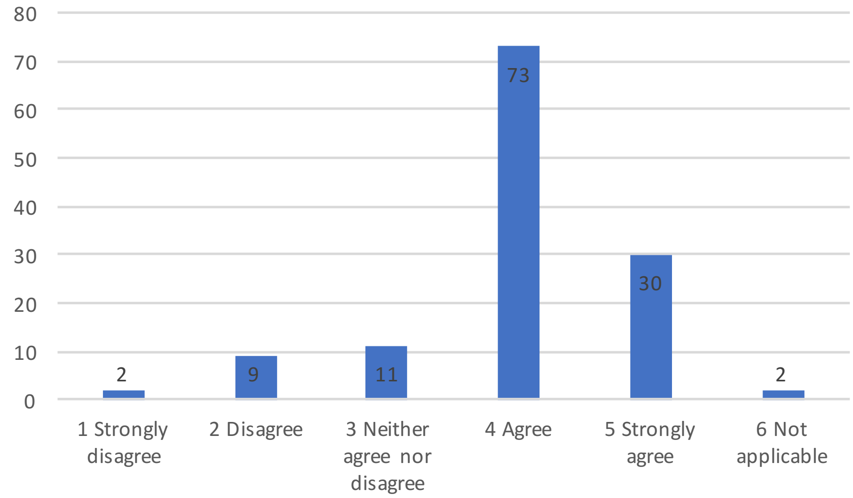
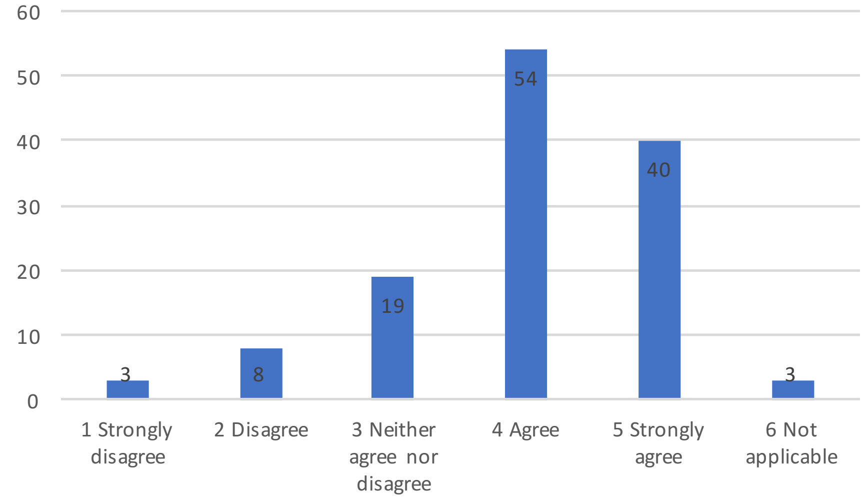


Figure 21 highlights that the majority of participants either agreed (n = 73) or strongly agreed (n = 30) that they know the proper channels to direct questions regarding patient safety. Eleven participants neither agreed nor disagreed with the statement, while the remaining strongly disagreed (n = 2), disagreed (n = 9) or did not see the item as applicable. There were no missing data for this item.

Item 22. I am proud to work at this health service.

Figure 22 I am proud to work at this health service



Ninety four respondents agreed (n = 54) or strongly agreed (n = 40) that they were proud to work at the health service. There were 19 responded as neither agreeing nor disagreeing with the statement. The remaining respondents strongly disagreed (n = 3), disagreed (n = 8) or found the statement to be not applicable (n = 3). There were no missing data for this item (see figure 22).

Item 23. Disagreements in my work area are resolved appropriately (i.e. not who is right, but what is best for the patient).

Figure 23 Disagreements in my work area are resolved appropriately (i.e. not who is right, but what is best for the patient)

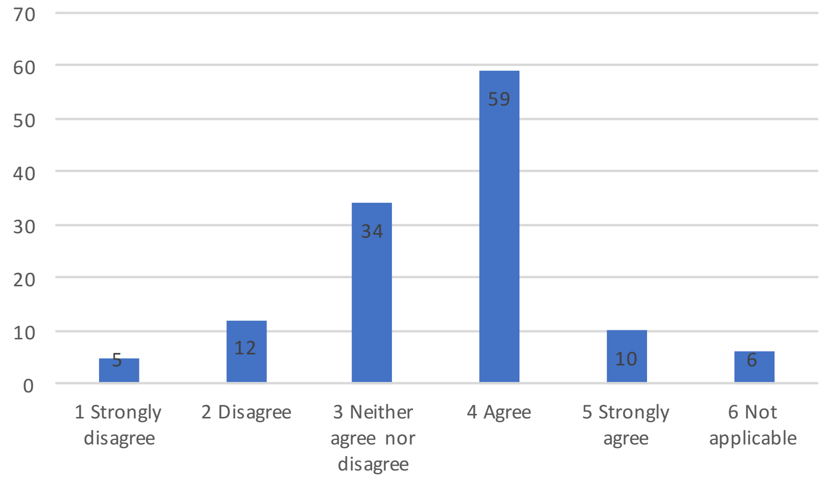


Figure 23 shows that 59 of the participants agreed that disagreements in their work area are resolved appropriately. Thirty four remained neutral about disagreement resolution and the remaining respondents either strongly disagreed (n = 5), disagreed (n = 12), strongly agreed (n = 10) or ranked the statement as not being applicable (n = 6). There were no missing data from this item.

Item 24. I am less effective at work when fatigued.

Figure 24 I am less effective at work when fatigued

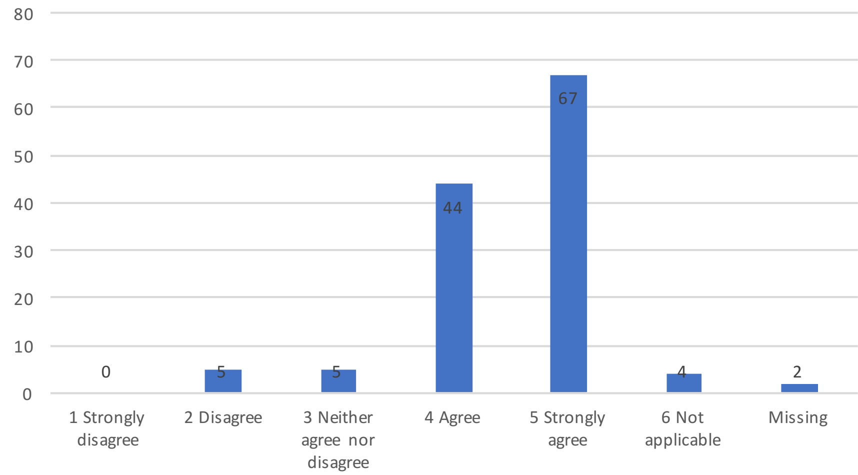
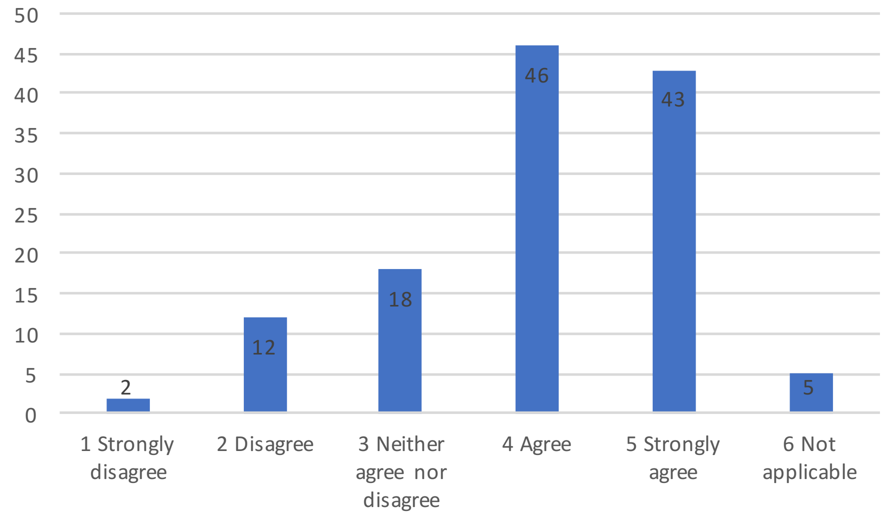


Figure 24 highlights that there was a majority of participants agreed (n = 44) and strongly agreed (n = 67) that they were less effective at work when fatigued. The remaining respondents either disagreed (n = 5), were neutral (n = 5) or indicated that the statement was not applicable (n = 4). There were no respondents that strongly disagreed and two occurrences of missing data.

Item 25. I am more likely to make errors in hostile or tense situations.

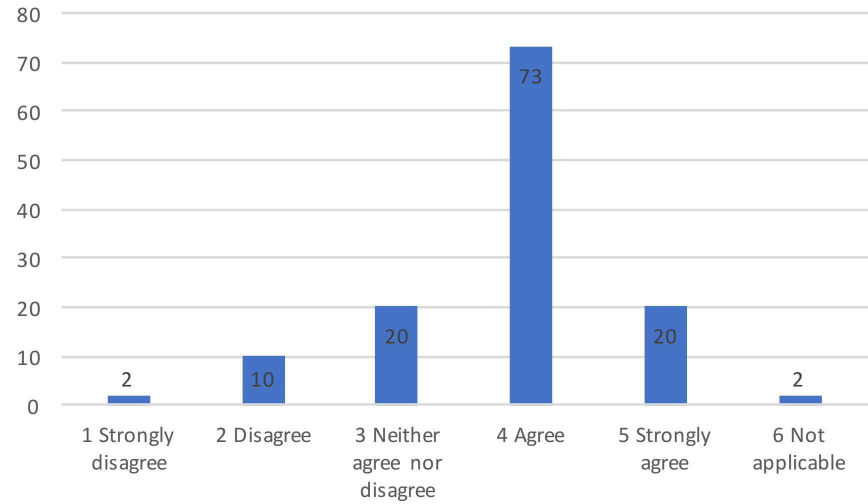
Figure 25 I am more likely to make errors in hostile or tense situations



When asked whether they were more likely to make errors in hostile or tense situations 89 participants responded with agree (n = 46) or strongly agree (n = 43). There were 18 participants that neither agreed nor disagreed and the remaining 19 respondents either strongly agreed (n = 2), disagreed (n = 12) or did not rate the statement as applicable to them. There were no missing data for this item (see figure 25).

Item 26. I have the support I need from other personnel to care for patients.

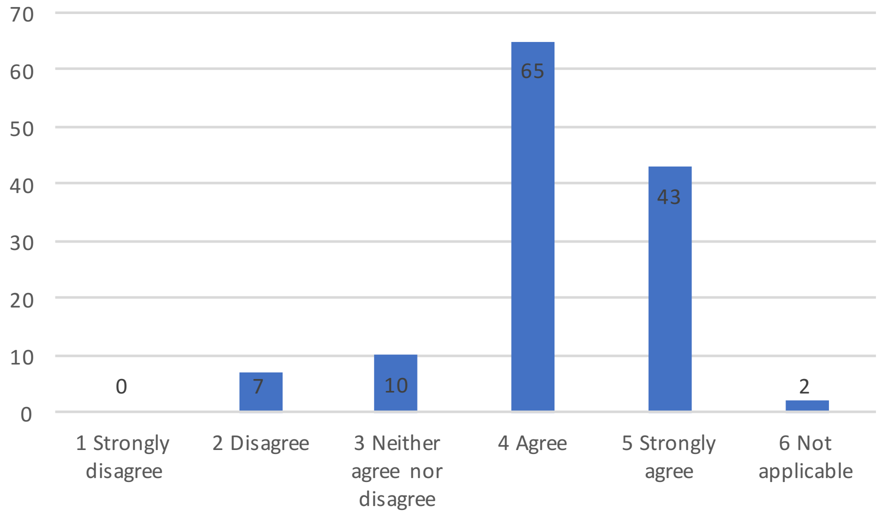
Figure 26 I have the support I need from other personnel to care for patients



More than half of the participants (n = 73) agree that have the support they need from other personnel to care for patients. An equal number of participants (n = 20) remained neutral or strongly agreed with the statement. The remaining 14 either strongly disagreed (n = 2), disagreed (n = 10) or did not consider the statement to be applicable. There were no missing data for this item (see figure 26).

Item 27. It is easy for personnel in my work area to ask questions when there is something that they do not understand.

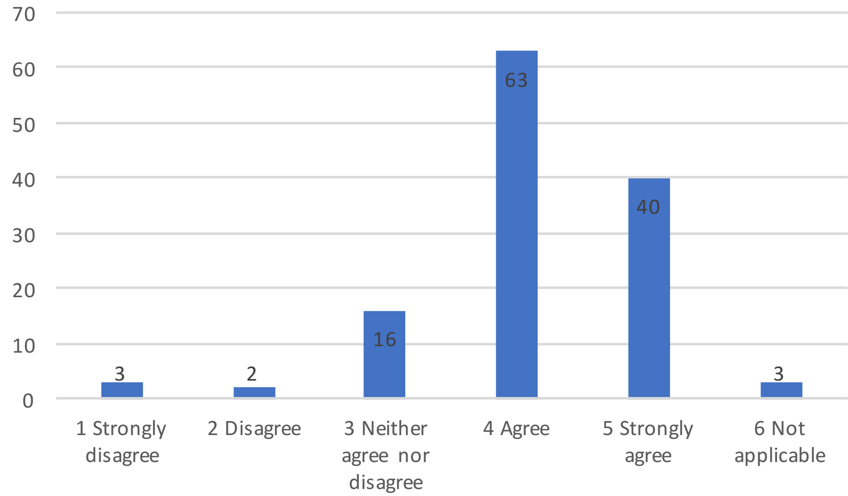
Figure 27 It is easy for personnel in my work area to ask questions when there is something that they do not understand



The majority of respondents agreed (n = 65) or strongly agreed (n = 43) that it is easy for personnel in their work area to ask questions when there is something that they do not understand. Ten people remained neutral, while the remaining participants either disagreed (n = 7) or did not see the statement to be applicable (n = 2). Nobody strongly disagreed and there were no missing data for this item (see figure 27)

Item 28. The doctors and nurses in this health service work together as a well-coordinated team.

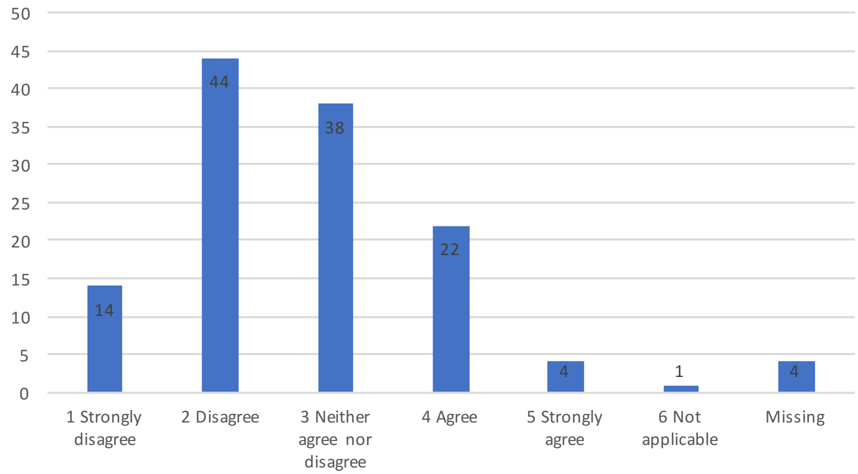
Figure 28 The doctors and nurses in this health service work together as a well-coordinated team



As is indicated by figure 28, there was a majority agreement that the doctors and nurses in the health service work together as a well-coordinated team, where 63 agreed and 40 strongly agreed. The remaining participants either strongly disagreed (n = 3), disagreed (n = 2), neither agreed nor disagreed (n = 16), while 3 respondents felt the statement was not applicable and there were no missing data for this item.

Item 29. I am frequently unable to express disagreement with doctors.

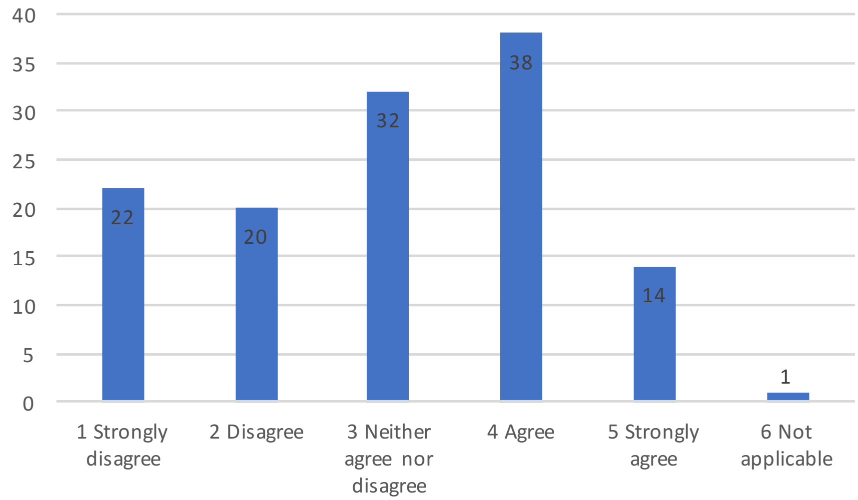
Figure 29 I am frequently unable to express disagreement with doctors



In another negatively worded statement, there was moderate disagreement about being frequently unable to express disagreement with doctors. Fifty eight either strongly disagreed (n = 14), disagreed (n = 44) and 38 participants remained neutral on this statement. The remaining respondents agreed (n = 4) or thought the item was not applicable. There were no missing data for this item.

Item 30. Morale in my work area is high.

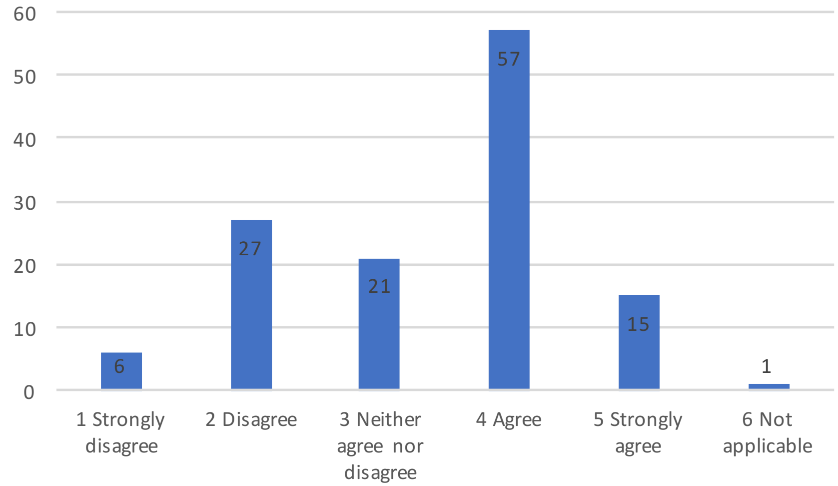
Figure 30 Morale in my work area is high



When asked if morale was high, there were 32 respondents that neither agreed nor disagreed, and was only a small difference between those who strongly disagreed (n = 20) and disagreed (n = 20) as opposed to those who agreed (n = 38) or strongly agreed (n = 14). A single participant considered the item to be not applicable and there were no missing data for this item.

Item 31. Trainees in my discipline are adequately supervised.

Figure 31 Trainees in my discipline are adequately supervised



There was slightly more variance when asked if trainees were in their own discipline are adequately supervised. There were 57 who agreed or strongly agreed (n = 15), as opposed to those who disagreed (n = 27) or strongly disagreed (n = 6). Twenty one participants neither agreed nor disagreed and one found the statement to be not applicable. There were no missing data for this item.

Item 32. I know the first and last names of all the personnel I worked with during my last shift.

Figure 32 I know the first and last names of all the personnel I worked with during my last shift

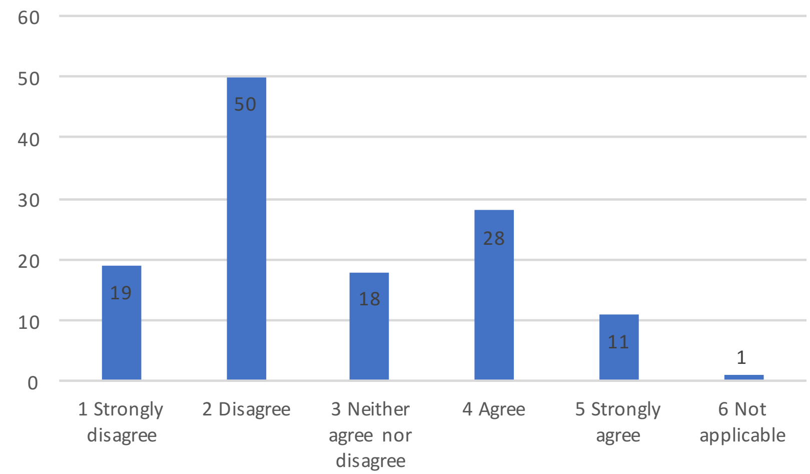
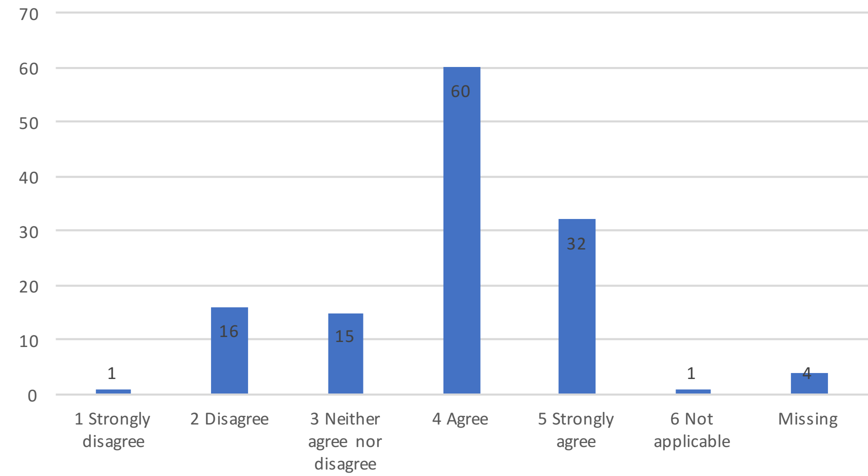


Figure 32 highlights that the majority of respondents either strongly disagreed (n = 19) or disagreed (n = 50) that they knew the first and last names of all the personnel they worked with during their last shift. On the other hand 39 either agreed (n = 28) or strongly agreed (n = 11). 1 person rated the statement as not applicable and there were no missing data for this item.

Item 33. Fatigue impairs my performance during emergency situations.

Figure 33 Fatigue impairs my performance during emergency situations



Again, in this item related to stress recognition, the majority of participants either agreed (n = 60) or strongly agreed (n = 32) that fatigue impairs their performance during emergency situations. There were fifteen participants that were neutral about the effects of fatigue on performance. The remaining either strongly disagreed (n = 1), disagreed (n = 16) or found the statement to be not applicable. There were four participants that did not respond to this item (see figure 33).

Item 34. Important issues are well communicated at shift changes/handovers.

Figure 34 Important issues are well communicated at shift changes/handovers

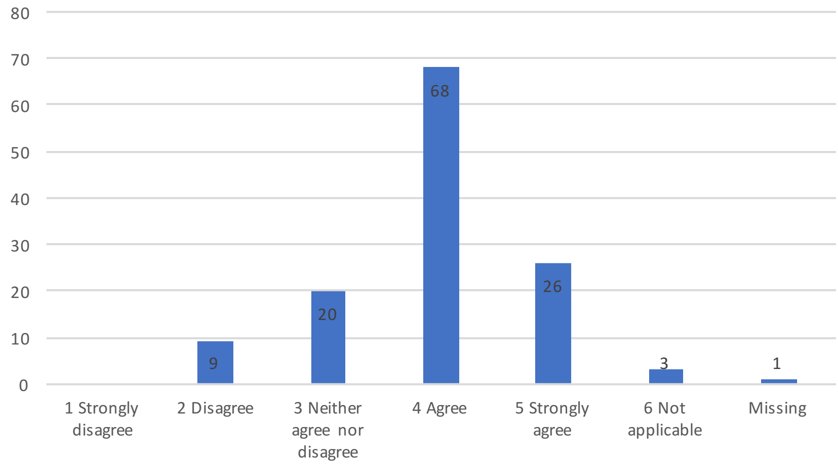
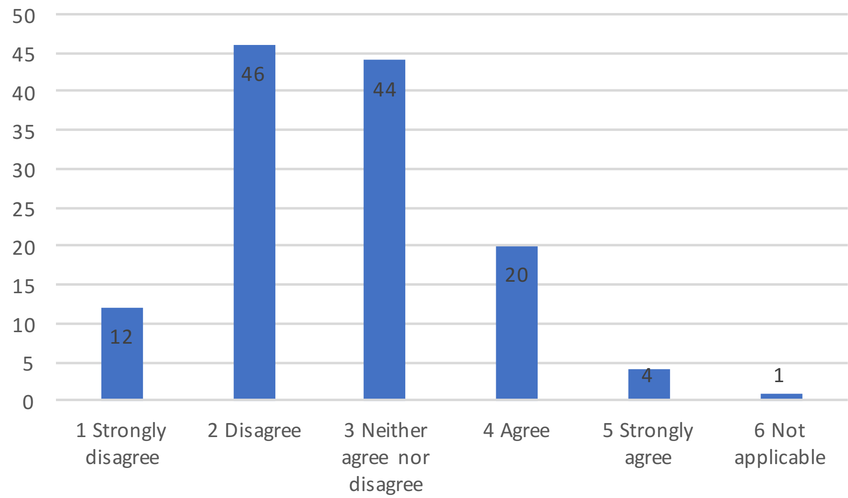


Figure 34 shows that the majority of participants either agree (n= 68) or strongly agree (n = 26) that important issues are well communicated at shift changes/handovers. No participants strongly disagreed and nine disagreed, while 20 participants responded neutrally. There were three who considered the statement to be not applicable and one person did not respond.

Item 35. Personnel frequently disregard rules or policies (e.g. treatment protocols/clinical pathways, sterile field, etc.) that are established for my work area.

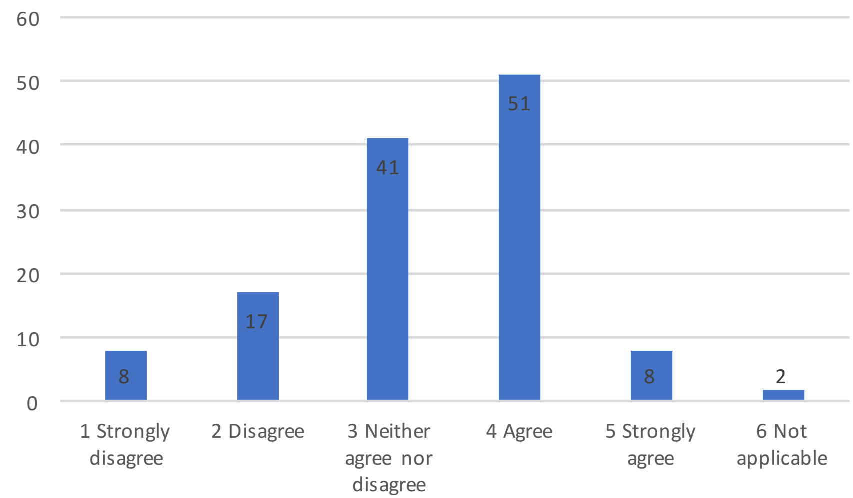
Figure 35 Personnel frequently disregard rules or policies (e.g. treatment protocols/clinical pathways, sterile field, etc.) that are established for my work area



There were a large number of respondents who neither agreed nor disagreed (n = 44) that personnel frequently disregard rules or policies that are established for the work area. Twelve people strongly disagreed and 46 disagreed. The remaining respondents agreed (n = 20), strongly agreed (n = 4) or thought the item was not applicable (n = 1). There were no missing data for this item (see figure 35)

Item 36. My suggestions about safety would be acted upon if I expressed them to management.

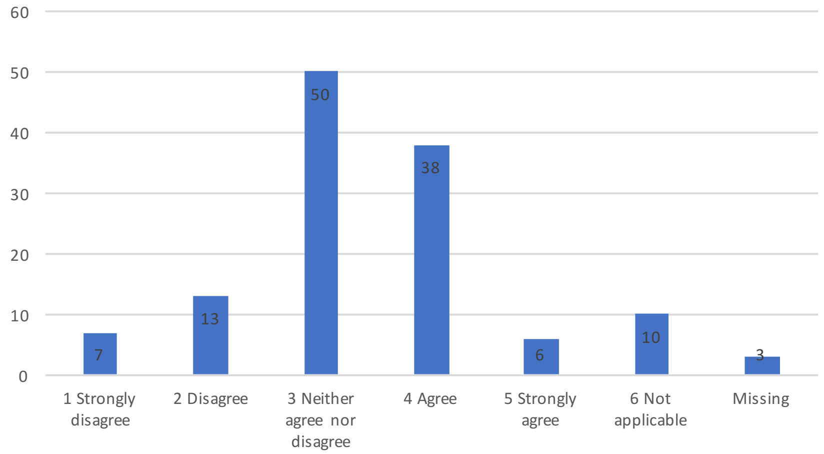
Figure 36 My suggestions about safety would be acted upon if I expressed them to management



Agreement related to participants' thoughts about whether their suggestions about safety would be acted upon if they expressed them to management varied. While 51 agreed and eight strongly agreed, 41 responded neutrally, eight strongly disagreed and two disagreed. There were two respondents that considered the statement to be not applicable and there were no missing data for this item (see figure 36).

Item 37. This health service is doing more for patient safety now, than it did one year ago.

Figure 37 This health service is doing more for patient safety now, than it did one year ago.



When asked whether health service is doing more for patient safety now, than it did one year ago the most frequent response was neutral (n = 50). Forty four either agreed (n = 38) or strongly agreed (n = 6), and of those who disagreed there were seven that strongly disagreed and 13 that disagreed. Ten responded that the statement was not applicable and there were 3 participants that did not respond to this item (see figure 37).

Item 38. I am satisfied with the quality of collaboration that I experience with nurses in my work area.

Figure 38 I am satisfied with the quality of collaboration that I experience with nurses in my work area

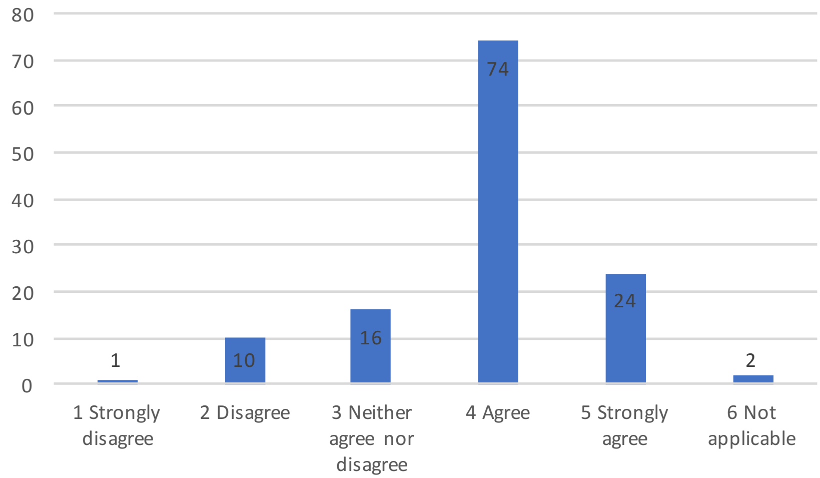
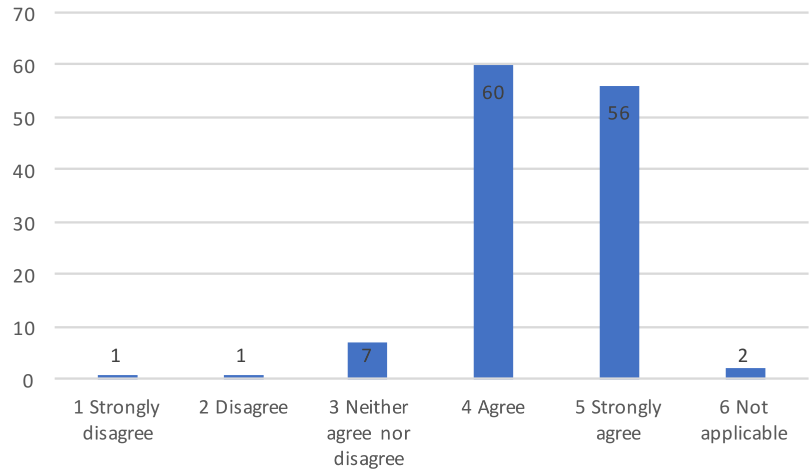


Figure 38 highlights that the majority of respondents agreed (n = 74) or strongly agreed (n = 24) that they were satisfied with the quality of collaboration that they experience with nurses in their work area. There were 16 participants that neither agreed nor disagreed. The remaining respondents strongly disagreed (n = 1), disagreed (n = 10) or did not think the statement was applicable. There were no missing data for this item.

Item 39. Briefing other personnel before the start of a shift or before a procedure is an important part of patient safety.

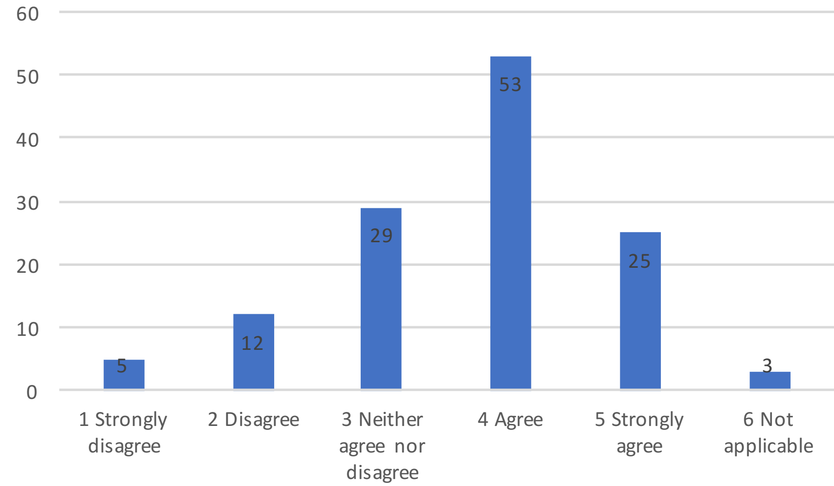
Figure 39 Briefing other personnel before the start of a shift or before a procedure is an important part of patient safety



There was an overwhelming majority of participants that either agreed (n = 60) or strongly agreed that briefing other personnel before the start of a shift or before a procedure is an important part of patient safety. There remaining respondents either strongly disagreed (n = 1), disagreed (n = 1), neither agreed nor disagreed (n = 7) or believed the item's statement to be not applicable. There were no missing data for this item (see figure 39).

Item 40. Leadership is driving us to be a safety-centred organisation.

Figure 40 Leadership is driving us to be a safety-centred organisation



When asked if leadership is driving towards a safety-centred organisation, respondents most frequently agreed (n = 53). There were, however, a moderate number of respondents who neither agreed nor disagreed (n = 29). Those who strongly agreed constituted 25 of the respondents and the remaining participants either strongly disagreed (n = 5), disagreed (n = 12) or believed the statement to be not applicable (n = 3). There were no missing data for this item (see figure 40).

Item 41. Executive management does not knowingly compromise the safety.

Figure 41 Executive management does not knowingly compromise the safety

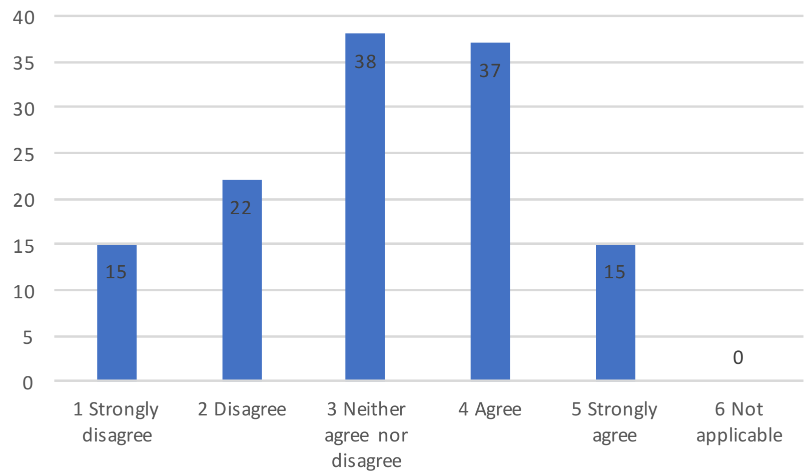
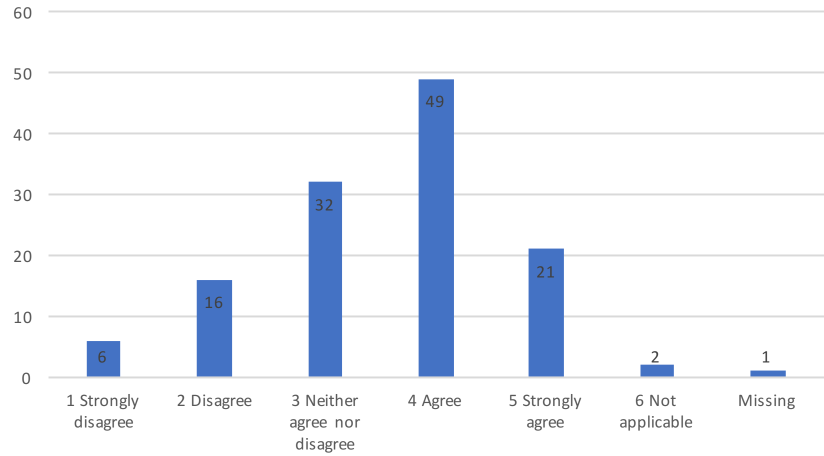


Figure 41 clearly shows that a neutral response was the most frequent (n = 38) when participants were asked if executive management does not knowingly compromise the safety. Thirty-seven agreed with this statement and 15 agreed. The remaining participants either strongly disagreed (n = 15), disagreed (n = 22) and there were no respondents that considered the statement as not applicable. There were also no missing data for this item.

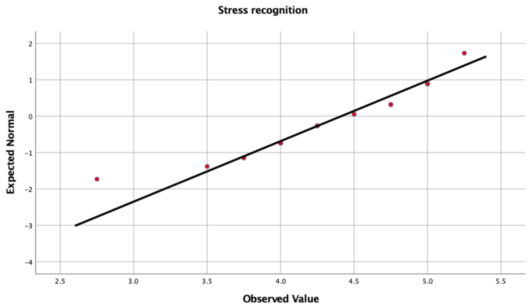
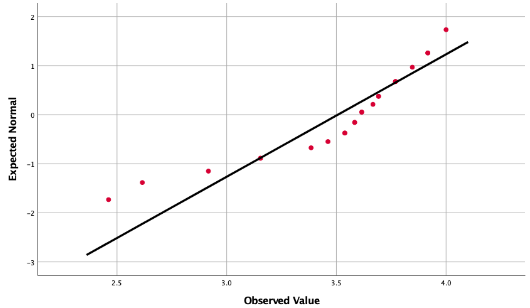
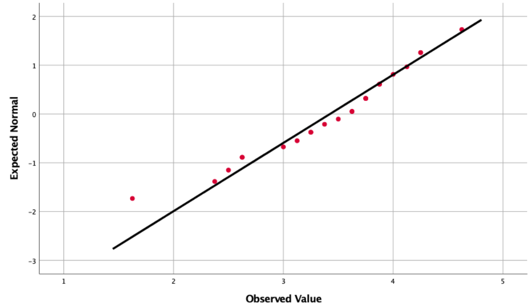
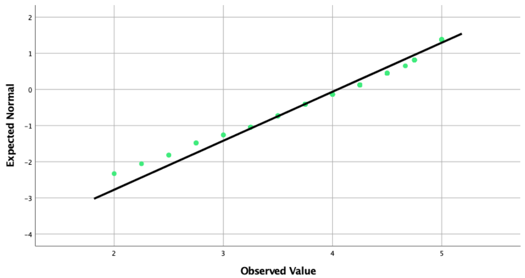
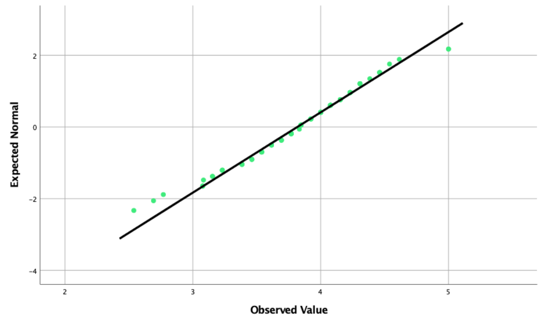
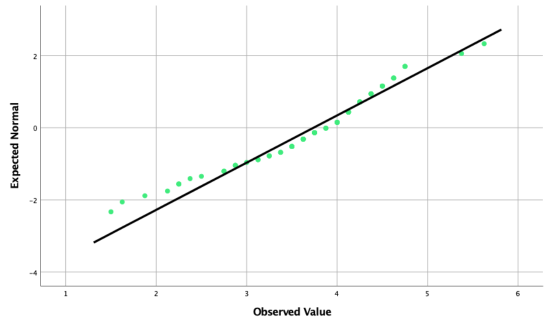
Item 42. Line managers in my work area do not knowingly compromise the safety of patients.

Figure 42 Line managers in my work area do not knowingly compromise the safety of patients

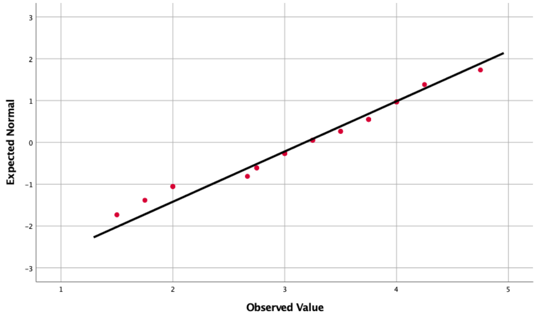
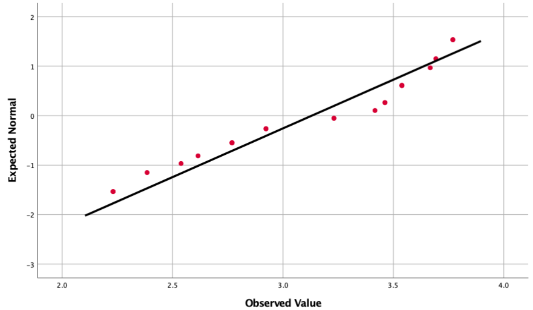
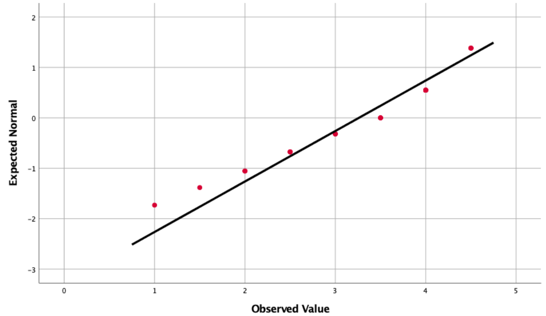
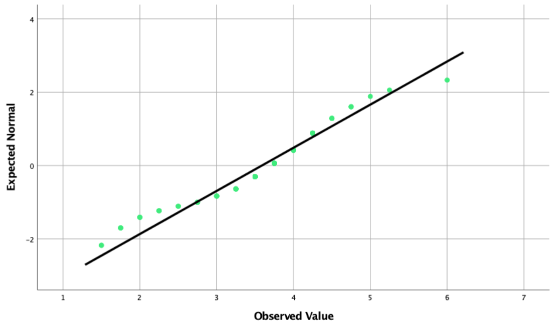
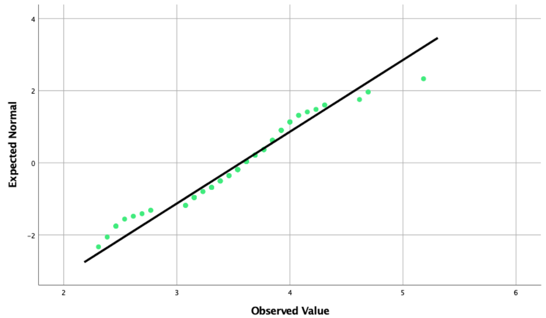
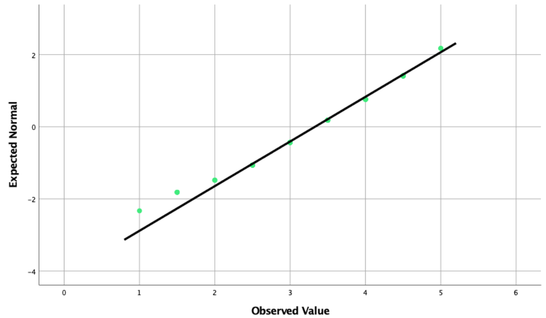


The results for the final item survey indicate that agreed (n = 49) and strongly agreed (n = 21) that line managers in their work area do not knowingly compromise the safety of patients. There were, however, 32 respondents who neither agreed nor disagreed. The raining respondents either strongly disagreed (n = 6), disagreed (n = 16 or found the statement to be not applicable (n = 2). There was one participant that did not respond to this item (see figure 42).

1.1. Normality Q-Q plots for doctors and nurses by survey domains

	Stress recognition	Team Climate	Job satisfaction
Doctors			
Nurses			

1.2. Normality Q-Q plots for doctors and nurses by survey domains

	Work conditions	**Safety Climate**	**Perception of management**
Doctors			
Nurses			

Appendix L. Safety Climate Survey Item and Domain Means

Table 2. Survey item and domain means

Domain Mean	Item Number	Item statement	Responses	Mean	Skewness
		Stress Recognition			
4.13	19	When my workload becomes excessive, my performance is impaired.	127	4.13	-1.156
	25	I am more likely to make errors in hostile or tense situations.	125	4.04	-.655
	24	I am less effective at work when fatigued.	126	4.03	-1.186
	33	Fatigue impairs my performance during emergency situations.	127	3.87	-.697
		Teamwork Climate			
3.76	11	Clinical handover is common in my work area.	127	4.72	-.483
	39	Briefing other personnel before the start of a shift or before a procedure is an important part of patient safety.	127	4.38	-1.100
	27	It is easy for personnel in my work area to ask questions when there is something that they do not understand.	127	4.18	-.786
	28	The doctors and nurses in this health service work together as a well-coordinated team.	127	4.13	-1.013
	7	Nurse input is well received in my work area.	127	4.1	-.992
	14	Decision making in my work area frequently utilises input from relevant personnel.	127	4.03	-.890
	34	Important issues are well communicated at shift changes/handovers.	125	3.95	-.358
	38	I am satisfied with the quality of collaboration that I experience with nurses in my work area.	124	3.91	-.702
	26	I have the support I need from other personnel to care for patients.	126	3.83	-.709
	23	Disagreements in my work area are resolved appropriately (i.e. not who is right, but what is best for the patient).	127	3.6	-.193
	18	In my work area, it is difficult to speak up if I perceive a problem with patient care.	127	3.48	.649
	29	I am frequently unable to express disagreement with doctors.	126	3.32	.410
	32	know the first and last names of all the personnel I worked with during my last shift.	127	2.72	.439
		Job Satisfaction			
3.7	2	I like my job.	127	4.37	-1.227
	12	This health service is a good place to work.	126	4.09	-.878
	22	I am proud to work at this health service.	127	4.02	-.817
	6	Working in this health service is like being part of a large family.	125	3.92	-.849
	20	I am provided with adequate, timely information about events in the health service that might affect my work.	125	3.49	-.239
	8	Health service management supports my daily efforts.	127	3.39	-.493
	41	Executive management does not knowingly compromise the safety of patients.	127	3.12	-.232
	30	Morale in my work area is high.	127	3.04	-.164

Working conditions					
3.5	5	All the necessary information for important decisions is routinely available to me.	127	3.84	-.750
	4	This health service does a good job of training new personnel.	127	3.62	-.616
	31	Trainees in my discipline are adequately supervised.	127	3.4	-.395
	17	This health service deals constructively with problem staff/personnel.	127	3.13	.017
Safety Climate					
3.49	1	I would feel safe being treated here as a patient.	127	4.26	-.591
	15	I am encouraged by my colleagues to report any patient safety concerns I may have.	127	4.13	-1.028
	21	I know the proper channels to direct questions regarding patient safety.	127	4.02	-.966
	3	Errors are handled appropriately in my work area.	127	3.8	-.599
	40	Leadership is driving us to be a safety-centred organisation.	127	3.71	-.495
	42	Line managers in my work area do not knowingly compromise the safety of patients.	127	3.55	-.392
	10	In my work area, it is difficult to discuss errors.	127	3.49	.790
	16	The culture in my work area makes it easy to learn from the errors of others.	127	3.45	-.583
	37	This health service is doing more for patient safety now, than it did one year ago.	127	3.43	.299
	9	I receive appropriate feedback about my performance.	127	3.39	-.421
	35	Personnel frequently disregard rules or policies (e.g. treatment protocols/clinical pathways, sterile field, etc.) that are established for my work area.	123	3.32	.460
	36	My suggestions about safety would be acted upon if I expressed them to management.	126	3.31	-.324
	13	The levels of staffing in my work area are sufficient to handle the number of patients.	127	2.91	.320
Perceptions of management					
3.34	20	I am provided with adequate, timely information about events in the health service that might affect my work.	125	3.49	-.239
	41	Executive management does not knowingly compromise the safety of patients.	127	3.12	-.232

Appendix M. All Medical Record Review Patient presenting problem

Table 1. Presenting problems allocated at triage

Presenting Problem	Frequency	Percent
Short of Breath	23	20.9
Febrile / PUO	11	10.0
Abdominal Pain	10	9.1
Fall	5	4.5
Generally Unwell	5	4.5
Alcohol related	4	3.6
Altered Consciousness	4	3.6
Cardiac Arrhythmia	4	3.6
Chest Pain - Cardiac	4	3.6
OD / Ingestion / Poison / Toxic exposure	4	3.6
Other / Specify	4	3.6
Chest Pain - Other	3	2.7
Back Pain	2	1.8
Convulsion	2	1.8
Cough	2	1.8
Dizziness	2	1.8
Fracture / Dislocation	2	1.8
GI Bleed (Upper/Lower)	2	1.8
Rash	2	1.8
Review (all)	2	1.8
Allergic Reaction	1	.9
Anxiety	1	.9
Burn / Scald / Chemical / Electrical	1	.9
Collapse	1	.9
Crying - distressed child/infant	1	.9
Diabetic Related Illness	1	.9
Leg Swelling	1	.9
Limb Injury	1	.9
Limb pain - no trauma	1	.9
MCA - Minor	1	.9
Urinary Retention	1	.9
Urine / Renal problem	1	.9
Vomiting	1	.9
Total	110	100.0

Table 2. ED Presenting Problem Association with Escalation Practices

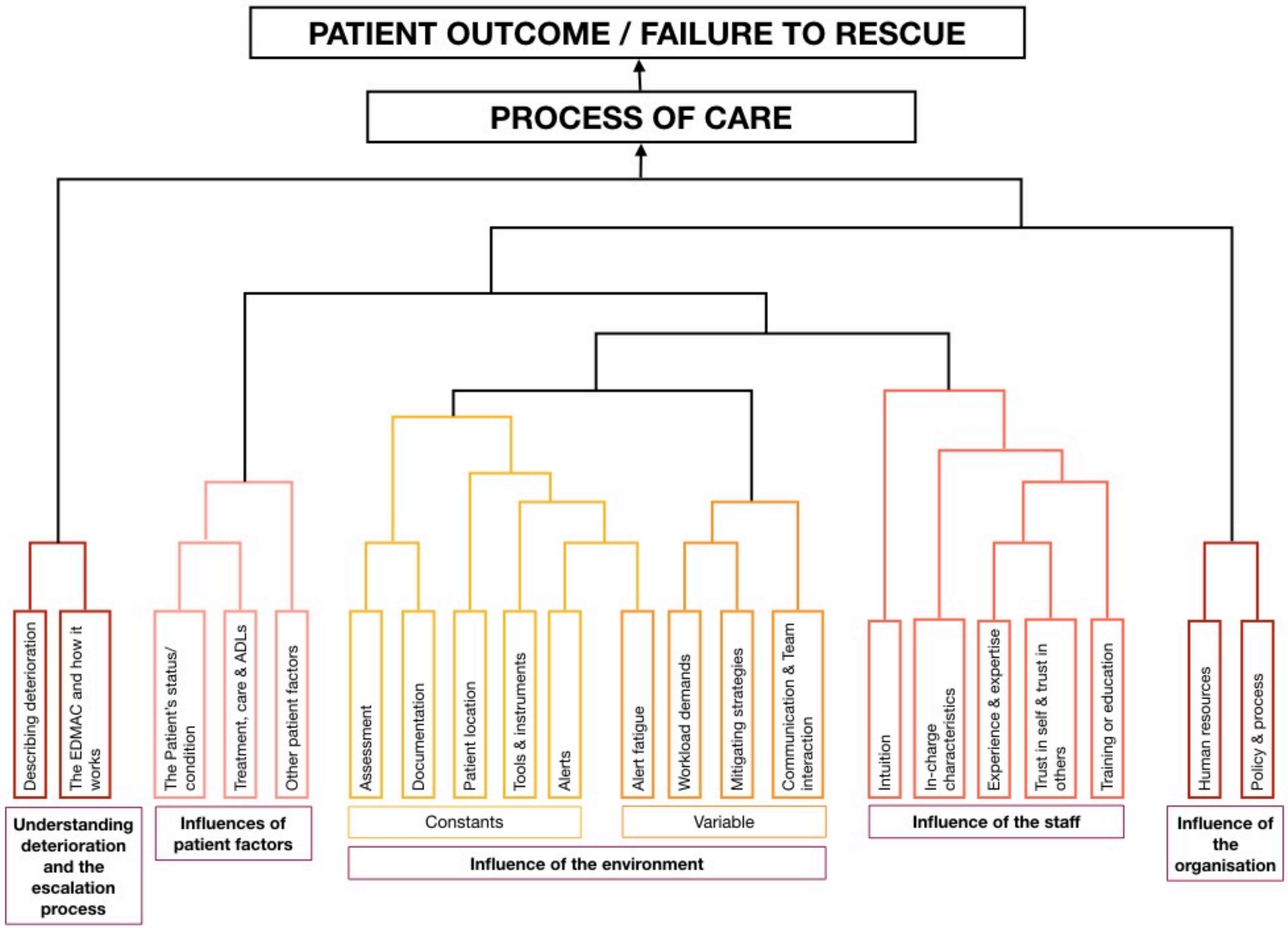
Presenting problem	Escalated	Not Escalated	Total	*p*
Abdominal Pain	6	4	10	
Alcohol related	1	3	4	
Allergic Reaction	1	0	1	
Altered Consciousness	4	0	4	
Anxiety	0	1	1	
Back Pain	2	0	2	
Burn / Scald / Chemical / Electrical	0	1	1	
Cardiac Arrhythmia	2	2	4	
Chest Pain - Cardiac	4	0	4	
Chest Pain - Other	1	2	3	
Collapse	0	1	1	
Convulsion	0	2	2	
Cough	1	1	2	
Crying - distressed child/infant	0	1	1	
Diabetic Related Illness	1	0	1	
Dizziness	1	1	2	
Fall	1	4	5	
Febrile / PUO	5	6	11	.585
Fracture / Dislocation	1	1	2	
Generally Unwell	3	2	5	
GI Bleed (Upper/Lower)	1	1	2	
Leg Swelling	1	0	1	
Limb Injury	1	0	1	
Limb pain - no trauma	0	1	1	
MCA - Minor	1	0	1	
OD / Ingestion / Poison / Toxic exposure	2	2	4	
Other / Specify	2	2	4	
Rash	1	1	2	
Review (all)	1	1	2	
Short of Breath	14	9	23	
Urinary Retention	0	1	1	
Urine / Renal problem	0	1	1	
Vomiting	0	1	1	
Total	58	52	110	

Appendix N. Interview participant details

		Doctor or Nurse		Level of competence					Role Description								Experience					
Interview ID	Interview length (minutes)	Doctor	Nurse	Novice	Advanced beginner	Competent	Proficient	Expert	RN[a]	CNS[b]	NIC[c]	Resident	CMO[d]	HMO[e]	Senior Registrar	Consultant in Charge	< 3 months	4 - 11 months	1 - 2 years	3 - 5 years	6 - 9 years	10 - 19 years
1	23		✓					✓														✓
2	34		✓			✓			✓									✓				
3	40		✓			✓											✓					
4	40	✓					✓												✓			
5	30		✓					✓	✓											✓		
6	42	✓						✓								✓						✓
7	34		✓					✓	✓													✓
8	27		✓					✓	✓											✓		
9	30		✓					✓									✓					
10	22	✓		✓								✓					✓					
11	18	✓		✓								✓					✓					
12	20		✓		✓				✓								✓					
13	28	✓					✓						✓									✓
14	40		✓	✓					✓									✓				
15	37	✓						✓								✓						✓
16	41		✓					✓			✓											✓
17	34		✓					✓	✓													✓
18	25	✓		✓										✓			✓					
19	36		✓					✓			✓									✓		
20	36	✓						✓								✓					✓	
21	32		✓			✓			✓										✓			
22	25		✓		✓				✓											✓		
23	33	✓					✓								✓					✓		
24	17		✓					✓	✓													✓
25	26		✓		✓				✓									✓				
26	33		✓			✓			✓										✓			
27	25		✓			✓			✓										✓			
28	25		✓			✓			✓										✓			
29	39		✓					✓	✓													✓
30	27		✓					✓		✓											✓	
31	43	✓						✓								✓						✓

[a] Registered Nurse, [b] Clinical Nurse Specialist, [c] Career Medical Officer, [d] Registered nurse, [e] House Medical Officer

Appendix O. Interview Themes and Sub-themes Relationships Dendrogram



Appendix P. Plan for Dissemination of Findings and Translation to Practice

The outcomes and recommendations from this thesis will be disseminated according to the following plan.

1. The results of the research will be disseminated:
   - As the final thesis submitted for examination by the PhD candidate,
   - By anonymised publication/s in peer reviewed academic journals
     - Quantitative papers
       - MRR results – Emergency care journal
       - Safety Climate Survey – Quality and safety journal
     - Qualitative paper
       - Interview Results – Emergency care journal
     - Mixed Methods Paper – quality and safety journal
   - Through anonymised presentation at relevant conferences
     - ANZICS Quality and Safety Conference 2019 - Abstract submitted
     - 17th International Conference for Emergency Nurses (ICEN) 2019 – Abstract submitted
   - In a final written report to the site ED management team and face-to-face presentation to staff and participants
2. The PhD candidate plans to pursue research funding for future translation of the study outcomes to practice and policy.