Responding to the deteriorating patient: A case study

By

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Abstract

Rapid response systems (RRSs) have been developed and implemented with the aim of improving recognition of and response to deteriorating patients. However, there is little evidence to support the effectiveness of such systems. A recurring theme within the clinical literature is that these systems are not activated or used effectively by nursing staff and the reasons for this are not fully understood. The practices of nurses who used an RRS are explored in this thesis. Ward patients also appear to be more vulnerable to deterioration in the hospital after-hours; in response to this, a number of patient safety initiatives have been developed. One of these initiatives is an after-hours nurse-led RRS, a service run by Advanced Practice Nurses (APNs). To date, there has been limited exploration of the impact of this patient safety initiative on patient outcomes. Whether the introduction the APN after-hours service improved patient outcomes is also explored in this thesis.

To develop in-depth knowledge and understanding of this contemporary and complex area of clinical practice, a single exploratory case study with two separate units of analysis was used. The context of the case was a large teaching hospital in Queensland; the case was the deteriorating ward patient. The first unit of analysis was nurse’s practices of using an RRS. The second unit of analysis was patient outcomes. In the first unit of analysis, 15 registered nurses who had cared for a deteriorating ward patient were interviewed about their practices of using an RRS and the resulting transcripts were thematically analysed. Four themes relating to participants experiences and perceptions of RRSs emerged from the data. These themes were: (1) sensing clinical deterioration; (2) resisting and hesitating; (3) pushing the button; and (4) reflecting on the Medical Emergency Team (MET).
The impact of the APN after-hours service on patient outcomes was explored in the second unit of analysis. A retrospective chart review of 300 patients’ medical charts was performed. A number of findings emerged from the chart review. The review revealed far greater proportion of adverse events than expected. While the charts reviewed were primarily of older, medical patients with increased risk of deterioration, the finding helps illustrate the need for continued education, support, and ongoing research in response to patient deterioration. The findings also included a greater number of major adverse events (MAEs), such as unplanned admission to the intensive care unit (ICU), after the APN after-hours service was implemented than before it was introduced. Analysis suggested that the introduction of the after-hours APN service might have been associated with an increase in surveillance of ward patients. Multiple logistic analysis demonstrated that changes in heart rate and reduction in Glasgow Coma Score (GCS) were significant predictors of an adverse event. Significant predictors of an MAE were low urine output and a drop of 2 or more in the GCS. Despite the illustration of the importance of clinical measure such as urine output and GCS, both significant and important predictors of clinical deterioration, these clinical parameters were frequently not documented on clinical records both prior to and following the introduction of the APN after-hours service.

Overall, the findings reported in this thesis confirm that RRSs are underutilised by nurses and this contributes to failure of these systems in reducing MAEs. This exposes the deteriorating patient to suboptimal care and increases the risk of MAEs and adverse events. Based on the findings presented in this thesis, a series of recommendations for how these deficits in the care and management of deteriorating ward patients can be proactively addressed by researchers, educationalists, and clinicians are presented in the thesis.
Statement of originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Deborah Louise Massey
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## Abbreviations

<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACSQHC</td>
<td>Australian Commission on Safety and Quality in Health Care</td>
</tr>
<tr>
<td>ALERT</td>
<td>Acute Life-threatening Events: Recognition and Treatment</td>
</tr>
<tr>
<td>APN</td>
<td>Advanced Practice Nurse</td>
</tr>
<tr>
<td>APO</td>
<td>acute pulmonary oedema</td>
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<tr>
<td>bpm</td>
<td>beats per minute</td>
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<tr>
<td>CCO</td>
<td>Critical Care Outreach</td>
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<tr>
<td>CCOT</td>
<td>Critical Care Outreach Team</td>
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<td>CCU</td>
<td>coronary care unit</td>
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<tr>
<td>CVA</td>
<td>cerebral vascular accident</td>
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<td>DVT</td>
<td>deep vein thrombosis</td>
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<tr>
<td>ED</td>
<td>emergency department</td>
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<tr>
<td>EWS</td>
<td>Early Warning Score</td>
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<td>GCS</td>
<td>Glasgow Coma Score</td>
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<tr>
<td>HDU</td>
<td>high dependency unit</td>
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<tr>
<td>HR</td>
<td>heart rate</td>
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<tr>
<td>HREC</td>
<td>Human Research Ethics Committee</td>
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<tr>
<td>ICU</td>
<td>intensive care unit</td>
</tr>
<tr>
<td>IHI</td>
<td>Institute for Healthcare Improvement</td>
</tr>
<tr>
<td>IQR</td>
<td>interquartile range</td>
</tr>
<tr>
<td>LOS</td>
<td>length of stay</td>
</tr>
<tr>
<td>MAE</td>
<td>major adverse event</td>
</tr>
<tr>
<td>MDC</td>
<td>Major Diagnostic Category</td>
</tr>
<tr>
<td>MET</td>
<td>Medical Emergency Team</td>
</tr>
<tr>
<td>MEWS</td>
<td>Modified Early Warning Score</td>
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<tr>
<td>MI</td>
<td>myocardial infarction</td>
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<tr>
<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>NCEPOD</td>
<td>National Confidential Enquiry into Patient Outcome and Death</td>
</tr>
<tr>
<td>NICE</td>
<td>National Institute for Clinical Effectiveness</td>
</tr>
<tr>
<td>NNP</td>
<td>Night Nurse Practitioner</td>
</tr>
<tr>
<td>NUM</td>
<td>Nurse Unit Manager</td>
</tr>
<tr>
<td>O₂ sats</td>
<td>oxygen saturations</td>
</tr>
<tr>
<td>PE</td>
<td>pulmonary embolism</td>
</tr>
<tr>
<td>PSS</td>
<td>patient surveillance system</td>
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<tr>
<td>RN</td>
<td>registered nurse</td>
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<tr>
<td>RR</td>
<td>respiratory rate</td>
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<tr>
<td>RRS</td>
<td>rapid response system</td>
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<tr>
<td>RRT</td>
<td>Rapid Response Team</td>
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<tr>
<td>S/B/P</td>
<td>systolic blood pressure</td>
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<tr>
<td>TTS</td>
<td>track and trigger system</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>UO</td>
<td>urine output</td>
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Dissemination of study results

Refereed publications


Conference presentations


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Chapter 1: Introduction

Introduction

Acute hospitals now have increasing numbers of patients with complex care needs, and these patients are at risk of clinical deterioration. Technological developments, an aging population and economic rationalisation are all factors contributing to increasing patient acuity on hospital wards. Several studies have demonstrated that patients who deteriorate on hospital wards exhibit premonitory signs of physical decline many hours before this clinical deterioration (Franklin & Mathew, 1994; Hodgetts, Kenward, Vlachonikolis, Payne, & Castle, 2002; McGloin, Adam, & Singer, 1999). Failure to escalate care for patients at risk of clinical deterioration contributes to negative patient outcomes (McGloin et al., 1999). This failure to escalate care may be explained by a number of factors. For example, clinical staff may lack the knowledge and skills required to safely and effectively manage the deteriorating patient, clinical staff may not have access to the appropriate resources, there may be inefficient systems for accessing appropriate help and support, or there may be a lack of appropriate supervision. Whatever the reasons, failure to escalate care for the deteriorating patient can have devastating consequences; it may lead to death (Ehsani, Jackson, & Duckett, 2006; Forster, Murff, Peterson, Gandhi, & Bates, 2003; Vincent, Neale, & Woloshynowycz, 2001; Wilson, Harrison, Gibberd, & Hamilton, 1999), increased length of hospital stay (McGloin et al., 1999), or decreased quality of life (Vincent et al., 2001), together with a significant increase in health-care costs (Baker et al., 2004; Brennan et al., 2004; Wilson et al., 1999).

In response to this recognised threat to safe, high-quality care, a number of patient safety systems have been developed and implemented. The most well known is the Rapid Response System (RRS). An RRS is a patient safety initiative aimed at improving the care
and management of the deteriorating ward patient (DeVita et al., 2010). An RRS provides a safety net for patients who deteriorate suddenly, and develop complex clinical care needs that may be outside the scope of clinical staffs’ knowledge and skills (DeVita et al., 2006).

At a minimum, RRSs must have an afferent (detection of patient deterioration) limb and efferent (response to patient deterioration) limb. Detection of patient deterioration (the afferent limb) utilises a set of predetermined objective criteria that involve the assessment, measurement, and documentation of patients’ vital signs (Cretikos et al., 2008; Cuthbertson, Boroujerdi, McKie, Aucott, & Prescott, 2007; DeVita et al., 2010;). These criteria are increasingly referred to as a track and trigger systems (TTS) (DeVita et al., 2010; Gao et al., 2007).

The efferent limb of an RRS directs response to the deteriorating patient. The two most common types of efferent limb systems are the “high capability team” and the “ramp up team” (Devita et al 2006). A high capability team is physician led (Cretikos & Hillman, 2003; Lee et al., 1995) whilst, ramp up teams are primarily nurse led (Coombs & Dillon, 2002; DeVita et al., 2006; McArthur-Rouse, 2001; Robson, 2002). The Medical Emergency Team (MET) is an example of a high capability team. The Critical Care Outreach Team, the Intensive Care Liaison Nurse, and the after-hours advanced practice nurse service are all examples of a ramp up team. The key aims of an RRS are to improve the care and management of the deteriorating patient by averting admission to critical care units, facilitating discharge from a critical care facility and sharing critical care skills throughout the hospital (DeVita et al., 2006).

Nurses are integral to the success of an RRS in reducing the negative patient outcomes and associated life-threatening clinical deterioration. However, nurses appear resistant to these systems (Hillman et al., 2005; Massey, Aitken, & Chaboyer, 2010) and there is a lack of research exploring the reasons for their resistance. This study reported in this thesis
responded to the need to explore and describe nurses’ knowledge, understanding, and practices in relation to recognising and responding to the deteriorating patient. The research, designed as a case study, is divided into two separate units of analysis. The first unit of analysis explored nurses’ practices and attitudes to RRSs. The second unit of analysis explored the effect of a nurse-led RRS in the hospital out-of-hours. An introduction to the study, including background, a statement of the research problem, and an outline of the significance of the work to be undertaken are presented in this chapter.

**Background**

Technological developments, an aging population, and economic rationalisation have changed the way that health care is delivered in Australia (Sinuff, Kahnamoui, Cook, Luce, & Levy, 2004). These changes have created challenges in the delivery of health care over the previous decade that have increased the demand for hospital beds and the episodes of hospital admissions (weighted separations) in both the private and public health-care sectors. During 2006–2011, the number of patient days in public acute hospitals increased by 13.3%; in private hospitals, the number increased by 21.5% (Australian Institute of Health and Welfare, 2012). The average length of stay (LOS) for acute care in public hospitals (excluding day procedures) decreased from 3.7 days in 1996–1997 to 3.0 days in 2010–2011 (Australian Institute of Health and Welfare 2012).

Another significant demographic factor influencing health care in Australia is the decline in mortality, which has contributed to significant growth in the number of people in older age groups. During the past several decades, the number and proportion of the population aged 65 years and over have risen considerably. In 2009, more than 2.9 million Australians (13.3%) were 65 years or over, compared with slightly fewer than 1.1 million (8.3%) in 1971. The increase in the population aged 85 years or older has been even more
marked, with the number of people in this age group increasing more than fivefold over the same period (Australian Institute of Health and Welfare 2012).

Economic rationalisation may result in insufficient health-care resources in hospitals, which in turn means that patients who would benefit from those resources (for example, a critical care bed) do not have access to them and the patient remains on the hospital ward (Sinuff et al., 2004). The increasing demand for hospital beds, coupled with an ageing population and shorter hospital stays, has resulted in increased patient acuity (Australian Institute of Health and Welfare, 2012). Inpatients now have more complex clinical care needs and a greater number of co-morbidities than at any other time in the past (Hillman, 1999; Hillman, Chen, & Brown, 2003). Because of their complex clinical care needs; hospitalised ward patients have an increased risk of life-threatening clinical deterioration, which significantly effects their morbidity and mortality (Bucknall, Jones, Bellomo, & Staples, 2012; Buist & Bellomo, 2004).

The increase in patient acuity impacts on clinical practice in a number of ways. First, clinical staff may not have the knowledge or skills to safely identify the deteriorating patient (Daffurn, Lee, Hillman, Bishop, & Bauman, 1994; Levett-Jones et al., 2010). Second, clinical staff may lack the knowledge or skills to safely care for these patients (Smith, Osgood, & Crane, 2002; Smith & Poplett, 2002). Third, there may be a lack of effective supervision or inefficient systems for accessing appropriate help and support within the hospital environment. Fourth, major adverse events (MAEs) including cardiac arrest, unplanned admissions to the intensive care unit (ICU), and death occur more frequently in the deteriorating patient. Studies have shown that these clinical events are preceded by warning signs in the form of physiologic instability for example, tachypnea, tachycardia, hypotension, decreased oxygen saturation, and changes in conscious state (Harrison, Jacques, McLaws, & Kilborn, 2006; Harrison, Jacques, Kilborn, & McLaws, 2005; Jacques, Harrison, McLaws, &
Kilborn, 2006). An international study examined the physiological abnormalities preceding cardiac arrests, deaths, and unanticipated ICU admissions in participating hospitals in the UK, Australia, and New Zealand (Kause et al., 2004). Kause and colleagues (2004) reported serious physiological abnormalities in 60% of all ward patients in their study. In Australia, Hillman and colleagues (2001) also found a high incidence of serious vital sign abnormalities in the period before potentially preventable hospital deaths. In theory, if abnormal physiology is identified early and corrected effectively, patient outcomes may improve.

A UK study (McQuillian., et al 1998) highlighted significant errors in the care and management of the deteriorating ward patient prior to unplanned admission to the ICU. These errors in the care and management of the deteriorating patient contributed to an increase in patient mortality.

Hospitalised ward patients also appear to be more vulnerable to MAEs after-hours. The incidence of adverse events increases after-hours and weekends (17.00–07.00) (Alspach, 2010; Hamilton, Mathur, Gemeinhardt, Eschiti, & Campbell, 2010). These periods are characterised by decreased numbers of clinical and support staff, limited ancillary services, reduced clinical supervision, and strained communication with other on-call health-care providers (Alspach, 2010; Hamilton et al., 2010). These factors may contribute to suboptimal care for the deteriorating ward patient during the hospital after-hours and increase the risk of negative patient outcomes and MAEs.

Unfortunately, acute illness and life-threatening clinical deterioration have no concept of time, and patients are at risk of clinical deterioration at any time of the week, day or night. Fifty to seventy percent of patients are admitted during the hospital after-hours (Arabi, Alshimemeri, & Thaer, 2006). After-hours discharges from the ICU are also associated with increased mortality (Duke, Green, & Briedis, 2004; McLaughlin, Leslie, Williams, & Dobb, 2007; Peberdy et al., 2008; Pilcher et al., 2007; Tobin & Santamaria, 2006). Patients
discharged from ICU after-hours were 1.33 times more likely to die (Goldfrad & Rowan, 2000). Two Australian studies also demonstrated a similar effect of after-hours discharges from ICU on patient outcomes (Duke et al., 2004; Tobin & Santamaria, 2006).

There are a number of important factors linked to hospital after-hours shift periods that may explain their association with poorer patient outcomes, for example, staff availability and nurse: patient ratios in the general wards are lower after-hours. There may be insufficient time for adequate handover or for regular patient assessment and observations, which may lead to suboptimal care on the ward and expose patients to adverse events (Vincent et al., 2001). Junior and/or inexperienced clinical staff are also increasingly managing patients with complex care needs and may lack the confidence or the competence to care for those patients safely and effectively (Smith & Poplett, 2002). There may also be limited clinical support for staff and patients after-hours (McLaughlin et al., 2007). Having experienced clinicians on the ward is important, and the role of after-hours clinical support staff is vital in reducing negative outcomes and the incidence of adverse events in the deteriorating ward patient.

**Research problem**

Timely access to appropriate interventions is therefore crucial in improving the morbidity and mortality of the deteriorating ward patient and promoting safe, high-quality care. It is imperative that patient management in the ward setting is optimised by more judicious identification of patient deterioration. RRSs have been developed to meet these objectives. RRSs have been developed in Australia (Hillman et al., 2005), America (DeVita et al., 2006), and Europe (Priestley et al., 2004).

Nursing staff predominantly use and activate an RRS and are therefore integral to the afferent limb and the success of the system in improving the deteriorating hospitalised ward patient’s clinical outcomes (Hillman et al., 2005; Jones & Bellomo, 2006; Kenward, Castle,
Hodgetts, & Shaikh, 2004). However, despite patients fulfilling the criteria for RRS activation, nursing staff fail to call the RRS (Hillman et al., 2005). Although this clinical problem has been identified (Hillman et al., 2005; Kenward et al., 2004), there is a paucity of data explaining the extent of the problem or why it occurs.

The hospital after-hours is associated with an increased risk of clinical deterioration and MAEs (Alspach, 2010; Hamilton, Mathur, Gemeinhardt, Eschiti, & Campbell, 2010). The hospital after-hours is characterised by decreased numbers of clinical and support staff and limited ancillary services (Alspach, 2010; Hamilton et al., 2010). Recently, a number of nurse-led patient safety initiatives have been implemented to improve the care and management of the deteriorating patient in the hospital after-hours. In the UK, the “hospital at night” has been implemented (Beckett et al, 2009). In Queensland, Australia, a nurse-led RRS has been developed (Williams, Hughes, Timms & Raftery, 2012). This nurse-led after-hours service is viewed as a proactive strategy aimed at improving the care and management of the ward patient at risk of life-threatening clinical deterioration in the hospital out-of-hours. Although the service has been introduced in New Zealand, the UK and Australia, it has yet to be formally evaluated. Empirical evidence is therefore required to examine the effectiveness of this role on patient outcomes.

In summary, patient acuity on hospital wards is increasing and this has an impact on clinical practice in a number of ways. Patients on hospital wards are generally older and often have multiple co-morbidities and, therefore, have more complex clinical care needs. Hospitalised ward patients are at increased risk of experiencing clinical deterioration, which increases their risk of experiencing an MAE or other serious adverse event, especially during the hospital out-of-hours. Clinical staff appear to lack the clinical skills required or are unable to attain the appropriate resources to effectively and safely care for these patients. MAEs and other serious adverse events negatively impact on patients’ clinical outcomes and quality of
life, and significantly increase health-care expenditure. RRSs have been developed and implemented with the aim of improving the clinical outcomes of the deteriorating ward patient. While evidence of the effectiveness of RRSs remains inconclusive, a recurring theme within the literature is that these systems are not activated or used appropriately by nursing staff and this may have a negative impact on the deteriorating ward patient’s outcomes.

Study aims

The study reported in this thesis had two overall aims. The first aim was to explore and improve the understanding of the factors that influence nurses’ activation of an RRS and to explore nurses’ practices in using an RRS. The second aim of the study was to explore if the introduction of an APN after-hours service improves patient outcomes.

Significance of the study

It is increasingly recognised that nursing staff are responsible for activating the RRS (Kenward et al., 2004) and that nurses often fail to activate the RRS despite patients fulfilling the activation criteria (Hillman et al., 2005). Within the literature, there are no contemporary studies exploring nurses’ clinical practices in relation to RRS activation and no studies that examine nurses’ perceptions of the barriers to RRS activation. The study reported in this thesis is important because it provides valuable knowledge and information regarding nurses’ understanding, attitudes, and practices in relation to RRSs’ use and activation. This study provides new evidence-based knowledge in relation to RRSs and nurses’ practices when using these systems. This new knowledge can be used to inform educationalists’, clinicians’, and health-care managers’ understandings of the barriers and challenges nurses encounter when using RSSs. Recommendations regarding how these challenges may be addressed to promote early recognition of the deteriorating patient to ensure timely and appropriate
escalation of care are offered in this thesis. This has the potential to improve patient care and patient outcomes, and reduce health-care costs.

In the last decade, many countries have experienced an unprecedented increase in the numbers and types of new nursing roles, such as acute care nurse practitioners, advanced practice case managers, and clinical nurse specialists (Bryant-Lukosius, Alba DiCenso, & Pinelli, 2004; Chaboyer, Gillespie, Foster, & Kendall, 2005; Chang & Wong, 2001; Coombs, Chaboyer, & Sole, 2007; Gardner, Chang, & Duffield, 2007; Mick & Ackerman, 2000, 2002a). Advanced practice has always existed in nursing. However, the concept of the Advanced Practice Nurse (APN) was formally developed in the late 1970s in USA when nurses began to perform tasks previously undertaken by medical officers. The goal of advanced practice nursing is to deliver quality care that enhances patient outcomes (Ball & Cox, 2003). In the USA, the APN role is well established and APNs are educated and prepared according to national standards. APNs are recognised by nurses, professional bodies, other healthcare professionals, and the public (Mick & Ackerman, 2000, 2002a, 2002b). In the UK and Australia, the acknowledgment of APN roles and development of curricular standards, as well as position statements, are still evolving (Coombs et al., 2007; Gardner et al., 2007). The aim of the work presented in this thesis is to explore the impact of an APN service on deteriorating patients’ outcomes. The contemporary nature of APNs in Australia dictates that empirical evidence is required to explore the effectiveness of the APN service on patient outcomes. This research is timely in that it responds to the need to explore the effectiveness and efficacy of such roles. The findings of the study will provide nurse leaders, health-care managers, and policy makers with objective data that will aid their decisions regarding the value of developing similar roles in the acute care area. The economic impact of APN services needs to be more fully understood and appreciated in the Australian health-care context and a rigorous, objective exploration of the impact of an APN on
deteriorating ward patient outcomes will enable a transparent debate regarding the effectiveness of the role.

*Clarification of terms*

Commonly used terminology and titles associated with this study are briefly described below to aid interpretation and contextualise the study.

The deteriorating patient is defined in this thesis as a patient whose clinical condition worsens suddenly. According to the National Institute of Clinical Excellence (2009), this clinical deterioration “can occur at any stage of illness, although there will be certain periods during which the patient is more vulnerable, such as the onset of illness, during surgical or medical intervention and during recovery from critical illness” (p19).

Rapid Response Systems (RRSs) identify deteriorating hospitalised patients prospectively and seek to alter their clinical course by escalating the clinical resources directed to them. RRSs have the potential to prevent adverse clinical outcomes, including cardiac arrest and death. There are two key features of an RRS: (1) an afferent limb (how the team is activated); and (2) an efferent limb (the response of the team).

Hospital after-hours signifies the time when the provision of care takes place outside standard hours. Standard hours are defined as Monday–Friday 8.00am–6.00pm. For the purpose of this study, the hospital after-hours hours is defined as 6.00pm–8.00am Monday to Friday, and all of Saturday, Sunday and public holidays (Peberdy et al., 2008).

Advance Practice Nurse (APN) is a “registered nurse who has acquired the expert knowledge base, complex decision-making skills and clinical competencies for expanded practice, the characteristics of which are shaped by the context and/or country in which s/he is credentialed to practice. A master’s degree is recommended for entry level” (ICN, 2002).
In this study, the APN is identified as one element of the efferent limb of an RRS and is employed in the hospital after-hours to improve the care and management of the deteriorating ward patient.

**Structure of the thesis**

This thesis is presented in six chapters. This chapter contains an outline of the context of the topic as situated within a clinical, political, and economic background. The chapter includes an introduction of some of the important issues that are responsible for the increase in patient acuity in hospital wards and why the hospitalised ward patient is at increasing risk of clinical deterioration. The patient safety systems that have been implemented to improve the recognition and response to patient deterioration have been identified. The significance of the study to clinical practice and the research problem is also presented in this chapter.

The findings of a comprehensive and critical appraisal of the literature are presented in chapter 2. First, factors that contribute to suboptimal care of acutely ill ward patients are explored. Second, the incidence of MAEs in the hospital after-hours is presented. Third, the effects of RRSs in reducing MAEs in deteriorating ward patients are analysed.

A description and rationale for the use of case study as a research design is provided in chapter 3. The research questions and overview of the research design, the methodology and conceptual framework are also discussed. The procedures used in the data collection and analyses are presented. The ethical considerations relevant to this research study are also explored in this chapter.

The findings from 15 semi-structured interviews with registered nurses who had cared for a deteriorating patient are discussed in chapter 4. The four themes and their associated sub-themes are also presented in that chapter.
The results from a retrospective review of 300 medical patients’ charts are presented in chapter 5. First, demographic characteristics of the sample are described. Second, hypothesis testing through bivariate relationships are reported. Third, predictors of MAEs identified through the use of a logistic regression model are described.

Chapter 6 provides a platform from which the findings from this study are discussed alongside the current evidence. Recommendations for practice, education, and research are provided in the context of an RRS and the deteriorating ward patient so that relevant conclusions can be drawn. The limitations of the study are also recognised and discussed, demonstrating the framework from which the recommendations emerged. Throughout chapter 6, the contribution of the study to current knowledge and understanding of the deteriorating patient within the framework of an RRS is made explicit.
Chapter 2: Literature review

Introduction

In this chapter, the study is situated within the context of what is known about the deteriorating ward patient and the systems that have been developed and implemented to improve the management of this type of patient. Published research is analysed and synthesised, focusing on the factors that contribute to suboptimal care in the acute care setting. The research on MAEs in the hospital after-hours is explored in this chapter and finally, the research conceptualising and evaluating the outcomes of systems developed to improve the care and management of the deteriorating ward patient is reviewed. The aims of this review of the literature are to examine the published evidence pertaining to RRSs and the effectiveness of these systems in reducing the outcomes of in-hospital cardiac arrests, unplanned admission to ICU, and patient mortality. These three outcomes have been consistently to evaluate the effectiveness and efficacy of RRSs, and are increasingly referred to as MAEs (Ball, Kirkby, & Williams, 2003; Bellomo et al., 2004; Buist & Bellomo, 2004; Jones & Bellomo, 2006; Lee, Bishop, Hillman, & Daffurn, 1995).

Method

A critical review of the literature allows for the inclusion of studies using diverse methodologies, thus encouraging a greater contribution to nursing science and evidence-based practice (Whittemore & Knafl, 2005). However, the flexibility of this method has seen it be criticised for being less rigorous, and more subjective and inaccurate, than the traditional systematic review (O’Mathuna, 2000). Issues related to data collection, data extraction, analysis, and synthesis needed to be explicit and transparent. The theoretical framework outlined by Whittemore and Knafl (2005) is used to structure this chapter in an attempt to
produce a rigorous and objective analysis of the empirical and theoretical literature, thereby creating a comprehensive understanding of suboptimal care, the hospital after-hours and RRSs. This framework involves the following stages:

- Problem identification,
- Literature search,
- Data evaluation,
- Data analysis, and
- Discussion.

**Problem identification**

The initial stage of any review method requires a clear identification of the problem that the review is addressing. A well-specified research purpose and question facilitates the extraction of appropriate data from the identified primary sources (Whittemore & Knafli, 2005). Three main clinical problems associated with the deteriorating ward patient have emerged as being important: (1) suboptimal care; (2) the hospital after-hours; and (3) the RRS. The following section of the review defines these problems.

**Suboptimal care**

Failure to seek and provide appropriate and timely care to deteriorating ward patients has led to the concept of *suboptimal care*. During the late 1990s, a number of seminal studies were carried out that established that MAEs are frequently preceded by physiological abnormalities and are associated with suboptimal care (Goldhill, White, & Sumner, 1999; McGloin et al., 1999; Vincent et al., 2001). The findings from these influential studies have significantly impacted on health-care policy.

A confidential inquiry into the quality of care before admission to ICU demonstrated that the management of airway, breathing, and oxygen therapy for the ward patient may be
suboptimal and increases patients’ morbidity and mortality (McQuillan et al., 1996). That inquiry, although now dated, is considered the seminal study on the subject of suboptimal care, and has been particularly useful in categorising the causes of suboptimal care into five categories. The five categories are:

- failure to appreciate clinical urgency,
- failure to seek advice,
- lack of knowledge,
- failure of the organisation, and
- lack of supervision.

Numerous papers have referred to these categories in relation to suboptimal care (Garrard & Young, 1998; Hillman et al., 2002; Massey, Aitken, & Chaboyer, 2009; McArthur-Rouse, 2001; McLaughlin et al., 2007; Quirke, Coombs, & McEldowney, 2011; Ringrose & Garrard, 1999; Robson, 2002). However, there is insufficient data examining whether these categories do in fact contribute to suboptimal care. Evaluating if these factors are responsible for suboptimal care is therefore challenging.

The hospital after-hours

Acute care hospitals provide 24-hours-a-day, 7-days-a-week service. However, a majority of this time is classed as ‘after-hours’ and this period is characterised by decreased clinical and support staff numbers, limited ancillary services, reduced clinical supervision, and strained communication with other on-call health-care providers (Alspach, 2010; Hamilton, Mathur, Gemeinhardt, Eschiti, & Campbell, 2010). These factors may contribute to suboptimal care of the deteriorating patient during the hospital after-hours and this increases the risk of MAEs.

Unfortunately, acute illness and clinical deterioration have no concept of time, and ward patients are at risk of deterioration at any time of the week, day or night. Fifty to
seventy percent of patients are admitted to the hospital after-hours (Arabi et al., 2006). The effective and safe management of patients in hospitals during after-hours has therefore emerged as a key challenge for health-care providers in recent years. Although there is an emerging body of evidence that supports the theory that patients are more likely to experience an adverse event in the hospital after-hours, many of the studies have been conducted in the critical care patient cohort and have tended to examine admission and discharge times in ICU and patient mortality (Duke et al., 2004; Goldfrad & Rowan, 2000; Laupland et al., 2011; McLaughlin et al., 2007; Tobin & Santamaria, 2006). This literature review aims to analyse and synthesise the evidence about the hospital after-hours and the impact this has on MAEs in the deteriorating ward patient. This will contribute to the current knowledge and understanding of this important, but poorly understood, clinical issue.

**Rapid response systems**

The characteristics of patients in the hospitals are changing. Ward patients often have multiple co-morbidities and complex care needs (Ball & McElligot, 2003; Coombs & Dillon, 2002; Hillman, 2002; Robson, 2002; Vincent et al., 2001). Patients located in the acute care setting are at an increased risk of clinical deterioration during their hospital stay and of suffering an adverse event (Chaboyer, Thalib, Foster, Ball, & Richards, 2008; Harrison et al., 2006; Harrison et al., 2005; Jacques et al., 2006; McGloin et al., 1999; McLaughlin et al., 2007). Adverse events within the acute care sector continue to impact significantly on patient outcomes and are increasingly dominating the health-care agenda. The negative outcomes associated with adverse events and suboptimal care in hospitals has led to increasing interest from clinicians and health-care providers to develop effective interventions that may reduce the incidence of MAEs and promote optimal patient outcomes for this vulnerable patient group.
In an effort to improve the care and management of ward patients at risk of life-threatening clinical deterioration, a number of patient safety initiatives have been proposed and implemented. The RRS is perhaps the most widely known of these initiatives (DeVita et al., 2006). Although many of these systems vary in their structure and processes, their key aims and objectives are similar and include averting admission to critical care, facilitating discharge from a critical care facility, and sharing of critical care skills throughout the hospital (Chaboyer et al., 2005; DeVita et al., 2006; Priestley et al., 2004; Watson et al., 2006). Throughout this thesis, the term RRS is used to describe any of the systems specifically referred to as Critical Care Outreach Teams (CCOTs), Medical Emergency Teams (METs), Rapid Response Teams (RRTs), and Intensive Care Liaison Nurses. There has been widespread adoption of RRSs in the acute care sector both within Australia and internationally (Ball et al., 2003; Bristow et al., 2000; Buist et al., 2002; DeVita et al., 2006; Hillman et al., 2005).

The RRS usually consists of an ICU or emergency department (ED) registrar and an ICU or ED nurse (DeVita et al., 2006). All nursing, medical, and allied health teams are encouraged to activate the RRS if they are seriously worried about a patient’s clinical condition, or if a patient tiggers any of the defined objective physiological criteria. Once activated, members of the RRT assess the patient and institute emergency therapy to stabilise the patient’s clinical condition. The patients may be given an active care plan and remain on the ward, with or without a ‘not for resuscitation’ order in place. Alternatively, if a patient is not responding to therapy or considered too ill to remain in the ward environment, they are transferred to a clinical area that is able to provide more acute care, such as the ICU, the high dependency unit (HDU) or the coronary care unit (CCU).

An evaluation of RRS effectiveness and efficacy is problematic for a number of reasons. First, there is wide variation in the terminology used (Ball et al., 2003; Bellomo et
al., 2004; DeVita et al., 2006; Gao et al., 2007). Terms such as CCOT, MET, and RRT are often used interchangeably and may only describe one limb of the system. Second, how an RRS is implemented and operationalised differs between hospitals and this can make a comprehensive evaluation challenging.

In an attempt to address these issues, a recent consensus statement written by experts in the area of RRSs produced clear recommendations that clarify the nomenclature in this area (DeVita et al., 2006). One of the key messages from this consensus statement is that RRSs incorporate two separate but interlinked limbs: (1) the afferent limb; and (2) the efferent limb (see Figure 1). Previous systematic reviews have evaluated only the afferent limb (Gao et al., 2007) or the efferent limb (Esmonde et al., 2006; McGaughey et al., 2007), preventing a coherent analysis of the whole subject. The complexities of the different RRSs and the contemporary nature of the model proposed by DeVita at al. (2006) means that the application of this model to clinical practice has yet to be demonstrated.
In summary, three problems that require addressing have been identified. First, it remains unclear if all of the factors within the categories identified by McQuillan and colleagues (1998) do in fact contribute to suboptimal care. This uncertainty will be explored using the categories proposed by McQuillan and colleagues (1998). Second, while the hospital after-hours may be linked to an increased risk of MAEs in the deteriorating ward patient, to date there is a lack of empirical evidence examining this phenomenon. Third, there is a lack of data examining the effects of RRSs on MAEs.

**Literature search**

Well-defined literature search strategies are critical for enhancing the rigour of the review (Whittemore & Knafl, 2005). To identify appropriate literature on the topic, the following databases were searched: CINAHL, MEDLINE, EMBASE, and Cochrane. Search terms that
were used included Medical Emergency Teams, Rapid Response Systems, Rapid Response Team, Critical Care Outreach, Intensive Care Liaison Nurse, Early Warning Scores, Modified Early Warning Scores, suboptimal care, critically ill ward patients, acutely ill ward patients, deteriorating patients, adverse events, major adverse event, the hospital out of hours, the weekend effect, the hospital off hours, the hospital after-hours and the hospital at night. The search was restricted to the English language and by patient age category (all adults over 16 years). Although computerised databases are efficient and effective, limitations associated with inconsistent search terms may only yield about 50% of eligible studies (Whittemore & Knafl, 2005). Therefore, ancestry searching and hand searching of peer-reviewed journals were also used to ensure all relevant literature was accessed (Conn et al., 2003).

**Inclusion/exclusion criteria**

Literature was included if it was published 1998–2012 and written in English. This span of 14 years was chosen to provide the most current articles relevant to the subject. The contemporary nature of the topic dictated the chosen timeframe. The concepts of suboptimal care on the ward, the deteriorating ward patient, and the RRS were only just being recognised and studied 14 years ago. Studies were included if they provided empirical data on any of the three key outcomes of in-hospitable cardiac arrest, unplanned admission to ICU, and hospital mortality, and were related to the five categories developed by McQuillan and colleagues (1998). Studies were excluded if they did not use primary data collection or if they evaluated other aspects of the RRS (for example, team performance or the introduction of an RRS).

**Data evaluation**

Once the literature was accessed, common themes were extracted for analysis and synthesis. This process was essential to ensure methodological rigour (Brown et al., 2003).
The quality of included studies was determined by evaluating their internal validity—“the extent to which the study design, conduct, and analysis systematically avoid or minimise potential sources of bias” (Conn & Rantz, 2003). Whittemore and Knafl (2005) suggest that because evaluating the quality of different designs is complex, no gold standard exists and this quality assessment exercise should use generic methodological criteria. In conducting this review, the criteria suggested by Whittemore and Knafl (2005) were used to assess the quality of the accessed studies. These criteria consisted of assessing the inclusion and exclusion criteria of the study and the sample size justification. Outcomes were assessed for appropriateness and the measures used were assessed for reliability and validity. Statistical tests were assessed for their appropriateness and, finally, any intervention used was assessed for randomisation of subjects to treatment and control group.

**Data analysis**

The next stage in the review is data analysis (Whittemore & Knafl, 2005). Data from the included studies were ordered, categorised, and summarised to produce a coherent and logical conclusion. The data analysis stage of the review is presented in the next section of this review. First, McQuillan and colleagues’s (1996) five categories of factors that contribute to suboptimal care are presented, and how these factors contribute to suboptimal care and the deteriorating patient is explored. Following on, an analysis of the acutely ill ward patient at risk of clinical deterioration in the hospital after-hours and the incidence of MAEs is presented. Finally, the afferent and efferent limb of RRSs are explored and analysed in the context of the deteriorating patient.
Suboptimal care: Failure to appreciate clinical urgency

The first category McQuillan and colleagues (1998) identified as contributing to suboptimal care was failure to appreciate clinical urgency. This category is defined as healthcare providers failing to respond to patient deterioration (Buist et al., 1999; Franklin & Mathew, 1994; McGloin et al., 1999). Two studies used a retrospective analysis of patient records (Buist et al., 1999; McGloin et al., 1999) and one used a case series approach (Franklin & Mathew, 1994) to demonstrate this. An Australian study (Buist et al., 1999) investigated the nature and timing of premonitory signs and symptoms in patients prior to a ‘critical event’ (cardiac arrest or unplanned ICU admission) and concluded that critical events in hospitalised patients were preceded by premonitory abnormal vital signs. Seventy-six percent of critical events occurring in non-ICU patients were accompanied by premonitory signs that were present for more than one hour before the critical event; in one third of these critical events, documented instability continued for more than 24 hours prior to the cardiac arrest or unplanned admission to ICU. Buist and colleagues (1999) failed to identify the number of patients who developed acute physiological changes but did not decline into cardiac arrest; thus, the number of serious adverse events may be much higher than actually reported.

A UK study (McGloin et al., 1999) investigated the incidence of unexpected deaths and the relation of this to suboptimal care in a six-month audit on general wards. This study concluded that a gradual life-threatening clinical deterioration was observed in ward patients’ physiological and/or biochemical variables but appropriate action was not taken, arguably because health-care providers failed to appreciate the clinical urgency of the situation. McGloin and colleagues’s study supports the findings of other studies in relation to suboptimal care and the failure of health-care providers to appreciate clinical urgency (Cioffi, 2000b; Considine, Botti, & Thomas, 2006; Odell, Victor, & Oliver, 2009) and recognise and
respond to the deteriorating patient. However, McGloin and colleagues’s (1996) study was an audit and, therefore, it is not possible to generalise the findings to the wider acute care hospital population. The use of retrospective case analysis is a common method employed by researchers investigating suboptimal care on the ward (Buist et al., 1999; McGloin et al., 1999). However, this form of data is often incomplete, making an objective and unbiased judgment problematic.

Franklin and Matthews’s (1994) US study investigated the frequency of premonitory signs and symptoms before a cardiac arrest in patients on a general medical ward and how nurses and physicians responded to these signs. Franklin and Matthew (1994) argue that their findings confirm nurses fail to notify a physician of a change in the patients’ mental status, again suggesting this may be the result of failure to appreciate the clinical urgency of the situation. However, the inclusion criteria of this study consisted of patients who had experienced a critical incident defined as either a cardiac arrest, unplanned admission to ICU, or death. Only 150 patients fulfilled this criterion. Arguably, by widening the inclusion criteria and clearly defining a critical event, a much larger sample could have been recruited that may have been a more reliable indicator of the true prevalence of suboptimal care in the population of deteriorating ward patients.

The risk of adverse events increases with age. Patients over 65 years of age have been found to have an independent association with in-hospital mortality (Brennan et al., 1991; Wilson et al., 1995; Neal et al., 2001). Therefore, nurses need to be aware that older patients often have more complex health needs, and co-morbidities and are more likely to experience clinical deterioration. Gender is not associated with an increase in adverse events (Brennan et al., 1991; Wilson et al., 1995; Neal et al., 2001; DeVries et al., 2008) with both males and females just as likely to experience an adverse event in hospital.
Data does appear to suggest that most MAEs are preceded by a period of physiological instability, and that the clinical urgency of this physiological instability may not be recognised, acted on, or appreciated by ward nurses.

**Suboptimal care: Failure to seek advice**

The second category McQuillan and colleagues (1998) identified as contributing to suboptimal care was failure to seek advice. Failure to seek advice is defined as the presence of physiological deterioration that is not acted on.

Failure to seek advice was examined in only four studies (see appendix 1 for critique of relevant studies). Two descriptive Australian studies highlight that nurses often used intuitive judgment rather than objective physiological data when seeking support and advice (Cioffi, 2000a, 2000b). Although both of these studies focused on nurses’ decision-making when activating a MET, the findings support the assumption that the subjective nature of intuitive judgement may render it ineffective and undervalued by nurses and medical officers. It is generally acknowledged that successfully accessing a medical review for ward patients requires the use of objective and quantifiable data. This is supported by a UK study (Andrews & Waterman, 2005), which argues that, from a nursing perspective, it is much more difficult to access medical support if subjective evidence is presented.

An Australian study by Daffurn and colleagues (1994) explored nurses’ opinions, knowledge, and use of the MET using hypothetical clinical scenarios to identify if nurses used physiological criteria to activate the MET. That study found that only 17% of nurses would activate the MET for patients who clearly met the objective physiological criteria identified in the MET criteria, and as many as 41.5% of nurses would choose to call a medical officer instead of activating the MET. This is of concern because studies have demonstrated that medical staff may lack appropriate levels of knowledge to safely care for
the acutely ill ward patient at risk of clinical deterioration (Smith et al., 2002; Smith & Poplett, 2002, 2004). Similar to other studies (Cioffi, 2000a, 2000b), this study focused on nurses’ knowledge and decision-making in relation to the MET. METs are not available in all acute care hospitals (Martin et al., 2007). Nurses who do not have access to these systems of care may therefore employ very different decision-making processes when seeking advice about caring for acutely ill ward patients. Three studies (Andrews & Waterman, 2005; Cioffi, 2000a, 2000b) used exploratory methods and the findings of these studies cannot be generalised to other health-care settings. The only study that used a quantitative methodology (Daffurn et al., 1994) is more than 20 years old and the questionnaire was distributed at a single site to only 140 nurses. Accordingly, the findings may not reflect nurses’ current clinical reasoning and decision-making when summoning emergency assistance for the deteriorating patient. Despite these methodological limitations, findings from these studies highlight that nurses appear to lack confidence in their judgment and clinical decision-making. This may be detrimental to deteriorating patients. Poorer outcomes in ward patients are associated with delays in appropriate intervention (Buist et al., 2003; Hodgetts, Kenward, Vlackonikolis, et al., 2002; Neale, Chapman, Hoare, & Olsen, 2006).

**Suboptimal care: Lack of knowledge**

Lack of knowledge was the third category identified by McQuillan and colleagues (1998) as contributing to suboptimal care. Lack of knowledge is defined as the failure to recognise patient deterioration. As surgical and technological developments continue to offer patients with multiple co-morbidities and chronic health conditions more invasive treatment options, patient acuity will increase. The ability to recognise physiological abnormalities is a key factor in the prevention of an impending adverse event. The recognition and interpretation of physiological abnormalities is primarily a nursing responsibility (Considine,
Respiration rates are increasingly cited as one of the most sensitive and important indicators of an impending MAE (Considine, 2005; Cretikos et al., 2008; Goldhill et al., 1999; Jacques et al., 2006). Despite this, there is increasing evidence that nurses do not routinely assess, record, or document this important physiological parameter (Chaboyer et al., 2008; Cretikos et al., 2008; Cullinane, Findlay, Hargraves, & Lucas, 2005; McLaughlin et al., 2007).

Accurate and timely assessment is therefore a vital component of holistic patient care; care is suboptimal when patient assessments are not comprehensive (West, 2006). West (2006) argues that contemporary nursing practice needs to embrace all aspects of structured physical assessment to ensure safe and effective care. In their grounded theory study, Andrews and Waterman (2005) highlight that nursing staff lack the confidence to articulate their theoretical knowledge to patients and other health-care providers. It has been argued that the lack of biological sciences within pre-registration nursing curricula disadvantages both nurses and their patients. Nurses are unable to apply the theory of biological science to their practice (Clancy, McVicar, & Bird, 2000) and their communication with other health-care providers may become fragmented, disjointed, and even antagonistic (Andrews & Waterman, 2005). This delays the medical review of deteriorating ward patient and predisposes them to detrimental outcomes and suboptimal care.

Lack of knowledge (Smith et al., 2002; Smith & Poplett, 2004) has been identified as a factor in the failure by medical staff to detect clinical deterioration (see Appendix 1). Two studies have explored the impact of medical knowledge in relation to the care and management of the deteriorating ward patients (Smith & Poplett, 2002, 2004). Smith and Poplett’s (2002) study used a questionnaire to demonstrate that many trainee doctors have significant gaps in their knowledge and understanding of the signs of acute illness, which impedes their ability to effectively and efficiently identify an impending adverse event or
clinical deterioration. Accordingly, although responsible for the care and management of perhaps one of the most complex and challenging patient groups, trainee doctors are poorly prepared to identify and treat the deteriorating ward patient. If medical officers have significant gaps in their knowledge and understanding in relation to this complex patient cohort, it is likely that the same could also be assumed about nurses’ knowledge and understanding, although this assumption would require further investigation.

To date, only one study has explored the experiences of nurses caring for acutely ill ward patients (Cox, James, & Hunt, 2006). This exploratory descriptive study interviewed ward nurses caring for acutely ill ward patients. The participants in that study did not identify that they lacked knowledge in relation to caring for acutely ill ward patients, although they appeared to have difficulties in identifying their educational needs in relation to caring for this patient group. This concept is referred to as secondary ignorance (Cutler, 2002) “they do not know what they do not know” (Benner, Tanner, & Chesla, 1992) and creates what Cutler (2002) refers to as a paradox in that ward nurses are unaware of their educational needs. Without the recognition of their learning needs, it is problematic to develop effective teaching and learning strategies to promote knowledge development in this important area.

**Suboptimal care: Failure of the organisation**

Organisational factors were identified by McQuillan and colleagues (1998) as antecedents to suboptimal care. These factors are related to how medical and nursing care are organised. A number of studies have identified that nursing workloads can influence patient outcomes (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Needleman, Buerhaus, Stewart, Zelevinsky, & Mattke, 2006).

The term failure to rescue is increasingly being used to examine the ways nurses influence patient outcomes. Failure to rescue has been defined as:
“[a clinicians’ inability to save a hospitalised patient life when he [sic] experiences a complication (a condition not present on admission)” (Bry, Stettner, & Marks, 2006, p24).

It is exigent to unravel if failure to rescue differs from suboptimal care and adverse events. This is not explored within the literature. Nonetheless, failure to rescue is becoming a familiar term within nursing and patient safety literature (Needleman & Buerhaus, 2007) and is increasingly linked to suboptimal care (Aiken et al., 2002; Ball, 2006; Clarke, 2004; Clarke & Aiken, 2003). Two possible phases are involved in rescuing patients from the possible dangers they are exposed to while an inpatient (Clarke, 2004): (1) surveillance and timely identification of complications; and (2) the launching of a successful rescue response. Because of their close and continual monitoring of patients, nurses are often the first to detect the early signs of physiological derangements and clinical deterioration. Nurses’ continual surveillance of patients ensures nurses are ideally positioned to launch a successful rescue operation.

The success of the rescue operation, however, depends on a number of important factors for example, an effective patient: staff ratio is essential to facilitate effective surveillance. The ability to mobilise hospital resources is also an important factor in a rescue operation. While nurses may be able to survey and monitor patients, the surveillance becomes meaningless if their role within the organisation is not valued and their voices and concerns are neither listened to nor acted on. Clarke (2004) believes that these organisational characteristics fundamentally affect a health-care provider’s abilities to initiate these phases, thereby contributing to patients’ potential exposure to suboptimal care. This argument has not yet been empirically demonstrated, although evidence highlights that patient:staff ratios are an important indicator of quality of care (Aiken et al., 2002; Aiken et al., 2001b; Ball et al., 2004; Subbe et al., 2004).
Organisational features are directly related to failure to rescue, and Clarke and Aiken (2003) contend that failure to rescue is a better indicator of a hospital’s quality than the rate of adverse events alone. Therefore, in relation to patient safety, it is important to consider the factors responsible for MAEs as well as their incidence and occurrence (Tourangeau, Cranley, & Jeffs, 2006; Tourangeau et al., 2007). By focusing solely on the incidence and consequences of MAEs, the emphasis is shifted away from the importance of examining organisational processes that increase the risk of adverse events and contribute to suboptimal care.

There needs to be an organisational shift committed to developing and adopting a robust quality assurance model that enables and encourages the exploration of all the relevant issues rather than continued concentration on the clinical issues alone. Given that nurses provide most of the direct and ongoing patient care, it can be assumed that nursing care structures and processes are important determinants of patient mortality and, therefore, an indicator of quality and patient safety.

The relationship between indicators of nurse staffing and failure to rescue was examined by Needleman and colleagues (2002). Higher proportions of registered nursing hours were associated with lower failure to rescue interventions for medical patients. In a study of surgical patients, each additional patient in excess of a four-patient workload resulted in a 7% increase in mortality and a 7% increase in the odds of a failure to rescue occurring (Aiken et al., 2001a). Many of these studies have been conducted on specific patient cohorts, for example, surgical patients (Aiken et al., 2002), medical patients (Needleman et al., 2002), and critical care patients (Knaus, Draper, Wagner, & Zimmerman, 1986) and therefore it is difficult to generalise these findings to the wider hospital inpatient population. Many different factors and variables influence ward patient mortality and control, and manipulation of these factors is problematic within the acute care hospital environment.
Traditionally, studies that explored the link between nursing staffing levels and hospital mortality have relied on administrative data (Aiken et al., 2001b; Knaus et al., 1986; Needleman et al., 2002). This form of data can restrict the range of background factors that can be examined. Data may be missing or incomplete, making an objective and unbiased judgment difficult. Needleman and Buerhaus (2003) argue that the impact of nurse staffing on hospital mortality, although seductive, is not yet conclusive. At this stage, there is a lack of empirical data directly linking organisational culture and suboptimal care.

**Suboptimal care: Lack of supervision**

The final category that contributes to suboptimal care is lack of supervision. Interestingly, no empirical studies were identified that demonstrated that a lack of supervision is associated with suboptimal care and the deteriorating ward patient. An understanding of the term ‘supervision’ and its role in developing practice is imperative to understanding its importance and value in promoting safe and effective patient care.

Supervision has been defined as an exchange between practicing professionals to enable the development of professional skills (Wood, 2004). Recently, clinical supervision has been seen as a more contemporary approach to supervision and has been widely adopted within the UK health-care system in response to the clinical governance model and quality assurance drivers. Clinical supervision has been defined as a process that brings practitioners and skilled supervisors together to reflect on practice with the aim of identifying solutions to problems and improving practice (Sloan & Watson, 2002).

In its embryonic stage, clinical supervision was viewed as a democratic process focusing on professional growth and development rather than quality assurance outcomes. However, clinical, demographic, and educational changes meant that the clinical supervision profile within the UK health-care system became more strategic. If clinical supervision
contributes to improving quality levels of service delivery and reducing costs, this should have an impact on the number of adverse events and reduce suboptimal care. However, the clinical supervision model has tended to be introduced as a professional development activity rather than a management supervision activity and is, therefore, seen as voluntary, non-hierarchical, and democratic. Consequently, it has proven problematic to fully evaluate the effects and impact of this model on patient outcomes.

**Suboptimal care: Summary**

In the first section of this review, it was established that suboptimal care patient exists. However, McQuillan and colleagues’s paper is now dated and has two significant methodological flaws. First, McQuillan and colleagues (1998) relied on reviewers’ implicit assessments of suboptimal care because the authors argued that explicit and objective definitions of suboptimal care were difficult and problematic. However, the use of expert reviewers as a method has been criticised as being subjective and unscientific (Gorard, 1999). The assessors were not blinded to the patients’ outcomes, which may have influenced their clinical reasoning for example; the reviewers may have been more likely to cite evidence of suboptimal care if the patient had died. Second, McQuillan and colleagues’s (1998) study used a very small sample size so accurate assessment of the extent of suboptimal care within the deteriorating ward patient population was problematic. There is an urgent need for more contemporary, valid, and reliable research that explores the factors that contribute to suboptimal care of the deteriorating ward patient.

McQuillan and colleagues categories of suboptimal care on the ward were used as a framework for analysis for this component of the chapter. The review was unable to clearly demonstrate that all of the categories proposed by McQuillan and colleagues contribute to suboptimal care. Many of the factors regarding suboptimal care and the deteriorating patient
remain unexplored. There is a lack of evidence exploring nurses’ knowledge and understanding in relation to caring for the deteriorating ward patient, and this is clearly an area that requires further research.

**The hospital after-hours**

The second problem that was identified in this chapter was the increased risk of MAEs in the hospital after-hours. In the next section of the literature review, the evidence on the hospital after-hours, the risk of MAEs, and the deteriorating ward patient is analysed.

A clear definition of the hospital after-hours would enable a more objective and systematic review of the literature. However, there is wide variation in the literature about what constitutes ‘after-hours’. Pilcher and colleagues (2007) define after-hours as starting at 1800hrs, while Morales and colleagues (2003) define 1701hrs as the beginning of after-hours. Different terminology is also used. A number of studies refer to after-hours as “the weekend effect” (Clarke et al., 2010; Maggs & Mallet, 2010; Wong & Morra, 2011) whereas other studies use the terms “after hours” (Pilcher et al., 2007; Santamaria, 2007; Santiano et al., 2009; Singh, Nayyar, Clark, & Kim, 2010; Tobin & Santamaria, 2006) and “off hours” (Luyt et al., 2007). The lack of a clear definition of what constitutes ‘after-hours’ makes a structured and coherent review more difficult and challenging.

**Major adverse events in the hospital after-hours**

Survival rates from cardiac arrests are lower after-hours and at weekends (Priestap & Martin, 2006; Tobin & Santamaria, 2006). To date, only a small number of studies have explored if there is a relationship between the hospital after-hours and the incidence of MAEs in the deteriorating ward patient. In their retrospective study, Maggs and Mallet (2010) found mortality was significantly increased in emergency medical patients admitted to hospital
during the night (OR 1.32 [95%, CI 1.20–1.45] \( p < 0.001 \)). Peberdy and colleagues (2008) measured survival to discharge following in-hospital cardiac arrest and reported that rates of survival to discharge were lower during the after-hours time period compared with standard operating hours.

Admission to hospital at the weekend has been associated with adverse outcomes (Barba et al., 2012; Bell & Redelmeier, 2001). These negative outcomes have been referred to as the positive weekend effect, signifying increased patient mortality in the hospital at the weekend (Clarke et al., 2010; Maggs & Mallet, 2010). Five studies reported significantly higher mortality rates for weekend admissions than weekday admissions (Aylin, Yunus, Bottle, Majeed, & Bell, 2010; Barba et al., 2012; Bell & Redelmeier, 2001; Cram, Hillis, Barnett, & Rosenthal, 2004; Freemantle et al., 2012). A number of studies reported specific conditions and found that patients admitted at weekends had increased mortality. Stroke patients were reported as experiencing a positive weekend effect (Saposnik, Baibergenova, Bayer, & Hachinski, 2007), as were patients with renal disease (James et al., 2010), myocardial infarction (Becker et al., 1998; Clarke et al., 2010; Kostis et al., 2007), and upper gastrointestinal bleeding (Dorn, Shah, Berg, & Naessens, 2010).

A significant number of hospital admissions occur during after-hours (Luyt et al., 2007; Wong & Morra, 2011). These admissions are unplanned and unexpected, and patients admitted after-hours are often sicker and therefore more at risk of clinical deterioration than patients admitted during standard operating hours (Bell & Redelmeier, 2001). The current health-care model means that the hospital after-hours is associated with decreased clinical and support staff numbers, limited ancillary services, and reduced clinical supervision (Hamilton et al., 2010). These factors may contribute to suboptimal care in the deteriorating ward patient (Massey, Aitken, & Chaboyer, 2009; McGloin, Adam, & Singer, 1999) and increase the risk of negative patient outcomes and MAEs.
The hospital after-hours: Summary

This review highlights the complexities of attempting to synthesise and evaluate the deteriorating patient in the hospital after-hours. The review reveals that weekends are associated with poor quality outcomes, even among diverse patient populations. However, there is little evidence of increased MAEs in the hospital at night, with the majority of studies (Ala, Pakraven, & Ahmadi, 2011; Arabi et al., 2006; Barnett, Kaboli, Sirio, & Rosenthal, 2002; Bendavid, Kaganova, Needleman, Gruenberg, & Weissman, 2007; Bhonagiri, Pilcher, & Bailey, 2011; Laupland et al., 2008) exploring admission and discharge from ICU after-hours rather than the incidence and cause of MAEs in general ward patients after-hours.

There were a number of limitations in this section of the literature review and it is important to acknowledge these. First, only papers written in English were included. This may have excluded some important and relevant studies. Second, the inclusion criteria dictated that only studies using data that explored MAEs in the hospital after-hours were reviewed. The incorporation of other methodological studies may have highlighted important subjective factors that contribute to negative patient outcomes in the hospital after-hours, for example, staffing levels, staff fatigue, or models and processes of nursing care. The studies reviewed also had methodological failings, for example; the majority of studies used retrospective chart review as their data collection tool, and this has inherent limitations. Although the majority of researchers implemented quality control measures for data abstraction, there may have been errors in this process and/or the data may have been incorrectly coded in the database, which may have resulted in incorrect data entry and/or analysis. Patient mortality was the most common quality outcome studied. This is not surprising given mortality is clearly important and easily identified in the datasets. It is also a common measure of quality care. However, in-hospital cardiac arrest was evaluated in only one study and unplanned admission to ICU was not reported in any of the studies. Three
MAEs have been frequently used in the literature to evaluate suboptimal ward care: (1) death; (2) in-hospital cardiac arrest; and (3) unplanned admission to ICU (Chen, Bellomo, Flabouris, Hillman, & Finfer, 2009; McGloin et al., 1999; McQuillan et al., 1998). Research is therefore needed to evaluate the relationship between the hospital after-hours and cardiac arrest and unplanned admission to ICU.

There was inconsistency in the studies reviewed about how after-hours were defined and how researchers analysed after-hours. Some researchers who studied both nights and weekends conducted their analyses together as opposed to performing separate analyses of nights and separate analyses of weekends. Again, this poses challenges when synthesising the results.

As discussed in chapter 1, a number of different systems have been developed to address the complex issues associated with providing quality care to the deteriorating ward patient. The effectiveness of RRSs in reducing the impact and incidence of MAEs in the deteriorating ward patient will now be explored.

**Rapid response systems: The afferent limb—track and trigger systems**

A necessary function of any RRS is a clear method of detecting “emergent unmet patient needs” (DeVita et al., 2006). The afferent limb of an RRS should be able to detect patients at risk of clinical deterioration and trigger a response to that clinical deterioration. Most RRSs use a set of predetermined objective criteria that involve the assessment, measurement, and documentation of patients’ vital signs (Cretikos et al., 2008; Cuthbertson, Boroujerdi, McKie, Aucott, & Prescott, 2007; DeVita et al., 2010;). These criteria are increasingly referred to as a track and trigger system (TTS) (DeVita et al., 2010; Gao et al., 2007).
The aim of a TTS is to ensure timely recognition of all patients with potential or established clinical deterioration and to ensure timely attendance by appropriately skilled staff. TTSs involve the use of a monitoring tool that alerts ward staff to physiological alterations in heart rate, respiratory rate, blood pressure, and other vital sign parameters (the ‘track’) with predetermined criteria (the ‘trigger’) for requesting the attendance of more experienced staff and escalation of the care for the patient (Gao et al., 2007).

Currently, two main types of TTS exist on general wards (Gao et al., 2007)—the single parameter system and the aggregate weighted scoring system. The single parameter system uses periodic observations of selected vital signs and compares these vital signs to a set of criteria with predefined thresholds. A response algorithm is then activated when any criterion’s threshold is met (Cretikos et al., 2007a; Gao et al., 2007). The aggregate weighted scoring system allocates a weight to predefined physiological criterion as a function of its abnormality and a summary score is derived. (Cuthbertson et al., 2007; DeVita et al., 2010; Gao et al., 2007; Gardner-Thorpe et al., 2006; Subbe, Kruger, Rutherford & Gemmel, 2001). Perhaps because of the difference in the systems in use, there is a lack of consensus within the literature as to the most effective, sensitive, and valid tool (Cretikos et al., 2007a; Esmonde et al., 2006; Gao et al., 2007; McArthur-Rouse, 2001). Despite this lack of consensus, the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) (Cullinane et al., 2005) and Devita and colleagues (2006) recommend health-care providers use a TTS. More recently, the National Institute for Clinical Effectiveness (NICE) has also recommended the use of a TTS to improve the safety and outcomes of acutely ill ward patients (NICE, 2007).

Track and trigger systems: The aggregate weighted scoring system

The Modified Early Warning Score (MEWS) is an aggregative scoring system that is widely used by hospitals as their TTS. The MEWS was adapted from Morgan’s (1997)
original Early Warning Score (EWS). However, this tool has only been presented in an abstract form and, as such, it is difficult to assess its sensitivity and specificity. Stenhouse and colleagues (1999) modified Morgan’s (1997) initial tool and this has become known as the MEWS. Stenhouse and colleagues (2007) found that use of the MEWS appeared to lead to earlier identification of surgical patients at risk of an MAE. Although this finding has been extensively cited in the literature, it was in fact a poster presentation, making a detailed analysis of methodological rigour problematic. Five papers have reported on the sensitivity and specificity of the MEWS (Gardner-Thorpe et al., 2006; Stenhouse et al., 2000; Subbe, 2006; Subbe et al., 2003; Subbe et al., 2001).

The impact of introducing a MEWS on patient outcomes has been examined in a number of studies (appendix 2). Subbe and colleagues (2003) conducted a single centre prospective cohort study with historical controls on the effect of introducing a MEWS in a general hospital in North Wales over a three-month period. The impact of implementing the MEWS was evaluated against three specific clinical outcomes: cardio-pulmonary arrests and intensive care utilisation in a particular inpatient group of acute medical admissions. Patients were classified according to their EWS as being at low risk (MEWS 1–2), intermediate risk (MEWS 3–4), or high risk (MEWS > 4) of serious clinical deterioration. Admission, clinical, and outcome data were available for 1695 patients. There was an increased incidence of cardio-pulmonary arrests in patients with a MEWS of 3 or 4. The rates of admission to ICU and HDU, and mortality were similar in both the study group and the control group ($p = < 0.06$). These outcomes were similar for the three levels of risk as classified by the MEWS, with overall mortality remaining unchanged irrespective of the level of risk. Subbe and colleagues (2003) concluded that the introduction of the MEWS did not change outcomes in acute medical patients. However, these findings cannot be generalised to other patient groups. The sample used by Subbe and colleagues (2003) excluded surgical patients, and the
researchers provided no rationale for the chosen sample selection. Subbe and colleagues (2001) also investigated the ability of the MEWS to identify medical patients at risk of clinical deterioration. This prospective cohort study applied the MEWS to patients admitted to a 56-bed acute medical admission unit. Data on 709 medical admissions were collected during March 2000. The endpoint outcome measures used in the study were death, ICU admission, HDU admission, cardiac arrest, survival, and hospital discharge at 60 days. The study used a MEWS of 5 or more as a critical score unlike other studies, which have used a score of 4 or more (Cuthbertson et al., 2007; Gardner-Thorpe et al., 2006; Goldhill et al., 2005). The study demonstrated that a MEWS score of above 5 is associated with an increased risk of mortality in medical patients.

The impact of using the MEWS on surgical patients has been evaluated by Gardner and colleagues (2006). The aim of this study was to assess the sensitivity (proportion of patients with established critical illness triggering the efferent arm of the system) and the specificity (proportion of patients without established critical illness who did not trigger the efferent limb of the system) using the threshold MEWS score of 4 or more to trigger a prescribed algorithm for a group of colorectal surgical patients. A total of 334 emergency and elective patients were prospectively studied. The MEWS score was recorded for these patients and the primary end point was transfer to the ICU or the HDU. Fifty-seven (17%) of the patients in the sample group triggered the activation algorithm. Sixteen (5%) were admitted to the ICU or the HDU. In this study, the sensitivity of the MEWS using the score of 4 or more was 75% for ICU or HDU admission and the specificity was 83%. The findings from this study indicate that the use of the MEWS on colorectal patients is a useful and important tool that can assist nursing staff correctly identify patients at risk of clinical deterioration and confirms the findings of similar studies conducted on the MEWS (Stenhouse et al., 2000). However, the study only included patients who had undergone colorectal surgery and, as such, it is
possible that the findings may not apply to the wider hospital population. Post-operative patients may be more sensitive to physiological changes than other patient groups and may therefore exhibit more obvious signs and symptoms of clinical deterioration.

Two studies (see appendix 2) have attempted to identify risk factors associated with increased mortality and then use that information to develop robust and sensitive aggregate scoring systems (Duckitt et al., 2007; Hodgetts, Kenward, Vlackonikolis, et al., 2002). Hodgetts and colleagues (2002) identified risk factors for in-hospital cardiac arrests. Risk factors were identified from a detailed retrospective review of cardiac arrest comparing abnormal physiological variables with non-arrest control cases. Risk factors for cardiac arrest were then weighted, with higher weightings given to increasing physiological or biological clinical deterioration. Factors identified as significant predictors of cardiac arrest were dyspnoea, abnormal respiratory rate, abnormal pulse, reduced systolic blood pressure, abnormal temperature, reduced pulse oximetry, and nurse or doctor concern. The study then used this information to develop an aggregate scoring system to trigger an intervention. Although this tool has not been validated, it was the first evidenced-based approach to provide activation criteria for an RRT rather than relying on extrapolations from empirical models. The myriad of observations and assessments required to complete the tool would be available only to patients located in a critical care area and its complex nature may make it impractical for use on general wards.

An observational population-based single centre study (Duckitt et al., 2007) investigated the contributions of respiratory rate, heart rate, arterial pressure, temperature, oxygen saturation, and consciousness level on mortality and then used these data to devise a robust scoring system that could be used to trigger an intervention. This two-phase study comprised of an initial study period between July and November 2003 (n= 3184) followed by a validation of the tool between October and November 2005 (n=1102). Analysis of the data
from this study demonstrated that a respiratory rate >20/minute; a heart rate >102/minute, systolic blood pressure < 99 mmHg; a temperature <35.3 C; an oxygen saturation <96%; and disturbed consciousness were associated with increased mortality. Duckitt and colleagues (2007) then developed a simple EWS based on this information and validated this tool by applying the scoring system to the second data set. The second data set prospectively validated the effectiveness and efficacy of using this TTS in clinical practice. Duckitt and colleagues (2007) argue that this tool is simple to use and effectively alerted ward staff to patients at risk of clinical deterioration. However, Duckitt and colleague’s (2007) study is not without limitations. Firstly, the TTS is based on single, unvalidated measurements taken by ward staff on patient admission to the emergency admission unit and, as such, may be prone to measurement and recording errors. Another limitation is that it is a single centre study in an acute medical setting and would require validation in other acute areas.

**Track and trigger systems: The single parameter system**

Only one paper has evaluated a single parameter system (Cretikos et al., 2007). Cretikos and colleagues (2007) used a nested matched case control study to evaluate the ability of predefined objective clinical MET activation criteria to identify patients at risk of in-hospital cardiac arrest, unplanned ICU admission, or unexpected death. This study confirmed that, in combination, increased heart rate and respiratory rate, low systolic blood pressure, and a decrease in the Glasgow Coma Score (GCS) are specific predictors of cardiac arrest, unplanned ICU admission, and unexpected death. Although the MET activation criteria predicted an impending MAE, it demonstrated a low sensitivity. The investigators acknowledged that a significant number of observations were missing. This missing data may have considerable impact on the performance of the activation criteria and, arguably, on the final results of the study—for example, two of the seven hospitals that participated in the study had approximately 60% of observations missing. The most frequently missing
observation was respiratory rate with the proportion of missing respiratory rate observations from hospitals participating in the survey varying from 0.8% to 61.8%. Evidence increasingly highlights that a respiratory rate greater than 27 breaths/minute is one of the most important predictors of cardiac arrest on the general wards of the hospital (Considine, 2005; Fieselmann, Hendryx, Helms, & Wakefield, 1993; Jacques et al., 2006). TTSs will only reach their true potential if nurses use them correctly and this includes collecting and acting on abnormal physiological parameters that have been developed to identify the acutely ill ward patient at risk of clinical deterioration. The literature indicates that currently nurses are resistant, reluctant, or unable to use these systems effectively or appropriately. Presently, there is a gap within the literature exploring nurses’ reluctance to use these important systems.

**Track and trigger systems—the afferent limb: Summary**

The evidence from this integrative review highlights that many hospitals have developed and implemented their own TTSs but these tools have not been subjected to rigorous testing and evaluation. Several limitations to the use of the MEWS to predict clinical deterioration exist. Response times for the MEWS were not standardised so delayed responses, inadequate assessment, and inadequate treatment, interventions, and management plans may have impacted on the findings of these studies.

The role and importance of individual physiological variables require further study. The literature seems to suggest that many aggregate scoring systems continue to use physiological variables that have been demonstrated to have limited predictive value (Cuthbertson et al., 2007; Kellett & Deane, 2006). Threshold values also differ between different systems (Cuthbertson et al., 2007; Gao et al., 2007; Goldhill, Worthington, Mulcahy, Tarling, & Sumner, 1999; Goldhill, McNarry, Mandersloot, & McGinley, 2005; Subbe et al., 2001) and
different studies (Cuthbertson et al., 2007; Gardner-Thorpe et al., 2006; Stenhouse et al., 2000; Subbe et al., 2001). This can make generalisations problematic. It is clear that a threshold score for triggering an intervention should be derived from reliable methodologies rather than empirical models. In spite of these limitations, it must be acknowledged that the role of any EWS is to secure timely and appropriate intervention to patients exhibiting physiological signs compatible with clinical deterioration. These tools have not been developed as predictors of outcomes. However, given that the afferent limb of an RRS has been identified as an important limb of the system, it is important that the effectiveness of these models relative to meeting the three mains aims of an RRS be thoroughly evaluated.

**Rapid response systems: The efferent limb**

The efferent limb of an RRS responds to the deteriorating patient. The two most common types of efferent limb systems are the “high capability team” and the “ramp up team” (Devita et al 2006). A MET is an example of a high capability team. The CCOT, ICU Liaison Nurse, or the after-hours APN are all examples of a ramp up team.

**The efferent limb: Ramp up teams**

Ramp up teams are primarily a nurse-led system. A number of different types of ramp up teams exist, although the CCOT is perhaps the most well known. CCOTs have been developed predominantly in the UK. These teams implement interventions through the use of protocols, standing orders, and patient group directives (Coombs & Dillon, 2002; DeVita et al., 2006; McArthur-Rouse, 2001; Robson, 2002). Because the organisation and structures of CCOTs differ between hospitals, evaluating their effectiveness is challenging. CCOTs can vary significantly between different hospitals (Robson, 2002). A CCOT may be composed of a single critical care nurse or a team of critical care nurses, and may operate only during
particular times—for example, during normal working hours (Monday to Friday, 9.00 am to 5.00 pm) or weekends, or may operate as a 24-hour service.

Two systematic reviews have recently been undertaken in an attempt to demonstrate the effectiveness of a CCOT (Esmonde et al., 2006; McGaughey et al., 2007). The findings of both these reviews indicate a lack of high-quality studies evaluating these systems. The poor methodological designs used in the included studies prevented the reviewers from making clear recommendations about the role of a CCOT in improving patient outcomes. McGaughey and colleagues’s systematic review (2007) only included two studies. One of those studies was a prospective cluster randomised trial evaluating the effectiveness of a MET, despite the fact that the objective of McGaughey’s and colleagues (2007) systematic review was to determine the impact of a CCOT not a MET. A MET differs significantly in its organisational structure and processes to a CCOT, and it is questionable whether this study should have been included in the review. If it had not been included, there would have only been one study to review and that would significantly affect the review’s conclusions. Esmonde and colleagues (2006) undertook a systematic review of a CCOT. Seventeen papers were included in the review. The reviewers concluded that while improvements in patient outcomes were linked to the operation of a CCOT, the differences in service delivery and the diversity of the studies impacted on the findings of the review. Like McGaughey and colleagues (2007), that systematic review also included studies evaluating the effectiveness of a MET, again impacting significantly on the findings of that paper.

Only one group has undertaken a randomised control trial evaluating the effectiveness of CCOTs. Priestly and colleagues (2004) undertook a step-wise ward randomised trial with a phased introduction of CCOT intervention in 16 acute adult wards of one general hospital over a 32-week period. The outcome measures for this study were in-hospital mortality and length of stay. Priestly and colleagues (2004) did not measure in-hospital cardiac arrest or
unplanned admission to ICU. The findings demonstrated a statistically significant reduction in hospital mortality in wards where CCOTs operated compared to wards where CCOTs did not operate. A sequenced introduction of the intervention may have led to a contamination of the study wards and this may have impacted on the overall findings of this study.

In summary, ramp up teams have been developed and implemented with the aim of improving the clinical outcomes of the acutely ill ward patient at risk of clinical deterioration and the management processes involved in caring for these vulnerable patients. These teams have been operational for a number of years. However, there is paucity of high-quality data validating the effectiveness of ramp up teams in reducing in-hospital cardiac arrest, unplanned admission to ICU, and death.

**The efferent limb: High capability teams**

A MET is composed of at least one doctor with advanced life support skills and one nurse, and is available 24-hours-a-day, 7-days-a-week (Cretikos & Hillman, 2003; Lee et al., 1995). A MET is an example of a high capability RRS. Australia has been at the forefront of developing METs (DeVita et al., 2006).

Three systematic reviews (Chan, Jain, Nallmothu, Berg, & Sasson, 2010; Ranji, Auerbach, Hurd, O'Rourke, & Shojania, 2007; Winters et al., 2007) evaluated the effectiveness of high capability RRSs on hospital mortality and in-hospital cardiac arrest. Those reviews concluded that the available evidence about the effectiveness of RRSs is inconclusive, and that many of the positive improvements in patient outcomes are the results of improvement in the care and management of acutely ill ward patients and technological developments. These two systematic reviews call for more large randomised trials to clarify the efficacy of RRSs.
Three studies (see appendix 3) have failed to demonstrate that a MET positively influences hospital cardiac arrests, unplanned admission to ICU, or hospital mortality (Bristow et al., 2000; Hillman et al., 2005; Kenward et al., 2004). The only randomised control trial conducted on METs failed to reveal any differences between the intervention and the control hospitals in the primary outcome measures of in-hospital cardiac arrest, hospital mortality, and unplanned admission to ICU (Hillman et al., 2005). Twenty-three hospitals were randomised as either intervention hospitals \((n=12)\) or control hospitals \((n=11)\). Although the findings of this study imply that a MET is ineffective for improving the three outcome measures, there are a number of possible explanations for these findings. The timeframe for the implementation of the MET may have been too short, and there was a low rate of documentation of vital signs, which may have impacted on the number and timing of MET activations. There was a low rate of activation of the METs even when activation criteria were present. This study was the first randomised control trial on METs and there was a lot of national information and interest in the study and its findings and this may have led to the control hospitals being contaminated by the theories and ideas underpinning early recognition and intervention in the acutely ill ward patient, which raises the issue of the Hawthorn effect (Polit & Beck, 2008). These significant limitations may have been responsible for the study’s failure to demonstrate a reduction in the outcome measures.

Kenward and colleagues (2004) evaluated the activity and the impact of a MET one-year after implementation. This was a single centre cohort study using historical controls. This study failed to reveal any statistical significance of MET intervention on in-hospital cardiac arrests and hospital mortality. Similar to Hillman and colleagues’ 2005 study, Kenward and colleagues’ 2004 study also revealed a low rate of activation of the MET even when activation criteria were present. While the timeframe for evaluation of the impact of MET intervention was longer than in the MERIT trial (Hillman et al., 2005) (12 months
compared to 4 months), it still may have been too short to demonstrate any statistically significant effect on the outcome measure.

Bristow and colleagues (2000) evaluated the effectiveness of a MET in reducing the rates of in-hospital cardiac arrest, unplanned admission to ICU, and hospital mortality. This non-randomised cohort study with casemix adjustment found no significant difference in the rates of cardiac arrest and hospital mortality between the intervention hospital and the two control hospitals. Bristow and colleagues’s (2000) study did demonstrate a significant difference in the rates of unplanned admission to ICU in the intervention hospital. This study, like other studies (Cretikos et al., 2007b; Hillman et al., 2005), argues that patients exhibited premonitory signs of an impending adverse event that should have activated a MET response. However, of the 706 cases in which METs should have been activated, the METS were only activated in 150 cases. This clearly highlights that MET are underutilised and not activated appropriately, and this may have impacted significantly on the findings of this study.

Five single centre studies have demonstrated that METs are effective at reducing in-hospital cardiac arrests, hospital mortality, and unplanned admission to ICUs (Bellomo et al., 2003; Buist et al., 2002; Dacey et al., 2007; DeVita et al., 2004, Jones, Bellomo, et al., 2005). In a non-randomised before-and-after single centre cohort study, Buist and colleagues (2002) demonstrated a 50% reduction in hospital cardiac arrests. That study had a very protracted period between the control and intervention (three years) and this reduction in cardiac arrests may have occurred in response to other developments within the clinical arena—for example, improved assessment skills of practitioners or improved documentation of vital signs. DeVita and colleagues (2004) demonstrated, in a single centre cohort study using historical controls, a 17% reduction in the incidence of in-hospital cardiac arrests. The aim of that study was to assess if the implementation of a structured protocol improved the effectiveness of a MET. Evidently, a RRS was operational in the intervention hospital and the intervention being
measured was the protocol, not the effectiveness of the MET. This would indicate that the hospital where DeVita and colleagues (2004) undertook their study also experienced under-utilisation of the MET.

Bellomo and colleagues (2003) reported a significant reduction in the number of in-hospital cardiac arrests and hospital mortality following the implementation of a MET. This single centre cohort study used historical controls. Jones and colleagues (2005) also reported a sustained and progressive reduction in cardiac arrests in their single centre cohort study using historical controls, which took four years to complete. It is difficult to assess if the reduction in cardiac arrests was the result of the implementation of the MET or improvements in the clinical area. The most recent study evaluating the impact of a RRS on MAEs was conducted by Dacey and colleagues (2007). Dacey and colleagues’s (2007) single centre study also used historical controls. The results of that study demonstrated a significant reduction in the number of in-hospital cardiac arrests and unplanned admissions to ICU.

**The efferent limb of the rapid response system: Summary**

Currently, there are two similar yet distinct efferent limbs of the RRS: (1) nurse-led systems, referred to by Devita and colleagues (2004) as a “ramp up systems”; and (2) METs, referred to as “high capability systems”. Although similar, the different structures and processes that support and drive these models dictate that they should be evaluated separately.

The evidence regarding the effectiveness of the efferent limb of an RRS in reducing adverse events remains inconclusive. The only randomised controlled trial conducted on an RRS (Hillman et al., 2005) failed to significantly demonstrate a reduction in hospital mortality, in-hospital cardiac arrest, or unplanned admission to ICU. In spite of these inconclusive findings, the widespread and, as some argue, ill-conceived adoption of RRSs
within the acute care sector continues with a momentum that is difficult to control. This is evidenced by the Institute for Healthcare Improvement (IHI) in the USA recommending the implementation of RRSs in acute hospitals. The Australian Commission on Safety and Quality in Health Care has also recommended that all hospitals in Australia implement a RRS. In the UK, the National Institute for Clinical Excellence, which bases its recommendations on systematic reviews of the best available evidence, recommends that recognition and response to clinical deterioration in ward patients should be underpinned by an RRS (NICE, 2007). Health-care practitioners are consistently challenged to occupy an evidence-based paradigm and the controversial use of valuable resources in a system of care that has failed to demonstrate conclusively a positive impact on patient outcomes remains problematic.

RRSs are highly complex systems and many variables have an impact on their effectiveness. Even with the best methodology, it may not be possible to quantify the effects of a MET system. Hospitals are “chaotic” systems, and may be impervious to analysis using linear methodology (Kerridge, 2000). In this and other areas, it may be futile to attempt to go beyond qualitative research. This review has clearly demonstrated that a recurrent theme within the literature is that RRSs are under-utilised by health-care practitioners generally and particularly by nurses, who are responsible for activating 80% of these systems (Cretikos et al., 2007b; Cullinane et al., 2005; Hillman et al., 2005; Kenward et al., 2004). The under-utilisation of the systems suggests that many opportunities for early intervention for deteriorating ward patients are missed and this may have a significant impact on the findings of the studies reviewed in this chapter. The reasons why nurses appear reluctant to activate these systems are worthy of further investigation.

There are a number of other ramp-up RRSs that have been developed with the aim of improving the care and management of the deteriorating ward patient, for example, the ICU
liaison nurse role (Chaboyer et al., 2005; Chaboyer, Thalib, Alcorn, & Foster, 2007; Eliott et al., 2008; Endacott & Westley, 2006; Green & Edmonds, 2004). The ICU liaison nurse role has predominantly been developed and implemented in Australia. There is clear evidence that the ICU liaison role improves care delivery (Chaboyer et al., 2007; Endacott & Westley, 2006; Green & Edmonds, 2004). However, to date, no studies have been undertaken demonstrating the impact of the ICU liaison nurse in reducing the incidence of MAEs in the acutely ill patient at risk of clinical deterioration.

Many of the studies that demonstrate a favorable impact of METs have been criticised for their methodological frameworks. One of the frequently criticised frameworks is casemix adjustment. The use of casemix adjustment is problematic for a number of reasons. Casemix adjustment does not include socio-economic differences in patient populations, funding levels, staffing ratios, medical and nursing staff expertise, or ‘cultural’ differences between hospitals (Kerridge, 2000). The MERIT trial (Hillman et al., 2005) and the study by Bellomo and colleagues (2004) used a very short implementation period. In an environment as complex and chaotic as a hospital, a longer implementation period may be required for the significant cultural change required to assimilate a RRS into clinical practice. Most of the studies discussed in this chapter assessed the effect of a RRS implemented over a one- to two-year period. By comparison, the introduction of similar complex interventions and systems such as trauma systems have taken up to 10 years before any impact on mortality could be detected (Lecky, Woodford, & Yates, 2000; Nathens, Jurkovich, Rivara, & Maier, 2000).

**Summary**

In this chapter, a review of the published literature related to the factors influencing and impacting on the deteriorating ward patient has been presented in this chapter. Three main problems were identified and analysed. First, when hospitalised patients are exposed to
suboptimal ward care, the incidence of MAEs increases, which in turn increases negative outcomes. Second, deteriorating ward patients are more at risk of MAEs in the hospital after-hours, and a number of nurse-led initiatives have been implemented to improve the care and management of these patients. However, to date formal evaluation of these initiatives have not been conducted. Third, RRSs have been developed to improve the care and management of the deteriorating ward patient. The evidence underpinning the effectiveness of RRSs remains inconclusive. What is known about these systems is that nurses are their most frequent users, yet nurses are reluctant and resistant to use RRSs, but the reasons for this have not yet been explored.

Through this review, the economic, and clinical issues have been identified and described. This in-depth analysis of the literature has exposed and recognised the gaps in the current knowledge and understanding of this topic. In the following chapter the research questions are presented and the methodological approach used to conduct the study is described.
Chapter 3: Research methods

Introduction

The advantages of, and the challenges facing, RRSs have been highlighted in the previous chapter. The literature review also enabled a number of focused research questions to be developed. The research questions developed as a result of a critical analysis of the literature are outlined in this chapter. The study’s paradigm of inquiry is also presented. Established approaches to case study are discussed and the definition of the single exploratory case study used in this research is presented. Particular attention is paid to the conceptualisation of the case study and the case, and identifying the case. Finally, the methods used to answer the research questions are outlined.

The research questions

This single exploratory case study has two units of analysis. In the first unit of analysis, the practices of registered nurses using a RRS are explored. The research questions developed to meet the aim of this unit of analysis were:

- What do nurses identify as barriers to RRS?
- What do nurses identify as the strengths of the RRS?
- What are nurses’ experiences and perceptions of using RRS?

The aim of the second unit of analysis was to explore if a ramp-up RRS, the APN after-hours service improved patient outcomes. The research questions developed to meet the aim of the second phase were:

- To what extent does the introduction of the ANP after-hours service reduce MAEs in medical ward patients?
- To what extent does the introduction of the ANP after-hours service reduce adverse events in medical ward patients?
To what extent does the introduction of the APN after-hours service increase the activation of the MET?

To what extent does the implementation of the APN after-hours service reduce the physiological abnormalities associated with life-threatening clinical deterioration?

**Case study research: A pragmatic bridge**

In this study, an exploratory case study was used to understand the practices of nurses using an RRS and explore the impact of the implementation of an RRS nurse-led service. RRSs are complex and multidimensional, and cannot be separated from their context the clinical environment, because many variables have an impact on their effectiveness. Therefore, to enable a comprehensive understanding of these systems, they need to be studied within their clinical context.

In order to develop in-depth knowledge and understanding about this contemporary and complex area of practice, a case study research (CSR) design was used. Case studies are appropriate when the focus of the study is on contemporary phenomena within a real life context and the investigator has little control over events (Yin, 2009). CSR is used in a range of social science (Luck, Jackson, & Usher, 2006; Yin, 2009) and health-care settings (Anthony & Jack, 2009). CSR commonly explores, describes, or explains the case or cases of interest and therefore has the capacity to offer purposive, situational, or interrelated descriptions of the phenomena connecting practical, complex elements to theoretical abstractions (Stake, 2000). CSR enables a focus on stakeholders’ concerns within a contemporary context and facilitates the investigation of nursing practice (Anthony & Jack, 2009; Chaboyer et al., 2005; Solman, Conway, & McMillan, 2004; Yin, 2009). Depending on the research purpose, aims, and questions, both quantitative and qualitative methods can be applied and used, enabling a rich description of the phenomena of interest. The flexibility of
the methods used and the potential for pragmatic application were seen as the key strengths of using CSR in this research project.

Paradigms are patterns of belief and practices that regulate inquiry (Weaver & Olson, 2006). Paradigms direct the perspective from which the research questions are asked, problems are investigated, and the research is designed. Paradigms also direct the research methods used. For many years, these research paradigms have been separated and isolated from each other and paradigm purists have rejecting the use of multiple methods and methodologies or the combining of different research approaches. Research purists assume an ‘incompatibility thesis’ and argue that paradigms cannot be separated or segmented; therefore, the use of mixed methods or mixed models is unsustainable. Paradigm purists further contend the ongoing incompatibility between different research methods, arguing the epistemological, ontological, and methodological underpinnings of the different research paradigms are diametrically opposed. Incompatibility theorists argue that the underlying polarity between paradigms makes combining methods problematic (Morgan, 2007) and any combination of these paradigms will result in contradictory views of what constitutes reality and knowledge.

The incompatibility thesis has been challenged by the emergence of the third wave or third research movement, known as the pragmatic paradigm (Goles & Hirschheim, 2000). Pragmatism offers a logical and practical alternative to researchers struggling to combine the different philosophical approaches. Pragmatists espouse that not all research problems can be resolved with the use of a single method, that every method has limitations, and that multiple methods are often needed. Pragmatic researchers link the choice of research, approach and methods directly to the purpose and nature of research questions posed (Creswell, 2003). The pragmatists argue that instead of the method being most important, the problem is most important, and different approaches may need to be used to understand the problem (Goles &
Hirschheim, 2000). Rather than sitting comfortably within one paradigm, CSR has been likened to a bridge between the paradigms (Luck et al., 2006). This bridge offers the researcher flexibility in relation to methods and methodology.

**Defining case study**

Although case study has some definitional problems (Stake 1994), part of the generically accepted definition is that case study is an intensive, detailed, in-depth study, examination, or investigation of a single unit, the case (Dempsy & Dempsy 2000). One of the most population definitions of case study is put forward by Yin (2009), who defines it as:

> “An empirical inquiry that investigates contemporary phenomena within its real context, especially when the boundaries between the phenomena and context are not clearly evident.” (Yin, 2009, p13)

Stake (1994) provides a less clear definition of case study, stating that it “is a process of learning about the case and the product of our learning” (p.235). An alternative definition is offered by Gerring (2004), who defines case study as an intensive study of a single unit for the purpose of understanding a larger class of (similar) units. These numerous definitions create tension for the case study researcher, who is required to ensure their research study is rigorous and maintains methodological integrity but is unable to apply an agreed definition of the research design to their study. Failure to be explicit about terms and definitions used within CSR not only gives rise to incorrect assumptions about the robustness of the methodology (Braun & Clarke, 2006), but also creates increasing confusion about the application and implementation of the methodology. It is important, therefore, to ensure a clear definition of the research design and demonstrate a transparent research strategy before embarking on data collection and analysis. Yin’s (2009) definition offers a flexible and pragmatic approach to the research design while embracing the ideology of CSR taking place.
with contemporary phenomena in real life settings and, therefore, was adopted in this CSR project.

The two major proponents of CSR are Yin (2009) and Stake (2000) who, in their respective texts, offer two quite different approaches to CSR. Yin favors both quantitative and qualitative approaches to the data collection process, whereas Stake offers an approach that focuses exclusively on qualitative data collection methods. Yin (2009) presents a straightforward protocol approach for conducting CSR. The protocol has been developed to assist researchers to carry out CSR in a reliable, rigorous, and systematic manner. This study required the use of multiple methods and, therefore, was aligned with Yin’s approach to CSR. The use of a clear and structured framework also ensures that the research follows a “clear logic of design” that maintains the rigour and the methodological integrity of the study (Manias & Street, 2001; Rosenberg & Yates, 2007; Whitley & Ball, 2002).

A schematic representation of the components of the research was derived from Rosenberg and Yates’ model. The next section in this chapter includes an explanation of the procedural steps undertaken in the study and illustrated in Figure 2, which proved useful as it provided a visual ‘map’ of the interrelated elements of the study, gave structure to the audit trail, and illustrated the key concepts and underpinning theories of the research design and study (Rosenberg & Yates, 2007).
Figure 2—Schematic representation of procedural steps (modified from Rosenberg and Yates 2007).
Identifying the case

The ‘case’ must be clearly defined at the beginning of the inquiry. The term ‘case’ carries a variety of meanings (Ragin, 1999). Yin (2009) and Stake (1995) both note that one of the key challenges researchers face when designing case studies is the issue of clearly articulating the case. CSR has particular boundaries and it is essential that the case study researcher is able to define these boundaries, as the boundaries can assist in limiting data collection (Yin, 2009; Luck et al., 2006). Also, it is important that the case boundaries are congruent with and clearly linked to the research question and the data collection methods used (Luck et al., 2006). The case is, therefore, clearly defined by the research aims and questions. In this case study, the case was the deteriorating patient and the embedded units of analysis were, first, nurse’s practices of using an RRS and, second, patient outcomes. The context of the case was restricted to the Gold Coast Hospital and the RRSs used at the hospital. The hospital has 480 in-patient beds and caters for medical and surgical needs of adults and children, making it the third largest public teaching hospital in Queensland. The hospital services a large metropolitan population as well as tourists and a transient, seasonal workforce. The hospital has an established MET and recently implemented an APN after-hours service. The hospital has six medical wards and RNs were recruited for in-depth interviews from these wards. Medical wards were chosen because the incidence of adverse events is higher in this patient cohort (Hodgetts, Kenward, Vlackonikolis, et al., 2002; Stenhouse et al., 2000; Subbe et al., 2003).

Case studies can be descriptive, exploratory, or explanatory (Yin, 2009). This study explored nurse’s practices of using an RRS and patient outcomes following the introduction of an APN after-hours service, so the most appropriate case study design to use was an exploratory case study (Yin, 2009). Case studies can also be either single case or multiple cases. A single case study is one in which a single research/object or event is used. This
design is used when the case represents an extreme or unique case (Yin 2009). In this single exploratory case study, there were two embedded units of analysis. Each of these embedded units was explored separately, and the results from the analysis of these subunits were combined to yield a thick description of the case.

**Limitations of case study research**

Despite its increasing popularity, CSR has sometimes been perceived as lacking rigour and objectivity (Flyvbjerg, 2006) when compared to other research methods. One of the challenges in using CSR is the lack of clarity about case study methodology (Yin, 2009). Confusion exists about the name, nature of, and use of the term ‘case study’ (Anthony & Jack, 2009). Case studies have also been used in a variety of different ways and settings, which adds to the methodological confusion surrounding CSR. Meier and Pugh (1986), Yin (2009), and Anthony and Jack (2009) regard case study as a research strategy; Lincoln and Guba (1985) view it as a technique for reporting the findings of a naturalistic inquiry; other researchers (Henning, Nielsen, & Hauschildt, 2006; Kells & Koerner, 2005) argue that it is a teaching technique. Many researchers agree that CSR can be quantitative, qualitative, or a synthesis of both approaches (Anthony & Jack, 2009; Braun & Clarke, 2006; Yin, 2009). While this flexibility is clearly appealing to researchers who seek to study phenomena within a real life context, it also creates uncertainty and ambiguity for researchers when planning and designing the research study.

A criticism of CSR is the belief that it lacks generalisability (Stake, 1995). However, advocates of CSR argue that the purpose of CSR is not empirical generalisation (Yin, 2003) but analytical generalisation. Therefore, CSR aims to develop “theoretical explanation of phenomena” (Sharp, 1998). Additionally, CSR is concerned with the study of the “particular” and aims to provide an “holistic” (Yin, 2009) approach to the topic by providing rich
description of a phenomenon, which can then be used to inform practice, to establish the value of a case, and to add knowledge of a specific topic (Yin, 2009; Stake, 1995).

Yin (2009) recommends a number of strategies that the case study researcher can adopt to promote rigour:

- use a protocol to guide data collection,
- use multiple sources of evidence, and
- establish a chain of evidence.

These strategies were used in this CSR study to promote rigour and maintain the validity and reliability of the study. This case study is divided into two complementary but separate units of analysis. The methods for the two units of analysis will be presented separately to enable a more transparent understanding of the processes and decision-making in regards to the data collection activities and analysis this process will also enable the development of a clear audit trail.

The first unit of analysis: Practices of nurses using rapid response systems

Following ethical approval from the hospital and the university, the appropriate Nurse Unit Managers (NUMs) of the hospitals’ medical wards were contacted and given an explanation of the nature of the study as well as the opportunity to raise queries or concerns. The identification of a ‘gatekeeper’—who acts as a liaison between the researcher and the organisation—is recommended (Quirke, 2011). The NUMs were seen as the most senior ward nurses and, therefore, as being able to facilitate access to ward areas and the ward staff. With permission from these gatekeepers, access to the community of RNs was sought. “Getting in” (Buchanan, Boddy, & McCalman, 1998) refers to gaining the trust of the participants. In-service education sessions were delivered for two weeks prior to data
collection. These sessions enabled the researcher to introduce herself to some the nursing staff and explain the study.

**Selection of participants**

Purposive sampling was chosen as the sampling method for this unit of analysis. The objective of purposive sampling is to identify appropriate participants for in-depth examination (Patton, 2002). The purposive sampling was criterion based (Holloway & Wheeler, 2002). RNs who had cared for medical patients within the 12 hours prior to the patient’s unplanned admission to ICU was used as a criterion to identify potential participation. The timeframe of 12 hours prior to unplanned admission to ICU was chosen to cover the period when patients are unstable and, therefore, most likely to require an RRS to be activated. The interviews were conducted within 48 hours of the patients’ admission to ICU to ensure the participants’ accurate recall and recollection of the phenomenon of interest.

The ICU admission book was checked every morning to identify patients who had experienced unplanned admissions from the medical wards. If a patient had been admitted unexpectedly from the medical wards, the appropriate NUM was contacted and, following their approval, information sheets (see appendix 4) and consent forms (see appendix 5) were left with the NUM to distribute to the nurses who had cared for the patient during the 12 hours prior to the patient’s unplanned admission to ICU. The relevant RNs then contacted the researcher if they were interested in being interviewed. Interviews were conducted in a room at the hospital separate to the ward area and were arranged at a date and time convenient to the participant. All participants who agreed to be interviewed were given information sheets outlining the study (see appendix 4). All interviews were recorded using a digital recorder and transcribed by the researcher. Each participant was required to sign a consent form before
any data were collected (see appendix 2). Recruitment of participants continued until no new information was forthcoming from participants.

**Data collection methods**

Interviews are considered to be the “backbone of case study research” (Gangeness & Yurkovich, 2006, p.15) and are conducted to explain, describe, or elaborate on the phenomena of interest (Yin, 2009). In-depth, semi-structured interviews were the data collection method used in the first unit of analysis. In-depth interviews aim to elicit information about the meanings and participant’s interpretations of the phenomena of interest (Rice & Ezzy, 2001). Interview questions needed to be clear and unambiguous. Given that factors affecting nurses’ experiences, perceptions, and practices of using METs have been explored in a limited manner, interview questions were broad, giving participants the opportunity to tell their stories and recount their experiences (Quirke, 2011). An interview guide was developed to ensure that all relevant issues were discussed. The semi-structured interview included the following questions:

1. Can you start by telling me about your experience as an RN; for example, how long have you been registered? How long have you worked on this ward?
2. Can you tell me about your experience of caring for a specific patient who was admitted to the Intensive Care Unit?
3. How did you feel when the patient was admitted to ICU?
4. Can you tell me about the patient management decisions you made while caring for this patient?
5. Can you recall any of your assessments (e.g. pulse, blood pressure, heart rate) that you were concerned about?
6. What factors influenced your decision to activate or not activate the MET?
7. Do you feel anything could have been done differently as the patient’s condition deteriorated?
8. What are your experiences of using the MET?
9. What do you identify as the barriers in relation to activating the MET?
10. Can you identify any interventions or actions that would help you to activate the MET in a similar situation to improve MET activation?
11. Do you have access to support systems that assist your clinical practice when caring for an acutely ill ward patient?
12. Are there any skills or strategies or support systems that you would like to develop that you feel might help you deal with similar patients in the future?

Immediately after each interview, a contact summary sheet was completed (Miles & Huberman, 1994). This activity marked the beginning of the analytical process. Miles and Huberman (1994) encourage the use of summary sheets as they help guide and plan the next interview. By reflecting on the interview, the main concepts and issues raised in the interview can be identified. Contact summary sheets pulled together salient points and summarised these. Any questions arising from an interview that required inclusion in the subsequent interviews were also documented on the contact summary sheet. A copy of each contact summary sheet was attached to the corresponding section of the analysed data, making ongoing interpretation of the data easier. An example of a contact summary sheet is in appendix 6.

**Transcription of audio-taped interviews**

The researcher transcribed all the interviews. Each interview was assigned a number and a date. Each participant was given a pseudonym. Each interview took four to five hours to transcribe. Holloway and Wheeler (2002) suggest that data immersion and consideration of issues of significance occur when researchers transcribe the interviews they audiotaped during fieldwork. There is a possibility that researchers who do not transcribe the entire interview themselves will discount important information that would have been uncovered when listening to the tape and viewing the transcript (Holloway & Wheeler 2002).
Researcher as an instrument

In qualitative research, the researcher is regarded as a research instrument (Poggenpoel & Myburgh, 2003). In fact, they are often described as ‘the key instrument’. This is because all the research methods associated with qualitative research are heavily dependent on the researcher as interviewer, observer, facilitator, communicator, and interpreter of data. In other words, all data are filtered through the researcher. It is through the researcher’s facilitative interaction that a context is created in which participants share rich data regarding their experiences and life world. The advantages of the researcher as instrument includes the opportunity to capitalise on the interactive process that exists as a result of the interview process (Lincoln & Guba, 1985). The researcher is therefore able to be proactive, responsive, and flexible, which ensures the progression of a successful inquiry (Appleton & King, 1997). The position of the researcher as instrument necessitates the identification of personal values, assumptions, and biases at the outset of the research study (Cresswell, 2003). The investigator’s contribution to the research setting can be useful and positive rather than detrimental. My perceptions of the care and management of the deteriorating ward patient has been shaped by my personal experiences. I have worked in various clinical areas—for example, general medical and surgical wards critical care units, and HDUs—and at various levels—for example, as a staff nurse, charge nurse, NUM, and a clinical nurse specialist. I have been involved in planning, implementing, and delivering educational programs that develop ward nurses’ skills and knowledge when caring for acutely ill ward patients at risk of clinical deterioration. This understanding of the context, challenges, and opportunities nurses face when caring for the deteriorating ward patient enhances my awareness, knowledge, and sensitivity to the difficulties and issues encountered by ward nurses when caring for such patients. Therefore, I bring to the research study knowledge about the clinical environment, and nurses’ roles, responsibilities, and scope of practice.
As a result of previous clinical and educational experiences, I also bring certain biases to this study. These biases present challenges for the investigator. Poggenpoel and Myburgh (2003) argue that the researcher as an instrument can be the greatest threat to trustworthiness in qualitative research. Potential biases may include: (1) the investigator’s mental and other discomforts, which can pose a threat to the truth value of data obtained and information obtained from the data analysis; (2) the investigator not being sufficiently prepared to conduct the field research; and (3) the investigator conducting inappropriate interviews (Poggenpoel & Myburgh, 2003b). Three strategies were used in this research study to limit researcher bias and promote the trustworthiness of the study. The first strategy required that I developed a sense of self-awareness that ensured I did not enter the research field when I was tired or stressed. I also ensured that I gave myself adequate time to recover from previous interviews. These strategies ensured I was well prepared to interview the participants. The second strategy that was used to limit researcher bias and promote the trustworthiness of the study was a pilot study, and the third strategy was the use of a reflective journal.

**Pilot study**

A pilot study was conducted to test the quality of the interview guide and also allow preparation of the main data collection activity. One of the advantages of conducting a pilot study is that it highlights areas of the research that may fail because research protocols may not be followed, or proposed methods or instruments are inappropriate. For this research study, one pilot interview was conducted. Following feedback from the participant, slight changes were made to the wording of some of the questions. The audiotape of the interview was reviewed to ensure that the full range of data was evident and relevant to the research questions. The participant was able to answer all the questions and the information gained
from the participant could be linked to the research question; therefore, no questions were removed from the interview guide.

**Reflective journal**

A reflective journal was used extensively as a means of contributing to the trustworthiness of the study. Furthermore, the use of a journal reduced my tendency to accept internalised assumptions related to the context, thus enabling me to experience the phenomena of interest with a renewed worldview. It was imperative that my prior exposure to this context did not influence my objectivity and professional judgment (Manias & Street, 2001). Keeping a journal allowed me to consider ideas that emerged as part of the research process and helped me in preparing for subsequent interviews. Issues pertaining to self and method, as well process, thoughts, and feelings, were recorded and detailed, providing a transparent audit trail of the reflections of the human instrument (Lincoln & Guba, 1985). Presenting this audit trail contributes to the credibility of the final account (Lincoln & Guba, 1985).

**Thematic data analysis**

Themes derived from this study’s data were developed using an inductive approach (Braun & Clarke, 2006). Boyatzis (1998) describes a theme as “a pattern found in the information that at a minimum describes and organises the possible observations and at a maximum, interprets aspects of the phenomenon” (p.4). The process of inductive analysis used in this study involved two levels of interpretation. The analysis of individual transcripts was the first level of analysis, and involved reading and re-reading individual participant transcripts several times to identify sub-themes (Braun & Clarke, 2006; DeSantis & Ugarriza, 2000). It was important to re-read the transcripts individually to ensure that sub-themes were
not overlooked (DeSantis & Ugarriza, 2000). Continuous re-reading allowed for consistencies and inconsistencies to be discovered and emerging themes to be developed. This strategy also enabled immersion in the data (Braun & Clarke, 2006). Being clear about the study’s questions and aims is important because it ensures that the analysis process fits with the unique characteristics of the study. During this level of analysis, in-depth discussions were held with my research supervisors to interrogate the data analysis and challenge the emerging findings (Braun & Clarke, 2006). This entailed grouping segments of texts within transcripts. This comparative analysis (Polit & Beck, 2006) parallels the similarities and differences of the transcripts, and aids the development of overarching themes and sub-themes. These sub-themes were continuously reinterpreted were given broad descriptive names in order to capture the significant lines of inquiry (Benner et al., 1992). Initial interpretation of the transcripts revealed multiple sub-themes. However, with repeated immersion and analysis of the transcripts, similar sub-themes were grouped together in themes. During this second level analysis across the different interview transcripts was also performed with the aim of combining sub-themes into themes. Each theme was then labeled (Boyatzis, 1998). Themes were then conceptually developed to describe and interpret the phenomena of interest (Boyatzis, 1998). The conceptual, iterative theme development acknowledges that the boundaries for themes can sometimes become blurred (Braun & Clarke, 2006). The process of clarifying potential themes reflects the voice and perspective of the researcher (Freshwater & Avis, 2004) and illustrates the researcher as “the instrument of data analysis” (Jacelon & O’dell, 2005). Once no new themes emerged, it was assumed that data saturation had occurred.
Rigour

There is ongoing debate about rigour in qualitative research. The issue of rigour needs to be addressed by the researcher considering the methods, methodology, and philosophical underpinnings of the study. In qualitative research, this is acknowledged as “trustworthiness” (Lincoln & Guba, 1985) and a number of techniques are recommended to enhance the trustworthiness of the research study (Lincoln & Guba, 1985). These include dependability, creditability, transferability, and confirmability.

The issue of dependability relates to the consistency of the findings and enables the ‘auditor’ to clearly follow the decision trail left by the researcher (Lincoln & Guba, 1985; Sandelowski 1986). Dependability was incorporated into the decision trail of this study through the use of a reflective diary for example; I was able to identify how my shyness inhibited access to the research setting. Once I had identified this as an issue, I was able to discuss with my research supervisors the strategies I could develop to ensure I was more assertive. This provided a self-critical account of the research process. Fortnightly meetings were held with supervisors to discuss discrepancies identified during data collection and analysis. The inclusion of a clear and transparent audit trail facilitates dependability and reflexivity, and is central to the decision trail (Tobin & Begley, 2004).

To establish the credibility of a research study, it is imperative that all research participants are identified and described accurately (Holloway & Wheeler, 2002). Maintaining credibility relies on rigorous standards of data collection, analysis, and reporting (Patton, 1990). A number of different strategies have been suggested to improve the creditability in qualitative research, including prolonged involvement, triangulation, peer debriefing, and member checks (Guba & Lincoln, 1994; Holloway & Wheeler, 2002). Prolonged engagement was achieved in this study by ensuring sufficient time was allocated to data collection activities to achieve an in-depth understanding of the views of the
participants. Prolonged engagement with the data through repeated analysis of the interview transcripts and emerging sub-themes and themes also enabled a deeper understanding of the data. Credibility was also achieved through peer reviews. This involved the research supervisors reviewing the interview transcripts and the emerging sub-themes and themes. Research supervisors scrutinised the data process and the analysis, and the researcher provided evidence that validated the emerging sub-themes and themes.

The concept of transferability was achieved in this study was the use of thick description of the phenomenon of interest. Thick descriptions were used to present a participant’s narratives where the participant’s experience, if well described, represents a “slice of the world” (Sandelowski 1986). The concept of transferability is concerned with the issue of conceptual generalisability of the study’s findings (Lincoln & Guba, 1985). Readers usually make judgement of transferability and Sandelowski (1986) argues that a study meets the criterion of transferability when its findings can fit into contexts located outside the study situation and when its audience views its findings as meaningful and applicable in terms of their own experiences.

The final criterion for establishing a study’s trustworthiness is confirmability (comparable with objectivity or neutrality). Confirmability, offers ‘completeness’. Completeness allows for multiple realities, which not only confirm the existing data but also provide a deeper and more comprehensive understanding of the phenomena. In this study, the iterative nature of qualitative data collection and thematic analysis ensured a complete picture of the phenomena.

The preceding section sets out a description of the data collection methods developed for the first unit of analysis for the case study. The following section contains an outline of the data collection methods that were developed for the second unit of analysis. The aim of
the second unit of analysis was to explore if the introduction of an APN after-hours service improved patient outcomes.

**The second unit of analysis: Patient outcomes**

The aim of the second unit of analysis was to explore if a ramp-up RRS, the APN after-hours service—improved patient outcomes. The research questions developed to meet the aim of the second phase were:

- To what extent does the introduction of the ANP after-hours service reduce MAEs in medical ward patients?
- To what extent does the introduction of the ANP after hours service reduce adverse events in medical ward patients?
- To what extent does the introduction of the APN after-hours service increase the activation of the MET?
- To what extent does the implementation of the APN after-hours service reduce the physiological abnormalities associated with life-threatening clinical deterioration?

Medical ward patient outcomes were the second unit of analysis in this single case, exploratory case study. The aim of this unit of analysis was to explore if the introduction of an APN after-hours service improved patient outcomes.

**The APN after-hours intervention**

The Gold Coast hospital, Queensland is a 480 bed tertiary teaching hospital catering for emergency, surgical, medical, obstetric, neonatal and paediatric care. The hospital has over 67,000 emergency presentations and over 70,000 overnight hospital admissions a year. The APN after-hours service was introduced in July 2008 at the Gold Coast hospital to provide a rapid response to clinical services throughout the hospital after-hours. The service operated from 2.30pm—7.30am, 7-days-a-week (Williams et al., 2012). Medical ward patient outcomes were the second unit of analysis in this single exploratory case study. The aim of
this unit of analysis was to explore if the introduction of an APN after-hours service improved patient outcomes. The APN after-hours service was introduced in July 2008 and operated from 8.00pm–8.00am 7 days a week. The service was provided by six experienced acute care nurses who supported ward nurses and the multi-disciplinary team in the care and management of the deteriorating ward patient in the hospital after-hours. The APN after-hours service aims to: (1) Co-ordinate the care and management of the deteriorating patient; (2) Identify and monitor the deteriorating patient; (3) educate ward nurses on the care at management of the deteriorating patient; and (4) reduce the incidence of MAEs and other serious adverse events (Williams et al., 2012). This innovative nursing service is, therefore, classed as a ramp-up, nurse-led RRS (DeVita et al., 2006). The APN after-hours service operated as a two tier RRS within the Gold Coast hospital and complemented the existing RRS in the hospital. The hospital also used the MET and the ICU liaison nurse as part of its response to the deteriorating ward patient. Ward nurses were responsible for alerting the APN after-hours service via the hospital pager system. The APN after-hours service responded to these concerns by assessing, monitoring, reviewing, treating or escalating care as required and supporting and educating ward nurses via informal teaching opportunities (Williams et al., 2012). Ward nurses were responsible for alerting the APN after-hours service via the hospital pager system, of potential or actual patient deterioration. The APN after-hours service responded to these concerns by assessing, monitoring, reviewing, treating or escalating care as required and supporting and educating ward nurses via informal teaching opportunities (Williams et al., 2012).

Patients exposed to the ANP after-hours service (the intervention) were compared to patients not exposed to the intervention (the control). Several studies have used the incidence of MAEs to measure the impact of an RRS on patient outcomes (Bristow et al., 2000; Chen et al., 2009; Cretikos & Hillman, 2003; Hillman et al., 2005; Jones, Hart, Bellomo, & Martin,
2008; Needle & Anderson, 2006). However, those studies have only measured METs, not nurse-led RRSs. This study expands on the existing research and contributes to the body of knowledge by measuring the impact of a nurse-led RRS on patient outcomes. Based on the review of the literature, the following hypotheses were generated:

- Medical ward patients hospitalised prior to the implementation of the APN after-hours will have significantly more MAEs.
- Medical ward patients hospitalised prior to the implementation of the APN after-hours will have significantly more adverse events.
- Medical ward patients hospitalised prior to the implementation of the APN after-hours service will experience significantly more physiological abnormalities associated with life-threatening clinical deterioration.
- Medical ward patients hospitalised prior to the implementation of the APN after-hours will have significantly more MET activations.
- Age, gender, hospital length of stay, existence of MET activation criteria, and the absence of the APN after-hours service will predict MAEs.
- Age, gender, hospital length of stay, existence of MET activation criteria, and the absence of the APN after-hours service will predict adverse events.
- Age, gender, hospital length of stay, and the presence/absence of the APN after-hours service will predict MET activation criteria.

Because it involves human participants, in health care it is not always possible, feasible, or ethical to manipulate the independent variable (Polit & Beck, 2004). Thus, most studies in nursing are non-experimental (Polit & Beck, 2004). In this study, it was not possible to manipulate the independent variable, because the APN after-hours service (the intervention) had already been introduced, a non-experimental approach was taken. A causal-comparative study was undertaken for this unit of analysis (Johnson, 2001). Causal-comparative research, also known as ex-post facto research (Polit & Beck, 2004), aims to find a cause or explanation for existing differences between (or among) groups. Two or more existing groups are compared retrospectively. The main weakness of this method is the lack
of control over the independent variable. A direct cause and effect relationship cannot be drawn between the independent and the dependent variable. Therefore, possible alternative explanations need to be considered when presenting conclusions and definitive statements avoided.

**Sample**

The cohort of interest was adult medical patients who presented to the Gold Coast Hospital medical unit during January 2008 – October 2008. The methods used to estimate sample size depend on the study’s methodology and methods. It is generally acknowledged that the number of predictors influences the sample size, the more predictors involved, the larger the sample size required to produce a significant result. Another consideration in calculating sample size is the probability of obtaining a significant statistical result—the power of the statistic (Polit & Beck, 2006). The larger the sample, the greater the power or probability of avoiding a Type II error (Polit & Beck, 2006). There were no formal power calculations undertaken in this study, because no literature was available on the effect of the intervention on MAEs and adverse events. Instead, the sample size was determined by previous studies that used medical records and MAEs and adverse events as outcome measures (Chaboyer et al., 2008, McQuillan et al., 1998). The rule of thumb formula was also used to determine the sample size for the logistical regression analysis (Green, 1991). The rule of thumb formula suggests $N > 50 + 8m$ (where $m$ is the number of predictor variables). Nine predictor variables were entered into the regression model in this study. Based on this, Green’s (1991) rule of thumb formula the sample size of 300 patients’ medical records should have been sufficient.

The following inclusion and exclusion criteria were used to optimise homogeneity of the sample and to identify potential participants:
Inclusion criteria:

- Medical patients identified by the Major Diagnostic Category (MDC). The MDC is a category generally based on a single body system or aetiology that is associated with a particular medical specialty. MDCs are subdivided into a maximum of three separate partitions (Department of Health and Aging, 2008).
- Patients with a hospital LOS greater than two days. The length of stay of a patient was calculated by subtracting the date the patient was admitted from the date of discharge. The decision to exclude patients if they had been admitted for less than two days was taken because a large cohort of patients are admitted overnight following minor procedures. For example, colonoscopy, endoscopy. It is very unlikely that this cohort of patients would have been exposed to the intervention.
- Patients admitted to one of Gold Coast Hospital’s four medical wards.

Exclusion criteria:

- Patients aged less than 18 years.
- Patients in standalone specialised units—for example, pediatrics, long-term rehabilitation patients, maternity, ICU patients, and palliative care and patients on surgical wards.

The cohort included only medical patients because this patient group has an increased risk of suffering an adverse event (Buist et al., 2004; Goldhill & McNarry, 2004; Goldhill et al., 2005) and is therefore more likely to trigger the activation of the RRS. The decision to exclude patients if they had been admitted for less than two days was taken because a significant number of patients are admitted to the Gold Coast Hospital for minor procedures. For example, colonoscopy and endoscopy therefore, it is very unlikely that this cohort of patients would have been exposed to the intervention.

Outcomes

In this study the data dictionary developed by Woloshynowch et al (2003) was used (see appendix 7) with permission. Fifteen criteria were used to define MAEs and adverse
events. A data dictionary was developed (see appendix 7). Fifteen criteria were developed and these were used to define major adverse events and adverse events. The data dictionary defined major adverse events as:

Death:

- Defined as death from all causes during hospital stay.

1. In-hospital cardiac arrest:
   - Defined as the sudden onset of all the following:
     - lack of palpable pulses
     - unresponsive
     - documented initiation of basic life support (Bellomo et al., 2003; Buist et al., 2003; Hillman et al., 2005).

2. Unplanned admission to ICU:
   - Includes patients who are transferred from the general medical wards as an unexpected admission. Patients excluded from this definition include patients transferred to an ICU from another ICU/HDU, operating theatre, recovery, or ED (Cretikos et al., 2006).

3. Adverse events:
   - The data dictionary defined adverse events (see appendix 7). This provided guidelines and protocols that instructed the researcher in the collection of the data, and served as a reference manual as to how the data were abstracted from the medical record.

**Predictor variables**

A range of predictor variables were also assessed. These variables were based on a review of the literature (Massey et al., 2010 Chaboyer et al., 2008; Harrison et al., 2006; Jacques et al., 2006; Kause et al., 2004). The predictor variables were the following:

- Age.
- Gender.
- Diagnostic category. This is a patient classification scheme that provides a clinically meaningful way of relating the types of patients treated in a hospital to the resources required by the hospital.
- Hospital length of stay.
- RRS activation criteria that highlight staff to potential patient clinical deterioration:
  - respiratory rate <5 or >36 breaths/min
  - heart rate <40 or >140 bpm
  - systolic blood pressure <90mmHg
  - decrease in GCS >2 points
  - oxygen saturation <95%
  - urine output <0.5mls/kg/hr.

**Data collection**

By definition, retrospective studies rely on archival data retrieval. The term archival research refers to the use of archives or records that already exist (Panacek, 2007). The use of chart review, as a recognised data collection method is prevalent in health-care research. Gilbert et al. (1996) reviewed three different medical journals over four years and found that 25% of research articles used a retrospective chart review. Previous research demonstrates that inter-rater reliability of chart audits can be more than 80% with adequate training (Thomas, Lipsitz, Studdert, & Brennan, 2002). The reliability and accuracy of retrospective chart reviews has also been demonstrated in previous research on the extent, nature, and consequences of adverse events (Chaboyer et al., 2008).

The use of chart reviews as a method of data collection has several advantages. Data collection covering many hours of care can be completed in a relatively short timeframe, which results in less expense than if real-time data collection was undertaken. Chart review data also has the advantage of being easy to access, subject to appropriate approval. Finally, the use of chart review data also negates the need for participant involvement, thereby removing one of the key limitations of case controlled studies: recall bias (Gilbert et al.,
However, there are a number of important limitations inherent in the use of chart review data that required consideration during data collection. Data sources are collected for purposes other than research and, as a consequence, there is no control over the creation or storage of data, or the environment in which that data were collected. These raw data are collected by someone other than the researcher and, as a result, may be inflexible and unyielding (Panacek 2007). Also, chart records may also be incomplete or difficult to understand, and important and relevant variables may be absent or incorrectly recorded (Panacek 2007).

During the planning and the design of this research project, these limitations were acknowledged and a number of steps were implemented to improve the validity of the data collection method, as suggested by Gearing and Colleagues (2006). First, the research questions and study aims were prospectively defined. In the study design phase of the research, the outcomes and predictors were clearly identified. Clear definitions of all study predictors were developed to optimise accurate and consistent data abstraction. The chart review and the data abstraction process was standardised through the use of a validated data abstraction form (Chaboyer et al., 2008; Woloshynowych et al., 2003).

Following ethical approval, the medical records department of the hospital was contacted in order to gain access to the data required. The sample for this phase of the research study consisted of two separate groups of ward patients. The control group consisted of 150 randomly selected medical patients admitted to Gold Coast Hospital before the introduction of the APN after-hours service (January 2008-March 2008). The intervention group consisted of 150 randomly selected medical patients admitted to the Gold Coast Hospital 3 months after the introduction of the APN after-hours service (August 2008-
October 2008). The medical records department forwarded the researcher an Excel™ spreadsheet with the URL numbers of all admissions that met the inclusion criteria and who were admitted 3 months before the intervention and a similar spreadsheet of all admissions who met the inclusion criteria and who were admitted 3 months following the implementation of the intervention. The researcher generated a random list of 150 URL numbers for the control group and 150 URL numbers for the intervention group using Excel™ random number generator function. This list was then sent back to the medical records department. The medical records department then contacted the researcher when the records were available for review. Understanding the design of an existing medical record and how data was recorded was an important part of the data collection process. It was important to ensure that the information required for the research study was available in the medical record. Prior to the data collection process commencing, three medical charts (Gearing, Mian, Barber, & Ickowicz, 2006) were assessed for the flow of information in order to identify the established charting processes used in the hospital.

**Pilot study**

A pilot study of two charts was performed and provided valuable information about the planned study. The adequacy of the data abstraction tool was assessed and any potential difficulties with data collection were evaluated. Following this pilot study, minor changes were made to format of the data abstraction form to enable data entry to occur in a more logical way.

**Data analysis**

The data from the medical record were analysed in three phases: (1) data entry and cleaning; (2) descriptive statistics; and (3) inferential statistics to test the hypothesis. A chi-
squared test of independence was performed to establish what relationship existed between predictor variables and outcome variables at a bivariate level. As a final step, multiple step-wise logistic regression was used to determine which of potential predictors along with the APN intervention were significantly and independently associated with MAEs. The following description presents the three phases of this data analysis plan.

**Data cleaning**

Data cleaning and coding was necessary prior to data analysis. Data cleaning involved two types of checks (Polit & Beck, 2008). First, a check for outliers was performed. Outliers are values that lie outside the normal range of values of the other cases (Polit & Beck, 2008). Outliers were detected by inspecting the frequency of distributions for each variable so that any incorrectly coded data was identified. Second, double entry of 30 (10%) of the data abstraction forms was performed to establish rates of error in data entry. In 4,800 data entries, 26 errors were detected.

**Descriptive statistics**

Statistical analyses were performed using SPSS version 18.0. Descriptive statistics were used to explore and describe the characteristics of the sample. Descriptive statistics included measures of central tendency, such as mean (standard deviation), medium (interquartile range (IQR)) and frequency. These descriptive statistics were used to explore the sample characteristics and the frequency of MAEs and adverse events in the two groups: the intervention (exposed to the APN after-hours service) group versus the control (not exposed to the APN after-hours service) group. The groups were viewed as independent from each other (Polit & Beck, 2008).
**Inferential statistics**

The non-parametric Mann–Whitney U test was performed to assess for differences in the continuous variables of age and length of stay between the two groups. The Mann–Whitney U test was used because of the skewed nature of this data. The chi-squared test of independence was used to assess for differences in categorical variables—for example, gender, diagnostic categories, MET activation, MAE, and adverse event—between the two groups.

The non-parametric chi-squared test of independence was used to examine differences between the intervention and the control groups. Differences explored included ‘MAEs’, ‘all other adverse events’, ‘MET calling criteria’, and ‘MET activation’. Variables that were found to be significant on bivariate analysis were entered into the multiple stepwise regression model.

Multiple logistic regression modeling, as described by Hair and colleagues (2010) was subsequently performed to determine which of the potential predictors together with the APN intervention were significantly and independently associated with MAEs. Using the stepwise model, only those variables that were significant were retained in the model. When variables were shown to be not significant using likelihood ratio they were removed from the model and then the next variable was entered and tested. Two-tailed tests were used and a level of significance was set at p <0.05 with 95% confidence limits.

**Reliability and validity**

The following section details the issues and strategies developed to overcome threats to reliability and validity for phase two of the study.
Reliability is the degree of consistency or dependability with which an instrument measures an attribute (Polit & Beck, 2008). The process used in this study has been used in previous studies measuring similar outcomes (Chaboyer et al., 2008; Woloshynowycz et al., 2003). In this research, study intra-rater reliability was assessed by re-checking 17 medical charts over a one-month period and comparing the results with original data entries. The results of this intra-reliability revealed a 97% accuracy rate.

Validity refers to the degree to which an instrument measures what it is supposed to be measuring (Polit & Beck, 2008). Both internal and external validity were important concepts in this research study. External validity refers to the extent to which a study can be generalised to the wider population (Polit & Beck, 2008). Internal validity is concerned with whether or not the actual observations and measurements made by the investigators are truly representative of what is being measured and observed (Polit & Beck, 2008).

The external validity in this study was enhanced by ensuring the sample selection was representative of the population to which the study can be generalised. A random sample of all medical patients was included in the analysis; thus, the findings of the study can be generalised to a similar sample of medical patients in another hospital. The use of CSR design also promoted external validity. CSR design encourages detailed exploration of ‘how’ and ‘why’ questions about a contemporary issue that occurs in a natural setting. This created a study situation that is a replication of the real world, enhancing the external validity of the study and emphasising naturalistic generalisability (Polit & Beck, 2008).

Three factors are recognised as threatening the internal validity of this study: (1) bias (systematic error); (2) confounding (an unrecognised variable influencing the results) and (3) history. The first threat, bias, is an influence that produces a distortion or error in the study results. Bias may arise in several ways. Selection bias occurs when subjects included in the study are different in a systematic way from those excluded. Error can also result from the
investigator entering incorrect patient details or missing data. Methods of minimising selection bias in this study involved meticulous attention to data entry process and frequent re-checking of these processes.

The second threat to validity was confounding. Confounding occurs where the association between two variables could be due to a truly causal relationship, chance, or another variable. There are multiple possible variables inherent in the clinical context, which cannot be controlled for and are inherent in clinical research. Confounders are controlled through an effective design prior to data collection or by analysis following data collection. In the design phase of the study, a range of predictor variables were examined. These variables were based on a review of the literature and all-important variables were included in the data collection tool, for example, age and length of stay. Confounding was also controlled through analysis with the use of multivariate analysis to take into account more than one variable simultaneously. However, it was always possible that some unknown variable influenced the results and it was not possible to control for every potential confounder, for example changes in staffing levels or skill mix on the medical wards.

The third threat to the internal validity of the study was history. History is an event that may have occurred either inside or outside the research setting. This event may influence the effect of the intervention (Polit & Beck, 2008). For example, in this research the effect of the intervention could have been influenced by the educational activities that ward nurses may have engaged in or by changes in the way vital signs were documented. In this study data were collected immediately prior to the implementation of the intervention and then again as soon as it was feasible post the implementation of the intervention to reduce the threat of history.
**Ethical Consideration**

Ethical approval was gained from the Human Research Ethics Committee (HREC) of the Gold Coast Health Service District (HREC/09/QGC/17) and Griffith University (NRS/38/09/HREC). The right to full disclosure was obtained and interview participants were given verbal and written information about the nature of the study. Generic principles as outlined in the Australian Code for the Responsible Conduct of Research (NHMRC, 2007) were applied to the study. Researchers have the responsibility to adhere to the value set of “respect for human beings, research merit and integrity, justice and beneficence” (NHMRC, 2007). In this study, this included adhering to appropriate ethical standards about confidentiality, storage and management of research data and primary materials, and consent.

In the first unit of analysis, the ethical principle of autonomy was observed by ensuring that consent was informed, given without coercion, and acknowledged the participant’s rights of refusal in the interviews. The consent of each participant was voluntary and each participant could withdraw their consent at any time without reprisal. All processes in obtaining the informed consent of each participant adhered to the Griffith University guidelines about informed consent set out in the Research Ethics Manual Booklet Informed Consent in Human Research (Griffith University, 2003) and the Queensland Health guidelines. The informed voluntary written consent of each interview participant was obtained for all interviews. Each interview participant was given an information sheet and consent form explaining the study and their right to withdraw without penalty at any time.

Particular attention was paid to ensuring that the interview participants' identity remained protected at all times. This was achieved by using pseudonyms. Exemplars have been carefully selected to illustrate and present evidence that supports data analysis, without being specific enough to inadvertently provide disclosing information about the identity of any individual interview participant. Interviews were conducted in a quiet room, away from
the work area, so confidentiality was maintained and each participant’s privacy was respected. Only the research team had access to the data, which will be stored on a password-protected computer in a controlled access room of the university for a five-year period following the study’s completion. The human diversity within the group was respected, and no-one was excluded on the basis of ethnicity, gender, age, workplace role, or sexual orientation (Holloway & Wheeler, 2002).

The principle of non-maleficence (NHMRC, 2007; Polit & Beck, 2004) was upheld by ensuring the risk of harm, discomfort, and distress was minimal. There was potential for distress from participation in the interview if the events discussed were traumatic. However, each interview participant was free to decline participation in the study, free to withdraw at any time, and free to choose not to answer individual questions.

The principle of justice (NHMRC 2007; Polit & Beck, 2004) was maintained by the researcher providing neutral and unbiased treatment throughout the course of the data collection. The researcher remained non-judgmental and at all times respected the view of each interview participant. Consent to participate in the study was gained prior to data collection and anonymity was maintained by removing all identifying information from the data.

Ethical considerations needed to be considered in the second unit of analysis because of the use of potentially identifying patient information that was retrieved from the medical records. Confidentiality and anonymity of this potentially identifying data for example, patient’s diagnostic categories was ensured by using a numerical coding system. Data were analysed and stored on a secure network drive at Griffith University and protected by a password and were used only for the purpose of the study. Data access was restricted to the research team; in addition, confidentiality was maintained as no identifying information was published in any form. One issue relating to principle of respect was the use of medical
records for the purpose of identifying specific information about patients for example, reason for admission to hospital, LOS, and age and gender of patients. However, the risk to each patient was negligible because of the retrospective nature of data collection and, because of this, each patient’s consent was waived.

The aforementioned strategies ensure ethical standards were adhered to during the entire research process and were implemented within a flexible research process.
Chapter 4: Using the rapid response system

Introduction

In this chapter, the findings of the first unit of analysis are presented. The first unit of analysis explored the practices of registered nurses using an RRS. The research questions developed to meet the aim of this unit of analysis were:

- What do nurses identify as barriers to RRS?
- What do nurses identify as the strengths of the RRS?
- What are nurses experiences and perceptions of using RRS?

By exploring these questions, this research sought to build an understanding of how RRSs are used by nurses. The findings of a thematic analysis of 15 semi-structured interviews are presented in this chapter.

The research setting

An explanation of the research setting and the RRSs used in the setting helps to situate the findings of this thematic analysis and assess the transferability of the findings. The afferent limb—the TTS used to detect the deteriorating ward patients—in this research setting was a single parameter system (DeVita et al., 2006). The single parameter system was used at the Gold Hospital when the interviews were carried out. Nurses or clinicians using the single parameter system use periodic observations of selected vital signs and compared these vital signs to a set of criteria with a predefined threshold, and if any of the criteria for activation are met then a response algorithm is activated (Cretikos et al., 2007a; Gao et al., 2007). The efferent limb—the response to clinical deterioration—in this research setting was determined by the clinician activating an RRS in order to escalate care for patients experiencing, or at risk of, clinical deterioration. The clinician could choose to activate the
MET or the APN after-hours service. The research setting also used the traditional method of accessing immediate help and support—the arrest team—in the event of a cardio-respiratory arrest.

The participants

A total of 15 registered nurses were interviewed. All of the participants worked full time. The mean number of years of nursing experience of the participants was 5 years and 3 months, with the shortest being 6 months and the longest 22 years. The interviews took between 40 minutes and one hour.

Overview of findings

The following sections present and describe the themes and sub-themes that emerged from thematic analysis of the interview transcripts. Four themes relating to the participants’ experiences and perceptions of RRSs emerged from the data: (1) sensing clinical deterioration; (2) resisting and hesitating; (3) pushing the button; and (4) reflecting on the MET. Each of these themes is comprised of a number of sub-themes (see Figure 3).
Figure 3—Themes and sub-themes relating to participants’ experiences and perceptions of the MET
Throughout the description of each theme and sub-theme, quotes from the interviews with participants are provided to demonstrate and illuminate the interpretations that have been constructed from the data.

**Sensing clinical deterioration**

The first theme identified was sensing clinical deterioration. This theme denoted the characteristics participants used to identify a patient’s physiological decline. Examples of the participants sensing a patient’s clinical deterioration included the participant’s sensing oxygen saturations dropping, changes in level of consciousness, changes in temperature, and changes in blood pressure. Participants were aware that they were in a unique position to sense a patient’s clinical deterioration. One of their primary responsibilities was patient surveillance or observation, which involved identifying patients at risk of clinical deterioration. This was illustrated in Ann’s comment highlighting her role in sensing patient deterioration:

> “Then when I went to see her—that’s why I went in because she was tachycardic; she just was in respiratory distress. So I came round and said to the team that she was quite respiratory compromised at the moment and they’re like, ‘Oh yeah, we’ve just seen her’, and I said to them ‘Well, you had better come and look at her again’, and then they came in and I think they were a bit like shocked at her deterioration.” (Ann)

As Ann identified, she was the first person to identify the patient’s clinical deterioration and activate a response for the patient. An inability to sense patients at risk of clinical deterioration would therefore clearly hinder appropriate activation of the RRS.

The sub-themes associated with this theme were: (1) identifying and interpreting clinical deterioration; (2) knowing the patient; (3) gut feelings; and (4) experience and confidence.
Identifying and interpreting clinical deterioration

The most prominent sub-theme that emerged was the participants’ ability to identify and interpret patients at risk of clinical deterioration. Without this skill, the participants explained that activation of a MET would not be possible. The participants discussed that changes in patients’ physiological parameters enabled them to identify potential or actual patient clinical deterioration. Identifying and interpreting clinical deterioration was understood by the participants as changes in heart rate, blood pressure, respiratory rate, level of consciousness, or temperature. Changes in any of these observations were reported as being important in identifying and detecting clinical deterioration. For example, Helen illustrated how changes in a patient’s observations played an important role in identifying patients at risk of clinical deterioration.

“The observations are really important to detect clinical deterioration—for example, their temperature, are they getting a fever, how are they feeling, are they feeling unwell. So straight away they think some kind of infection or thing. High blood pressure, low blood pressure.” (Helen)

The participants frequently mentioned “doing the obs”, “the obs were ok”, “we did a set of obs”, and “the obs were all over the place”. The participants explained that changes in a patient’s observations were what alerted them to clinical deterioration and that they used this information to activate the MET.

Although the participants discussed the importance of recording the observations, they also identified that an equally important aspect of their role was interpreting and understanding what the changes in the observations meant in relation to a ward patient’s clinical deterioration. The participants highlighted that it was not enough to just record a patient’s vital signs; they also needed to decipher and understand them and, if necessary, act on those changes by accessing appropriate support and help. The participants explained that “doing the obs” and having documented evidence of a patient’s clinical deterioration was
important in validating their activation of the MET. As highlighted in Helen’s excerpt above, there is a need to comprehend what is happening to a patient by interpreting the changes in the patient’s vital signs. Helen used the example of a high temperature signifying a fever and infection. In another example, Penny illustrated how a change in a patient’s blood pressure indicates the onset of acute pulmonary oedema (APO):

“The blood pressure was what alerted me to her clinical deterioration. I went to see her and that’s when it became evident that she was in acute pulmonary oedema.” (Penny)

Penny’s narrative clearly demonstrated how she was able to link the patient’s blood pressure to the physiological disease process—she identified the low blood pressure and interpreted the changes in the vital signs to confirm APO. This validated her decision to activate the MET. Clearly, identifying and interpreting physiological responses to clinical deterioration was important in justifying activating the MET. However, participants also talked about the importance of ‘knowing the patient’ in relation to sensing clinical deterioration. This sub-theme is discussed in the following section.

Knowing the patient

The second sub-theme that emerged from sensing clinical deterioration was knowing the patient. Participants talked about focusing on what was important during the patient’s clinical deterioration. The ability to ‘know the patient’ emerged from the participants’ awareness of their surroundings, and knowing and understanding the patient and the patient’s disease process. This familiarity with the patient and their surroundings enabled the participants to observe patients’ clinical deterioration from multiple perspectives and situate this clinical deterioration within the context of the individual patient.
Observing and knowing the patient enabled identification of something that was significant and required attention. This is demonstrated in Tara’s interview when she discussed that the patient “did not look well”:

“Just looking at her she seemed... she was alert but she wasn’t very responsive; she was, you know, kind of sweaty; well, she was sick—her whole appearance. She kind of looked a bit washed out, she just didn’t look well.” (Tara)

The participants’ verbalised that their familiarity with the patient’s history, disease progression, and vital signs enabled them to understand and react quickly to the patient’s clinical deterioration—for example, “I knew her; you call the home team first because they know the patient, and you get to know what’s normal for the patient.” The participants’ knowledge of the patient enabled them to interpret vital signs and physiological indicators of clinical deterioration in the context of each individual patient. Knowing the patient helped the participants to identify subtle changes in the patient’s condition—for example, when a patient suddenly became quiet or withdrawn. When they did not know the patient, the participants reported feeling uncomfortable and unsure about their actions and this hindered recognition of clinical deterioration. Rachel also highlighted that while she was able to assess the patient, she did not get chance to read the patient’s notes and this hindered ‘knowing’ the patient. This made her uncomfortable and revealed some of the challenges and difficulties the participants faced when caring for a deteriorating ward patient who they did not know—for example:

“When I got her, I checked her obs and things but I did not get a chance to read her notes or anything. This made me uncomfortable because I felt I did not know the patient. Then when I got to ICU, I knew her name and that she was deteriorating but I did not know why and I could not give them anymore information so I felt really uncomfortable.” (Rachel)

Rachel identified that she should have been familiar with this patient’s illness, vital signs, and individual response to clinical deterioration; she described that this would have
enabled a more holistic and individualised handover of the patient. Without the knowledge of and familiarity with a patient, it became more difficult for the participants to identify and recognise the patient’s physiological clinical deterioration and this inhibited the participants triggering a MET and escalating care for the deteriorating patient.

Being able to sense clinical deterioration as a result of knowing the patient facilitated recognition of clinical deterioration. Participants also talked about having a “gut feeling” in relation to recognising and responding to the deteriorating ward patient, a sub-theme discussed in the following section.

**Gut feeling**

The third sub-theme in the sensing clinical deterioration theme was gut feeling. Gut feeling is understood as the use of instinctive reasoning when sensing the deteriorating patient. When using gut feelings, the participants identified that the patient’s physiological parameters appear normal but “something is not right”. The participants identified that they had a “hunch, feeling, or a sixth sense” about certain deteriorating ward patients, and this needed to be trusted and listened to. A number of the participants identified that gut feelings were enhanced by clinical experience. As the participants gained more experience and confidence, they processed information and understood their environment more quickly and, in some cases, this bypassed the need for conscious reasoning. The participants with more clinical experience spoke of being able to predict clinical deterioration before it actually happened. In those instances, early intervention was sought in an appropriate and timely manner and the escalation of patient care needs was often prevented. For example, Amy articulates this when she states:

“I think it’s more instincts than anything. As a nurse with a lot of experience, you get to know which of the patients are going to go off quickly and which aren’t. You can almost predict it but, yeah, it’s like a sixth sense.” (Amy)
Laura also talked about listening to her gut feelings and acting on these feelings:

“Yeah, I think it’s just more of a gut feeling you have more than anything, but you have to listen to that. You have to get someone to look at the patient or increase your observations and monitoring.” (Laura)

Clinically experienced participants discussed how listening to and being aware of these gut feelings was important in recognising and responding to the deteriorating ward patient. The participants reported that “something was not quite right” but were unable to identify or define what was actually wrong with the patient. Gut feelings were developed through clinical experience and this increased the participants’ confidence, which is explored next.

**Experience and confidence**

Experience and confidence was the fourth sub-theme in the theme sensing clinical deterioration. Experience, in the context of this study, is understood as the knowledge and skills that a participant acquired over time to enable them to recognise clinical deterioration. Confidence is linked to the participants feeling certain about something and was developed from an appreciation of their ability to identify that a patient’s care needs were escalating and the patient was deteriorating. The quotes from Ann and Helen interviews highlight how participants require a degree of confidence to activate a MET.

“Because I kind of believe that MET call is a confidence thing. Not panicking during a MET call. It’s just experience and confidence—I think if you’re given that experience, you feel a lot more confident when you call the code.” (Ann)

“You need to be more comfortable and have more confidence with clinical deterioration to feel that that is the right decision. You have to see more of them.” (Helen)

Confidence was developed from exposure to, and experience of, patient deterioration. There were frequent references within the transcripts of being familiar with the signs and symptoms of patient deterioration processes—for example, “you see pulmonary oedema all
the time”, “chest pain is one you see a lot”, “patients dropping their Glasgow Coma Score is common on this ward”.

Related to experience of patient deterioration was the notion that identification of ward patients’ clinical deterioration may be problematic because of inexperience. For example, Laura discussed how some practitioners—particularly enrolled nurses and new graduates—are not able to recognise when a ward patient deteriorates:

“What some people—particularly enrolled nurses—don’t have that knowledge and understanding to actually recognise a deteriorating patient sometimes, or graduates—they might go ‘Oh well, their heart rate is fast but that’s ok because a lot of people come on to the ward and their heart rate is fast’. You know that they don’t understand that this is where this could go.” (Laura)

Laura talks about nurses not being able to recognise and identify patients at risk of, or experiencing, clinical deterioration because of a lack of understanding and knowledge. This unawareness of clinical deterioration hindered participants from activating the MET because they felt they lacked the knowledge, experience, and confidence to identify patients at risk of, or experiencing, clinical deterioration.

Inexperience therefore precipitated a lack of confidence, which resulted in uncertainty and insecurity—for example; Jenny discusses how her lack of experience stopped her from activating a MET:

“I haven’t got that experience to call the MET. The nurse in charge needs to make that call. She can come in and quickly decide that we need help or the MET. I just could not be sure that the situation was a real emergency or if the patients just need more fluids or increased obs. I am not able to make this decision by myself yet.” (Jenny)

As Jenny identified, she felt that she lacked the experience, confidence, and knowledge to activate a MET. METs have clear guidelines and parameters that should alert health-care providers when activation criteria are not met. However, even these guidelines were discounted in the face of inexperience. Jenny, a newly qualified nurse who had been working
as an RN for six months, illustrated how lack of experience is a significant factor in deciding not to activate the RRS when she stated:

“We’ve got guidelines as what qualifies as a MET call and still don’t feel confident that I know enough to call.” (Jenny)

In summary, sensing clinical deterioration encompassed four sub-themes: (1) identifying and interpreting physiological response to clinical deterioration; (2) knowing the patient; (3) gut feelings; and (4) experience and confidence. All of these sub-themes highlighted how the participants sensed clinical deterioration in the ward patient and acted on this. The factors that facilitated or hindered detection of clinical deterioration in the ward patient also emerged in this theme.

The second theme that emerged from the analysis was clearly related to factors that hindered or obstructed the participants’ activation of the MET. This theme, resisting and hesitating calling the MET, is discussed in following section.

**Resisting and hesitating**

The theme resisting and hesitating is understood as either refusing to activate the MET or pausing before activating the MET. The participants expressed their reluctance to trigger a MET to respond to clinical deterioration in terms such as “I don’t know if it would be the right thing to do”, “I don’t want to look like an idiot”, and “I may get into trouble”. The participants admitted that they resisted or hesitated activating a MET because they were anxious or frightened about the consequences and the panic that would ensue following the arrival of a response team. The participants associated the activation of the MET with reprisals if they used the system incorrectly. Three sub-themes were associated with resisting and hesitating were: (1) fear; (2) anxiety; and (3) panic.
Fear

The first sub-theme related to the theme resisting and hesitating identified by participants was fear. Fear, in this context, is described as a distressing negative sensation induced by the perceived threat of reprisal, humiliation, or punishment that incorrectly activating a MET may initiate. The participants identified that they were “scared of the MET” and scared of the feelings that the MET evoked in them. The participants spoke of their “adrenaline going through the roof” and of “being scared of feeling helpless, frustrated, and angry”. Fear of reprisals or punishments were linked to failure to correctly recognise a patient who was deteriorating because of clinical inexperience and uncertainty. This is clearly illustrated in Tanya’s example when she talks about questioning her clinical and professional ability and how this may lead to her being “told off”:

“Maybe questioning my decisions: Am I over-reacting here? Is this real or am I just panicking? So just questioning my ability or my reality around what’s happening. Just not having enough experience. Just feeling I’d better not do that kind of thing or I might get told off.” (Tanya)

The fear of “being reprimanded”, “looking like an idiot”, or “being told off” was a powerful motivator that participants used to justify delaying activating the MET. Mary talked about being “told off” for time wasting and that nurses were frightened about the potential repercussions of incorrectly activating the MET:

“Nurses feel like they are going to be told off for wasting the medical emergency team’s time. Even though worried or concerned is on the little cards that we all carry around. That message has not been embraced by the nursing staff because people are still frightened I think. Talking to people they still think they are going to get told off or there are going to be repercussions.” (Mary)

Judy was clearly able to justify why she avoided calling the MET, and listed a number of reasons for this—for example, the patient has to be really unwell, there is an expectation that the ward can manage the deteriorating patient, and it is just not practical to call the MET for every patient who has only one physiological abnormality.
“I would not call the MET unless the patient was really unwell; you know, needed immediate care. I would always go through the nurse in charge and the doctors. I know the rationale behind the MET but I do think there is an expectation that we can manage these sick patients on the ward. If we called a MET every time one of the criteria was present, the team would be here constantly—it’s just not practical. Patients have to be really sick before you call a MET. You just would not call them for a low blood pressure—there has to be more than that.” (Judy)

The fear of being reprimanded meant the participants resisted and hesitated activating the MET when a patient deteriorated. Anxiety also appeared to inhibit triggering the afferent limb, and this is discussed in the following section.

Anxiety

Anxiety was the second sub-theme in the theme resisting and hesitating. In this analysis, anxiety was described as experiencing feelings of worry, uneasiness, and dread. The participants identified that they experienced these negative emotional responses when they anticipated activating a MET. The participants identified that caring for a deteriorating ward patient created anxiety. This was related to feelings of insecurity about their role and performance in caring for and managing a patient who was deteriorating. Activating the MET was associated with high levels of anxiety and stress. All of these emotions created a sense of anxiety. Ann’s example highlighted this:

“Everyone is shouting and no-one knows what’s happening—that makes you feel really anxious. I suppose it’s nerve-racking in emergency situations. All the people that are around and I thought I had to do something to help them but I just did not know what to do.” (Ann)

Not knowing what to do when everyone was shouting and the lack of direction created a sense of helplessness and anxiety. The participants highlighted that their previous exposure to a MET also contributed to their anxiety when they needed to call a MET. This aspect of their anxiety arose because of past occasions when their decision to activate a MET had been questioned in front of their colleagues, and their concern that this may be repeated created
feelings of anxiety and dread, which made them reluctant to activate the MET. This is illustrated in Laura’s interview:

“Sometimes the MET can be negative. For example, I remember the code was called and I think the patient was, I can’t quite remember, anyway, the patient was kind of stabilising when they got there and one of the doctors said, ‘Oh, why did you call? The patient’s kind of stable.’ Yeah, I remember I felt really embarrassed about it. They all went away and nobody really dealt with how I was feeling. Because of that experience, I feel really anxious when I need to call it and won’t call it unless the patient is as flat as a pancake and I know they need help.” (Laura)

Participants identified that activating a MET engendered feelings of anxiety and this was perceived as a negative emotion and one that should be avoided if possible. Linked to anxiety was the sense of panic that ensued when a MET was activated. This was the last sub-theme in resisting and hesitating, and is discussed below.

Panic

In the context of this study, panic is constructed to mean a strong feeling of distress that prevents reasonable thought or action. Participants identified that activating an RRS or caring for a deteriorating ward patient created feelings of panic. Statements like “it’s frightening because it’s instant panic” and “you just panic because you don’t know what to do” were used by participants to illustrate the emotions that activating the MET created for them. Amy spoke about how activating a MET created immediate feeling of panic:

“It’s like as soon as you ring that MET or push that button and you want a MET it’s panic stations, you feel stressed, and your adrenalin is going.” (Amy)

Activating a MET created a flight or fright response in participants as evidenced by Amy’s reference to her adrenaline release and feelings of stress. Katie also exemplified this in her interview. Katie talked about not wanting to go into panic mode because of the negative emotions that activating the MET creates and how it causes an adrenaline rush.
“People don’t want to go there. You don’t want to go into that panic mode because your adrenalin goes crazy when you call a MET.” (Katie)

Participants also identified that not knowing what to do in the presence of patient deterioration created feelings of panic. Again, this led to resisting and hesitating in activating a MET. Jenny spoke about how being a new graduate created uncertainty about what would happen when the MET arrived and how this made the whole process scary:

“As a new graduate, if I call a MET call for a deteriorating patient that I’m looking after, what do I do? Like when they get there. You know what I mean...what am I meant to do when the MET team get there? What do I do when they get there? Do I step away? It seems scary like, ‘Oooh, the MET call!’ What’s going to happen? Is someone going to jump out at me or something.” (Jenny)

Jenny’s inexperience created uncertainties about knowing what to do. Rachel, a newly graduated Registered Nurse (RN), echoed Jenny’s concerns. Rachel also identified that she panicked because she felt she should have identified that the patient was deteriorating sooner, and this panic was later replaced with anger at being allocated a patient who was not well:

“I suppose it’s nerve-racking in emergency situations. All the people that are around and I thought I had to do something to help them but I just did not know what to do. I was very nervous because even though the patient was my patient I did not know what I was supposed to do. I felt panicked because I thought maybe I should have noticed earlier. Then to be honest, I was angry like why did they allocate her to me when she wasn’t clearly very well. (Rachel)

Activating the MET created feelings of fear, anxiety, and panic for participants, who, clearly wishing to avoid these negative emotions, created certain coping responses. These responses included resisting the MET and hesitating in activating the MET. Both responses may have led to a delay in escalating care for the deteriorating ward patient. The participants were able to justify the delay in activating the MET by pushing the button. This theme is explored in the next section.
The third theme that emerged from analysis of the interview transcripts was pushing the button. This theme captured the notion of participants reacting to the deteriorating ward patient by engaging in a concerted effort to access immediate help and support. The button in this context was the emergency button that the participants associated with a medical emergency. In the acute care setting, the emergency button is pushed as a means to call for expert help and support, and has traditionally been used when a patient has suffered a cardio respiratory arrest. Pushing the emergency button rather than calling the MET on the phone represented a ‘true’ emergency. This is illustrated in the examples below. Helen talked about deciding if the patient can hang on a few more minutes and Tanya reported that if the patient was deteriorating, she would go to the nurse in charge whereas if a patient that was having a cardiac arrest, she would push the button.

“It would depend if I thought the patient could, I don’t know, hang on a few more minutes until people got there. But if I didn’t think I was going to get a quick response, I wouldn’t. I’d just do it; I’d push the button.” (Helen)

“If it’s a MET call, you go to the nurse in-charge. If it’s an arrest, I push the button and then it’s real because our buzzers call out at the time and everybody comes.” (Tanya)

In reality, this means that the MET was often not used as an early intervention strategy but rather like the cardiac arrest team. What the interviews clearly demonstrated was that the participants had difficulty separating the purpose of the cardiac arrest team from that of the MET. Laura provided an example of this in her interview:

“Same buzzer on the ward, same bell that goes out; everybody gets told the same message. I don’t differentiate at all between the code and MET—they are both the same thing in my mind.” (Laura)
The resuscitation status of the patient also influenced MET activation. Karen talked about how the resuscitation status of the patient dictated whether or not she activated the MET:

“The resus status of the patient is important. If they’ve been deteriorating on the ward and the team has been quite heavily involved that day, and they are thinking, ‘Oh well, they are DNR’, I’d call the home team rather than the MET because you’re not going to get them transferred to ICU. You’re going to do interventions that the ward can manage.” (Karen)

Two sub-themes emerged from the analysis of pushing the button: (1) misunderstanding the MET; and (2) timing of clinical deterioration.

Misunderstanding the MET

Misunderstanding the MET was the first sub-theme in the theme of pushing the button. This sub-theme was defined as failure to understand the aims and objectives of the MET and led to its incorrect use. The participants reported that they had witnessed the MET being used incorrectly on a number of occasions, often by senior medical staff, and this led to confusion about when, and how, to use the system. Katie, a very experienced RN, described how a consultant cancelled the MET because the patient was still breathing, despite the fact that the patient clearly met the MET activation criteria:

“Once it was a consultant on the ward and it wasn’t her patient. She came in and she goes, ‘Well, she’s still breathing, cancel the MET.’ I was like, ‘She’s unconscious’, and she ended up dying an hour later. She’d been a stroke patient and she’d extended and had dropped her GCS. She had a good GCS prior to that of about 14 or 15 and dropped to 3. So she warranted a MET call and she warranted urgent care but she was like, ‘Yeah she’s still breathing.’ I think there might have been that misinterpretation of, well, it’s not full cardiac arrest or respiratory arrest. We don’t need a code.” (Katie)

Misinterpretation and lack of understanding of the role of the MET led to confusion and uncertainty about when to push the button. The participants identified that, in their experience, METs are not perceived as an early intervention strategy but were unable to
articulate how this perception could be challenged and changed. Katie discussed this in their interview:

“I think it’s probably a lack of understanding of the MET and how it should be used. People don’t see it as an early intervention thing; I am not sure how you go about changing that. I can see that the patient is deteriorating and I can see that poor decisions are being made and it’s very frustrating, yet a MET is not called because the patient is not sick enough for a MET; it’s amazing.” (Katie)

As well as misunderstanding the aims and objectives of the MET, the participants also appeared to misunderstand the purpose of the MET activation criteria and appeared to challenge these criteria or ignore them if they disagreed with the parameters set. Judy, an RN who had been qualified for more than two years, stated that she would not activate a MET for a patient who was pyrexial or who had a systolic blood pressure of < 90mmHg, and argued for a systolic blood pressure of 30mmHg as a criterion for activating the MET.

“A temperature of 38 is not a MET call for me. In your mind, you think doctors’ blood cultures—let’s give him antibiotics. A resp rate of 30 is not a MET call. Most of them actually do sit at about 30, so you would not call a MET for a Cystic Fibrosis patient with a resp rate of 30. A systolic below 90 is not a reasonable calling criterion because you get people on the wards, which have a systolic below 90. Maybe below 30, that’s a good warning bell for most people. That could be criteria.” (Judy)

The questioning of the MET activation criteria was one factor that resulted in the participants being confused about when to push the button or when to activate a MET. By questioning and ignoring the MET activation criteria, the participants were complicit in ensuring that the aims and objectives of the MET as an early intervention strategy were not achievable.

**Timing of clinical deterioration**

Timing of clinical deterioration was the second sub-theme that emerged within the theme pushing the button. The time when patients deteriorated influenced MET activation. Timing of clinical deterioration referred to when during a 24-hour period the patient
deteriorated. After-hours was described as 5.00pm until 7.00am, with weekends defined as 5.00pm Friday until 7.00am Monday. After-hours signified lower numbers of medical and support staff in the hospital and was a time when METs were more likely to be activated and used by the participants. Tara clearly identified this in her interview.

“I am hundred times more likely to call a MET at night; in fact, I am a hundred times more likely to call it after 5.00pm. Your morning teams, they are going to be going sometime soon. They may have gone; you don’t know their social schedule. You don’t know what’s going on, they might have already left. During the day, they’re around and you’ve got your Regs around. You’ve got their experience around as well, so you can feel a little more confident with that.” (Tara)

The hospital after-hours was staffed by on-call medical staff and had a reduced nurse:patient ratio. The number of MET activations increased in the after-hours and the participants identified that this was the period during which they were most likely to push the button. A number of factors were responsible for the increase in MET activation. First, the participants identified that they lacked support in recognising and caring for the deteriorating patient during out-of-hours and weekends. Phrases like “it’s so scary at night” and “you feel like you are on your own” were used by the participants, illustrating that they felt unsupported and isolated. Helen spoke of the ward being a scary place and of feeling like nurses are alone.

“It’s just that during the night there are not as many people here as there would be during the day so it’s a bit scarier—you feel like you are more alone. It can get really scary actually, because you’re like, I just want all the lights on! God! Your codes and your MET calls I say are really good for nights because it’s that whole dark, scary environment. God, I hate the deep-breathing even! Where are the light switches?” (Helen)

The participants identified that it was more problematic and difficult to perform a holistic and systematic assessment during after-hours because the ward environment was perceived as being different. Penny discussed how at night patients could appear sicker and this led to an increase in RRT activation:
“And it’s scary, you know what I mean? Your nights have a different environment to the day when all your lights are on. You’re more likely to look at someone and think they’re off-colour at night than in the day when they are sitting up and talking and their obs are a bit off. Instead, when they are asleep and their obs are off again. You’re busier during the day and I of all people am like breathing, breathing, and breathing. I know it’s terrible but you do know what I mean every time you walk into a room you kind of eyeball them and make sure everyone is breathing. You don’t go round and check their obs. At night, you check their obs and check that they are breathing.” (Penny)

The participants clearly felt more isolated and vulnerable when caring for a deteriorating patient during after-hours, and this isolation and lack of support led to a decreased threshold to push the button and activate a MET.

In summary, the theme pushing the button included a number of issues that hindered or facilitated MET activation—for example, misunderstanding the role of the MET appeared to prohibit appropriate activation of the MET, whereas clinical deterioration occurring during after-hours appeared to support participants activating a MET. Looking at the final theme, reflecting on the MET, the participants identified a number of factors that influenced their decision to activate a MET.

**Reflecting on the MET experience**

The final theme that emerged from analysis of the interview transcripts was the participants’ reflections on the factors that facilitated and or obstructed the MET. This theme encapsulated what the participants considered important in enabling them to use the MET effectively and what factors they identified as hindering them in activating the MET. This theme is illustrated by Tanya, who clearly highlighted in her interview the importance of having an effective leader:

“I think if a clear leader is designated to manage and lead the code or the MET call that would be a big improvement. At the moment, it is chaotic and can be uncoordinated and that adds to an already stressful event.” (Tanya)
Within this theme, three sub-themes were identified: (1) leadership; (2) support; and (3) consulting and seeking advice. The first sub-theme, leadership, is discussed below.

Leadership

Leadership was the first sub-theme that was identified in the theme reflecting on the MET. Participants identified the importance of a designated leader to coordinate and manage the MET. In the context of this study, leadership is understood as the process by which a person influences others to accomplish an objective and how they direct the MET in a way that makes it more cohesive and coherent. The participants highlighted the identification of a named leader as important because it ensured that activation of the MET was less stressful and less disjointed. By promoting a more organised approach to managing the deteriorating patient, the participants identified that they were more likely to activate a MET in future. Therefore, an effective leader clearly facilitated the ongoing use of the MET. This is illustrated by Amy and Jenny, who both talked about the importance of a leader during the MET call:

“If you have a clear leader then everything always runs much smoother. It can make a huge difference to your experience of the MET having someone in charge who leads it.” (Amy)

“It really does depend on who is leading the code or the MET. The person in charge at that moment has a really big influence on everyone’s perception of the MET.” (Jenny)

The participants clearly felt that a smooth and cohesive MET call was important in reducing the stress and anxiety associated with managing a deteriorating patient and activating a MET. The participants said that identifying a designated leader could facilitate this. Exposure to a MET call that was organised and not disjointed resulted in a more positive experience of the MET and this appeared to positively influence the participants’ perceptions of the MET and contributed to them being more likely to activate a MET in future. The
participants identified that “support” was important in enabling them to activate and use the MET. The sub-theme support is discussed in the succeeding section.

Support

The participants referred to the importance of feeling supported and this was an important factor in them activating and using the MET. In the context of this study, support is about the participants feeling that their decisions to activate the MET would be defended as correct by their peers, the medical staff, and senior nurses. The importance of support is exemplified by Ann in her interview:

“It’s really important that the nurses feel supported about calling the MET and the message needs to be really clear that MET’s an early intervention rather than a last resort.” (Ann)

Lack of support was identified by participants as being a factor that hindered use of the MET. The participants described experiences in which MET members asked, “Why did you call a MET? The patient is stable…” and this made the participants question their ability to appropriately activate MET. Negative reactions from the MET created reluctance on the part of the participants to activate a MET in the future. Amy discussed how lack of support in regards to activating a MET created reluctance on part of nurses to use the system:

“The RNs who don’t feel supported in the decisions to call the MET are fearful, yeah, in situations like that where there is a bit of a grey area. They think, ‘Oh, I’m just going to do this,’ or they just do what they want. But I think if, you know, you are going to be supported in the first instance, you don’t have a problem calling the MET.” (Amy)

The final sub-theme that the participants identified as facilitating or obstructing activation of the MET was consulting and “seeking advice”. The sub-theme seeking advice is described in the following section.
Seeking advice

The final sub-theme that emerged in the reflecting on the MET theme was seeking advice. The participants acknowledged that they often required advice and help in relation to when to access the MET and, in order to access this help, they sought consultation from their peers, more-senior nurses, or medical staff. The ability to seek appropriate and timely advice appeared to be related to effective communication. The ability to “package” clinical deterioration effectively and therefore justify MET activation appeared to depend on the participants’ knowledge, confidence, and level of experience. However, the ability to access advice may, in fact hinder, the use of the MET. The participants talked frequently about “going to the nurse in charge first”. This effectively bypassed the MET and prevented its use as an early intervention strategy. Rachel clearly illustrated this when she discussed how she would access the nurse in charge rather than activating a MET.

“If I have a problem concern of whether it’s a deteriorating patient or a question about someone’s cares that may not be a deteriorating patient, I will go to the next level—the nurse in-charge—and speak to them and get advice as to what my next step would be so that would be how I would address the problem as a problem-solving kind of thing.” (Rachel)

This was also echoed in Tanya’s interview:

“Yeah, I think if I was concerned about someone in the first instance and it wasn’t—what’s the word? —critical. I’d certainly consult with the person in-charge and say, ‘Look, I’ve got Mr Jones over here and I really don’t think he’s doing well. His blood pressure has dropped a little bit and he looks a bit grey looking, he seems to be sort of deteriorating slowly but seems relatively stable. Can you come and review him at some point? But then that could be, it could be 10 minutes time or it could be 3 hours. I would still talk to the person in-charge first perhaps before we got to the decision-making of a MET call.” (Tanya)

Both of these examples clearly illustrate how the culture of seeking advice and support to validate clinical decisions and actions may impede the effective use of the MET and prevent escalation of care needs.
The final theme, reflecting on the MET, described the factors that the participants identified as important in facilitating or obstructing their use of the MET. Three sub-themes emerged from the thematic analysis of this theme: (1) leadership; (2) support; and (3) seeking advice. The participants identified that an identified leader was an important factor in ensuring a positive MET and this was more likely to result in them activating a MET for the deteriorating patient in the future. The importance of support was highlighted as an important factor in activating a MET by the participants. The participants identified they were more likely to activate a MET if they were supported in their actions to do so. Seeking advice from peers and colleagues delayed the participants activating the MET. The participants often sought advice from their peers and colleagues before activating the MET and often delayed the MET from escalating care for the deteriorating patient, which also prevented the MET from being used an early intervention strategy.

Summary

In summary, this first unit of analysis explored the nursing practices of registered nurses using an RRS. Fifteen RNs were interviewed. All of the participants worked in medical wards, which had on average 25 beds. Thematic analysis of the semi-structured interviews was undertaken with the aim of developing an understanding of nurses’ experiences and perceptions of using the MET. Four themes relating to participants practices of using a RRS emerged from the data. These themes were: (1) sensing clinical deterioration; (2) resisting and hesitating; (3) pushing the button; and (4) reflecting on the MET.
Chapter 5: The ANP after-hours service

Introduction

The overall aim of the second unit of analysis was to explore if the APN after-hours service improved patient outcomes. The APN after-hours service is a nurse led ramp-up RRS and was implemented at the Gold Coast Hospital with the aim of supporting ward nurses caring for the deteriorating patient and improving the care and management of the deteriorating patient. An overview of the APN after-hours service was provided in chapter 3 (page 70) of this thesis.

This study measured the extent to which: (1) the implementation of an APN after-hours service reduced the incidence of MAEs (unplanned admission to ICU/CCU, death, or in-hospital cardiac arrest) in the medical ward patient population; (2) the implementation of APN after-hours service reduced the incidence of adverse events; (3) the implementation of an APN after-hours service increased MET activation; (4) the implementation of an APN after-hours service reduced the physiological abnormalities associated with clinical deterioration; and (5) the predictors of MAEs and other adverse events in ward patients at risk of clinical deterioration could be identified using logistic regression. The sample for this phase of the research study consisted of two separate groups of ward patients. The control group consisted of 150 randomly selected medical patients admitted to Gold Coast Hospital before the introduction of the APN after-hours service. The intervention group consisted of 150 randomly selected medical patients admitted to the Gold Coast Hospital after the introduction of the APN after-hours service.

The research questions developed to meet the aim of the second phase were:

- To what extent does the introduction of the APN after-hours service reduce MAEs in medical ward patients?
To what extent does the introduction of the APN after-hours service reduce adverse events in medical ward patients?

To what extent does the introduction of the APN after-hours service increase the activation of the MET?

To what extent does the implementation of the APN after-hours service reduce the physiological abnormalities associated with life threatening clinical deterioration?

Medical ward patient outcomes were the second unit of analysis in this single exploratory case study. The aim of this unit of analysis was to explore if the introduction of an APN after-hours service improved patient outcomes. The APN after-hours service was introduced in July 2008 and operated from 8.00pm–8.00am 7 days a week. The service was provided by six experienced acute care nurses who supported ward nurses and the multi-disciplinary team in the care and management of the deteriorating ward patient in the hospital after-hours. The APN after-hours service aims to: (1) Co-ordinate the care and management of the deteriorating patient (2) Identify and monitor the deteriorating patient; (3) educate ward nurses on the care at management of the deteriorating patient; and (4) reduce the incidence of MAEs and other serious adverse events (Williams et al., 2012). This innovative nursing service is, therefore, classed as a ramp-up, nurse-led RRS (DeVita et al., 2006). The APN after-hours service operated as a two tier RRS within the Gold Coast hospital and complemented the existing RRS in the hospital. The hospital also used the MET and the ICU liaison nurse as part of its response to the deteriorating ward patient. Ward nurses were responsible for alerting the APN after-hours service via the hospital pager system. The APN after-hours service responded to these concerns by assessing, monitoring, reviewing, treating or escalating care as required and supporting and educating ward nurses via informal teaching opportunities (Williams et al., 2012).

Patients exposed to the ANP after-hours service (the intervention) were compared to patients not exposed to the intervention (the control). Several studies have used the incidence
of MAEs to measure the impact of an RRS on patient outcomes (Bristow et al., 2000; Chen et al., 2009; Cretikos & Hillman, 2003; Hillman et al., 2005; Jones, Hart, Bellomo, & Martin, 2008; Needle & Anderson, 2006). However, those studies have only measured METs not nurse-led RRSs. This study expands on the existing research and contributes to the body of knowledge by measuring the impact of a nurse-led RRS on patient outcomes. Based on the review of the literature, the following hypotheses were generated:

- Medical ward patients hospitalised prior to the implementation of the APN after-hours will have significantly more MAEs.
- Medical ward patients hospitalised prior to the implementation of the APN after-hours will have significantly more adverse events.
- Medical ward patients hospitalised prior to the implementation of the APN after-hours service will experience significantly more physiological abnormalities associated with life-threatening clinical deterioration.
- Medical ward patients hospitalised prior to the implementation of the APN after-hours will have significantly more MET activations.
- Age, gender, hospital length of stay, existence of MET activation criteria, and the absence of the APN after-hours service will predict MAEs.
- Age, gender, hospital length of stay, existence of MET activation criteria, and the absence of the APN after-hours service will predict adverse events.

**Sample characteristics**

The medical charts of 300 patients were reviewed (see Table 1). A Mann-Whitney U test revealed significant difference in age between the control group ($Mdn=70$ years, $n=150$), and the intervention group ($Mdn=74$ years, $n=150$) (see Table 1). There was no significant difference in length of stay or gender between the two groups.
Table 1—Sample characteristics (n=300)

<table>
<thead>
<tr>
<th>Demographic information</th>
<th>Control (pre-APN)</th>
<th>Intervention (post-APN)</th>
<th>U</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n=150</td>
<td>n=150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (in years)</td>
<td>70 (47–80)</td>
<td>74 (59–82)</td>
<td>9587</td>
<td>0.04</td>
</tr>
<tr>
<td>LOS (in days)</td>
<td>7 (4–12)</td>
<td>7 (4–14)</td>
<td>10695</td>
<td>0.06</td>
</tr>
<tr>
<td>Gender</td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td>2</td>
<td>p</td>
</tr>
<tr>
<td>Male</td>
<td>74 (48.6%)</td>
<td>76 (51.4%)</td>
<td>0.213</td>
<td>0.64</td>
</tr>
<tr>
<td>Female</td>
<td>76 (51.4%)</td>
<td>74 (48.6%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Patients were admitted to hospital with a range of diagnostic conditions. The most common diagnostic condition was respiratory, followed by neurological. There were no significant differences in diagnostic categories between the two groups (Table 2).

Table 2—Diagnostic categories (n=300)

<table>
<thead>
<tr>
<th>Diagnostic category</th>
<th>Control (pre-APN)</th>
<th>Intervention (post-APN)</th>
<th>^2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n=150</td>
<td>n=150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>36 (24.0%)</td>
<td>50 (33.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurological</td>
<td>38 (25.3%)</td>
<td>36 (24.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infection</td>
<td>19 (12.7%)</td>
<td>14 (9.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac</td>
<td>12 (8.0%)</td>
<td>18 (12.0%)</td>
<td>7.02</td>
<td>0.31</td>
</tr>
<tr>
<td>Gastrological</td>
<td>15 (10.0%)</td>
<td>13 (8.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urological</td>
<td>11 (7.3%)</td>
<td>6 (4.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>19 (12.7%)</td>
<td>13 (8.7%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The APN after-hours service was consulted on 23 separate occasions (15.3%) and patients who were reviewed by the APN after-hours service were only reviewed once. In total, 25 (8.3%) of the sample experienced an MAE. As shown in
Table 3, the chi-squared test of independence revealed a significant difference in the numbers of MAEs experienced between the two groups, with the intervention group experiencing significantly more MAEs than the control group.

Table 3—Incidence of major adverse events (n=300)

<table>
<thead>
<tr>
<th>Major adverse event</th>
<th>Control (pre-APN)</th>
<th>Intervention (post-APN)</th>
<th>Total Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7 (4.7%)</td>
<td>18 (12.0%)</td>
<td>25 (8.3%)</td>
</tr>
<tr>
<td>No</td>
<td>143 (95.3%)</td>
<td>132 (88.0%)</td>
<td>275 (91.7%)</td>
</tr>
</tbody>
</table>

Unplanned admission to ICU was the most frequent MAE in both the intervention and the control group (see Table 4). The relationship between the introduction of the APN after-hours service and the type of MAEs in the control and the intervention group was assessed using the chi-squared test of independence. There was a significant difference between the two groups in relation to the types of MAEs (see Table 4). However, because the assumptions of chi-squared test of independence may be compromised as a result of low sample numbers, the results need to be interpreted with caution.

Table 4—Types of major adverse events (n=300)

<table>
<thead>
<tr>
<th>Type of major adverse event</th>
<th>Control (pre-APN)</th>
<th>Intervention (post-APN)</th>
<th>Total Frequency (%)</th>
<th>2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unplanned admission to ICU/CCU</td>
<td>7 (4.6%)</td>
<td>8 (5.3%)</td>
<td>15 (5.5%)</td>
<td>8.92</td>
<td>0.01§</td>
</tr>
</tbody>
</table>
Notes:
5 cells (83.3%) have expected count less than 5. The minimum expected count is 1.12.
ICU=Intensive care unit. CCU= Coronary care unit. §Likelihood ratio.

The chi-squared test of independence revealed no significance difference between the
two groups in relation to the incidence of adverse events (see Table 5). Patient complications
including myocardial infarction (MI), deep vein thrombosis (DVT), pulmonary embolism
(PE), neurological deficits, and unplanned return to theatre were the most common adverse
events experienced by the intervention group. In the control group, the most common adverse
event was adverse drug reaction and hospital acquired accident or injury. There was no
significant difference in the types of adverse events between the two groups (see Table 5).

Table 5—Adverse events (n=300)

<table>
<thead>
<tr>
<th>Adverse event</th>
<th>Control (pre-APN) n=150</th>
<th>Intervention (post-APN) n=150</th>
<th>Total Frequency (%)</th>
<th>$^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>32 (21.3%)</td>
<td>36 (24.7%)</td>
<td>69 (23.0%)</td>
<td>0.30</td>
<td>0.58</td>
</tr>
<tr>
<td>No</td>
<td>118 (78.7%)</td>
<td>113 (75.3%)</td>
<td>231 (77.0%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Type of adverse events

<table>
<thead>
<tr>
<th>Complications including: MI, DVT, PE, CVA, neurological deficit, unplanned returned to OT</th>
<th>Control (pre-APN) n=150</th>
<th>Intervention (post-APN) n=150</th>
<th>Total Frequency (%)</th>
<th>$^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adverse drug reaction</td>
<td>8 (5.3%)</td>
<td>7 (4.7%)</td>
<td>15 (5.0%)</td>
<td>4.11</td>
<td>0.53</td>
</tr>
<tr>
<td>Hospital accident/injury</td>
<td>7 (4.7%)</td>
<td>3 (2.0%)</td>
<td>11 (3.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital acquired infection/sepsis</td>
<td>5 (3.3%)</td>
<td>6 (4.0%)</td>
<td>11 (3.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other adverse event</td>
<td>6 (4.0%)</td>
<td>8 (5.3%)</td>
<td>14 (4.6%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
MI = Myocardial infarction; DVT = Deep vein thrombosis; PE = Pulmonary embolism; CVA = Cerebral vascular accident; OT = Operating theatre.
The study evaluated whether or not the introduction of an APN after-hours service decreased the number of patients who met the MET activation criteria and whether or not the introduction of the APN after-hour’s service affected the number of MET calls. In both the control and the intervention group, more than 40% of patients met the MET activation criteria yet only 1.6% saw a MET activated during the two periods of data collection. There was no significance difference in the number of patients who met the MET activation criteria between the two groups (see Table 6). There was also no significant difference between the two groups in relation to the number of MET calls made.

Table 6— MET activation (n=300)

<table>
<thead>
<tr>
<th>Did patient meet MET criteria?</th>
<th>Control (pre-APN) n=150</th>
<th>Intervention (post-APN) n=150</th>
<th>Total Frequency (%)</th>
<th>2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency (%)</td>
<td>Frequency (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>63 (42.0%)</td>
<td>67 (45.0%)</td>
<td>130 (43.0%)</td>
<td>0.217</td>
<td>0.64</td>
</tr>
<tr>
<td>No</td>
<td>87 (58.0%)</td>
<td>83 (56.0%)</td>
<td>170 (57.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was MET activated?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1 (0.6%)</td>
<td>4 (2.6%)</td>
<td>5 (1.6%)</td>
<td>1.95</td>
<td>0.16</td>
</tr>
<tr>
<td>No</td>
<td>149 (99.4%)</td>
<td>146 (97.3%)</td>
<td>295 (99.3%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The fifth aim of this phase of the study was to explore if patients in the control and the intervention group experienced significant differences in the type and frequency of MET activation criteria. MET activation criteria are used to alert nursing, medical, and other allied health-care workers to patient deterioration. If any of the activation criterion are met or exceeded, in accordance with the single parameter system used at the Gold Coast Hospital, the MET should be activated. The most commonly occurring physiological abnormality in the control and the intervention group were abnormal respiratory rate and abnormal
temperature. There were significance differences between the two groups in relation to respiratory rate above 25 or below 5 breaths per minute, oxygen saturations less than 90%, heart rate above 110 or less than 50 beats per minute, a drop of 2 or more in the GCS, and urine output less than 0.5mls/hr/kg (see Table 7). However, the GCS and the low urine output results need to be interpreted with caution because the assumptions of the chi-squared test may be compromised as a consequence of a lack of documentation, resulting in low numbers. There were no significant differences in systolic blood pressure less than 90 mmHg and temperature above 38.0°C or below 35.0°C between the two groups. The results of the analysis are presented in Table 7.

Table 7—Physiological abnormalities (n=300)

<table>
<thead>
<tr>
<th>Physiological parameters</th>
<th>Control (pre-APN) n=150 Frequency (%)</th>
<th>Intervention (post-APN) n=150 Frequency (%)</th>
<th>Total Frequency (%)</th>
<th>2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR &gt;25 &lt;5 min</td>
<td>20 (13.0%)</td>
<td>34 (23.0%)</td>
<td>54 (18.0%)</td>
<td>4.42</td>
<td>0.03</td>
</tr>
<tr>
<td>O₂ sat &lt;90%</td>
<td>13 (8.7%)</td>
<td>38 (25.0%)</td>
<td>51 (17.0%)</td>
<td>14.76</td>
<td>&lt;0.00</td>
</tr>
<tr>
<td>HR &gt;110 or &lt;50 bpm</td>
<td>15 (10.0%)</td>
<td>27 (18.0%)</td>
<td>42 (14.0%)</td>
<td>3.98</td>
<td>0.04</td>
</tr>
<tr>
<td>SBP &lt;90mmHg</td>
<td>22 (15.0%)</td>
<td>27 (18.0%)</td>
<td>49 (16.0%)</td>
<td>0.61</td>
<td>0.43</td>
</tr>
<tr>
<td>Drop in GCS of &gt;2</td>
<td>7 (4.7%)</td>
<td>10 (6.7%)</td>
<td>17 (5.7%)</td>
<td>8.02</td>
<td>0.01#</td>
</tr>
<tr>
<td>Drop in GCS of &gt;2 not documented</td>
<td>124 (82.7%)</td>
<td>134 (89.3%)</td>
<td>258 (86.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UO &lt;0.5ml/kg/hr</td>
<td>0 (0%)</td>
<td>5 (3.0%)</td>
<td>5 (1.7%)</td>
<td>5.09</td>
<td>0.03§</td>
</tr>
<tr>
<td>UO &lt;0.5ml/kg/hr not documented</td>
<td>141 (94.0%)</td>
<td>136 (90.7%)</td>
<td>277 (92.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp &gt;38.0°C or &lt;35.0°C</td>
<td>28 (19.0%)</td>
<td>32 (21.0%)</td>
<td>60 (20.0%)</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>Temp &gt;38.0°C or &lt;35.0°C not documented</td>
<td>28 (19.0%)</td>
<td>32 (21.0%)</td>
<td>60 (20.0%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

# = Likelihood ratio, 2 cells, have expected counts of less than 5. The minimum expected count is 8.50.
§ = Likelihood ratio, 2 cells, have expected counts of less than 5. The minimum expected count is 2.50.
The study also examined if a number of independent variables were able to predict the occurrence of MAEs in medical patients. To achieve this aim, a model-building approach was taken. First, bivariate analysis was performed to identify significant associations between the predictor variables and the outcomes. Multiple logistic regression was used to determine which of the potential predictors, along with APN after-hours service intervention, were significantly and independently associated with MAEs. Using the enter method, all significant variables were entered into the model. The model contained nine independent predictor variables (see Table 8). The full model containing all the predictor variables was statistically significant, $\chi^2 (11, n=300) = 64.93, p <0.01$, indicating that the model was able to distinguish between patients who had an MAE and patients who did not experience an MAE. A post hoc power analysis was undertaken to determine if the sample size was adequate to demonstrate statistically significant differences for the main outcome measure, MAEs. With a sample size of 300, alpha of 0.05, Cox and Snell R squared 0.04 a power of 0.62 was identified. Because the power for this logistical analysis was low a type II error may have occurred.

As shown in Table 8, only two of the independent variables made a statistically significant contribution to the model (heart rate >110 or <50 beats a minute, and a drop of 2 or more in the GCS). The strongest predictor of a patient experiencing an MAE was a drop of 2 or more in the GCS. Patients who experienced a drop of 2 or more in the GCS were 5.19 times more likely to experience an MAE. The second strongest predictor of an MAE was patients with abnormally high or low heart rates; these patients had 5.04 times greater chance of experiencing an MAE (see Table 8).
The study examined whether a number of independent variables were able to predict other adverse events in medical patients. To achieve this aim, a model building approach was taken. First bivariate analysis was performed to identify significant associations between the predictor variables and the outcome. Multiple logistic regression was used to determine which of the potential predictors, along with APN after-hours service intervention, were significantly and independently associated with MAEs. Using the enter method, all significant variables were entered into the model. The model contained nine independent predictor variables (see Table 9). The full model containing all of the predictor variables was

Table 8—Predictors of major adverse events—Multivariant logistic regression model 

<table>
<thead>
<tr>
<th>Predictor variables</th>
<th>$b$</th>
<th>$p$</th>
<th>Odds ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR &gt;110 or &lt;50 BMP</td>
<td>1.61</td>
<td>0.01</td>
<td>5.04</td>
<td>1.42 – 17.73</td>
</tr>
<tr>
<td>Drop in GCS of &gt;2</td>
<td>1.64</td>
<td>0.02</td>
<td>5.19</td>
<td>1.19 – 22.59</td>
</tr>
<tr>
<td>U0 &lt;0.5ml/kg/hr</td>
<td>2.60</td>
<td>0.06</td>
<td>14.60</td>
<td>0.82 – 259.73</td>
</tr>
<tr>
<td>O₂ Sat &lt;90%</td>
<td>1.24</td>
<td>0.07</td>
<td>3.48</td>
<td>0.88 – 13.76</td>
</tr>
<tr>
<td>Temp &gt;38.0°C or &lt;35.0°C</td>
<td>−0.89</td>
<td>0.12</td>
<td>0.41</td>
<td>0.13 – 1.29</td>
</tr>
<tr>
<td>Length of stay</td>
<td>0.04</td>
<td>0.15</td>
<td>0.95</td>
<td>0.89 – 1.01</td>
</tr>
<tr>
<td>SBP &lt;90mmHg</td>
<td>0.72</td>
<td>0.23</td>
<td>2.06</td>
<td>0.62 – 6.84</td>
</tr>
<tr>
<td>RR &gt;25 or &lt;10 min</td>
<td>0.65</td>
<td>0.35</td>
<td>1.92</td>
<td>0.48 – 7.72</td>
</tr>
<tr>
<td>APN intervention</td>
<td>−0.33</td>
<td>0.57</td>
<td>0.71</td>
<td>0.22 – 2.26</td>
</tr>
<tr>
<td>Constant</td>
<td>−2.10</td>
<td>0.82</td>
<td>0.12</td>
<td></td>
</tr>
</tbody>
</table>

RR = Respiratory Rate, O₂ Sats = Oxygen Saturations, HR = Heart Rate, BMP = Beats per minute, S/B/P = Systolic Blood pressure, GSC = Glasgow Coma Score, UO = Urine Output, Temp = Temperature
statistically significant, $\chi^2 (11, n=300) = 61.50, p < 0.00$, indicating that the model was able to distinguish between patients who had an adverse event and patients who did not experience an adverse event. A post hoc power analysis was undertaken to determine if the sample size was adequate to demonstrate statistically significant differences for the outcome measure, adverse events. With a sample size of 300, alpha of 0.05, Cox and Snell R squared 0.18 a power of 0.99 was identified. Thus the sample size for this logistical analysis was adequate.

As shown in Table 9, four of the independent variables made a statistically significant contribution to the model (length of stay, low oxygen saturations, low blood pressure, and a drop of 2 or more in the GCS). The strongest predictor of an adverse event were patients who experienced a drop of 2 or more in the GCS, these patient were 3.5 times more likely to experience an adverse event. Patients with low oxygen saturations were 3.32 times more likely to experience an adverse event, and patients with a low blood pressure were 3.08 times more likely to experience an adverse event. For every extra day spent as an inpatient in hospital, patients had 1.04 increased risk of experiencing an adverse event.

Table 9—Predictors of adverse events— Multi variant logistic regression model ($n=300$)

<table>
<thead>
<tr>
<th>Predictor variables</th>
<th>$b$</th>
<th>$p$</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop in GCS of $&gt;2$</td>
<td>1.27</td>
<td>0.01</td>
<td>3.50</td>
<td>1.31 – 9.74</td>
</tr>
<tr>
<td>$O_2$ Sats $&lt;90%$</td>
<td>1.20</td>
<td>0.01</td>
<td>3.32</td>
<td>1.29 – 8.53</td>
</tr>
<tr>
<td>SBP $&lt;90$mmHg</td>
<td>1.21</td>
<td>0.07</td>
<td>3.08</td>
<td>1.36 – 7.00</td>
</tr>
<tr>
<td>Length of stay</td>
<td>0.45</td>
<td>0.05</td>
<td>1.04</td>
<td>1.01 – 1.07</td>
</tr>
<tr>
<td>Temp $&gt;38.0,^\circ C$ or $&lt;35.0,^\circ C$</td>
<td>$-7.0$</td>
<td>0.06</td>
<td>0.49</td>
<td>0.23 – 1.03</td>
</tr>
<tr>
<td>U0$&lt;0.5$ml/kg/hr</td>
<td>1.00</td>
<td>0.42</td>
<td>2.73</td>
<td>0.23 – 31.59</td>
</tr>
<tr>
<td>RR $&gt;25$ or $&lt;10$</td>
<td>$-0.28$</td>
<td>0.57</td>
<td>0.75</td>
<td>0.27 – 2.02</td>
</tr>
<tr>
<td>HR $&gt;110$ or $&lt;50$ BMP</td>
<td>0.24</td>
<td>0.59</td>
<td>1.28</td>
<td>0.58 – 3.21</td>
</tr>
<tr>
<td>APN intervention</td>
<td>0.12</td>
<td>0.69</td>
<td>1.13</td>
<td>0.59 – 2.18</td>
</tr>
<tr>
<td>Constant</td>
<td>$-1.20$</td>
<td>0.10</td>
<td>0.29</td>
<td></td>
</tr>
</tbody>
</table>

$RR$ = Respiratory Rate, $O_2$ Sat = Oxygen Saturations $HR$ = Heart Rate, BMP = Beats per minute, SBP = Systolic Blood
Summary

This second phase of the case study involved a retrospective chart review that explored one element of a RRS implemented at the Gold Coast Hospital. This element of a RRS was an APN after-hours service introduced in the hospital out-of-hours and was developed to improve the care and management of the deteriorating patient. Three hundred medical records were reviewed and these were split into two groups, the control group and the intervention group. The control group included 150 medical ward patients admitted to Gold Coast Hospital prior to the introduction of the APN after-hours service. The intervention group included 150 medical ward patients admitted to the Gold Coast Hospital following the introduction of the APN after-hours service. The control group was younger than the intervention group, and the control group had a median LOS of 7.0 days compared to 6.5 days for the intervention group. Both groups were admitted with a range of clinical conditions, the most common being respiratory followed by neurological.

The results of bivariate analysis revealed the intervention group experienced significantly more MAEs than the control group. Unplanned admission to ICU was the most frequent MAE in the total sample. The incidence of all other types of adverse events was similar between the two groups. In both the control and the intervention group, more than 40% of patients met the criteria that should have activated a MET, yet a MET was only activated for 1.6% of patients.

Results of a multiple logistic regression identified a significant, independent relationship between heart rate, a drop of 2 or more in the GCS, and an MAE. The strongest predictor of an MAE was low urine output, followed by a drop of 2 or more in the GCS. The
strongest predictor of a patient experiencing an adverse event was low oxygen saturation followed by a drop of 2 or more in the GCS.

A critical discussion of the key findings in the context of published literature and the research questions is presented in the next chapter.
Chapter 6: Discussion

The purpose of this case study was to explore and understand the phenomenon of deteriorating patient within the context of a RRS framework. Evaluation of either the afferent or the efferent limb of RRSs has been undertaken in the existing body of research. The present enquiry is the first known case study of the deteriorating patient in the context of a RRS. This single exploratory case study had two units of analysis. The first unit of analysis explored the practices of registered nurses using the MET. The second unit of analysis explored whether the APN after-hours service improved patient outcomes. The APN after-hours service is classified as a “ramp up” RRS (DeVita, et al., 2010) and was introduced at the Gold Coast Hospital with the aim of improving the recognition, care and management of the deteriorating patient. In this chapter the findings from this single descriptive case study are discussed and then compared and contrasted with the relevant literature. The contributions of this study to the body of evidence are also made explicit. A number of recommendations for clinical practice and education are presented and areas for further research are suggested. The limitations of the study are discussed and a conclusion to the study provided.

Overview of findings

Exploration of the of the afferent limb of the RRS involved exploring nurse’s perceptions of and attitudes towards the MET and exploring if the introduction of the APN after-hours service improved patient outcomes. Four themes emerged from thematic analysis of the fifteen interview transcripts and these were sensing clinical deterioration, resisting and hesitating, pushing the button and reflecting on the MET. The impact of introducing an APN after-hours on patient outcomes, utilisation of the MET and if the service reduced the frequency of physiological abnormalities in medical ward patients was also explored. Using a
multiple logistic regression model, the predictors of MAEs and adverse events were examined in the study. The findings indicate that the introduction of the APN after-hours service had no significant effect on patient outcomes, the physiological abnormalities of medical patients, or the utilisation of the MET. The strongest predictors of MAEs were an abnormal heart rate and a drop of 2 or more in the GCS; the strongest predictors of adverse events were hypotension, low oxygen saturation, and a drop of 2 or more in the GCS in medical ward patients.

**The afferent limb**

The afferent limb of the RRS incorporates case detection and a triggering response. In this study, nurses were interviewed about their experiences, perceptions, and opinions of activating and using a high capability team—specifically a MET. Nurses are ideally positioned to recognise and respond to the deteriorating ward patient because they are often the first to detect early signs of possible complications; their vigilance and constant surveillance of the patient means they are often the first health-care provider to identify and respond to patient deterioration (Clarke, 2004; Clarke & Aiken, 2003). Indeed, it is often a nurse who activates the RRS and escalates care for the deteriorating ward patient (Jones, King, & Wilson, 2009; Kenward et al., 2004). The ward nurse is therefore an important and pivotal element of the RRS’s afferent limb.

The findings of this study suggest that participants found the MET activation criteria useful in identifying clinical deterioration. This is reassuring; the afferent limb of the RRS was designed as a tool to alert health-care providers to potential and actual clinical deterioration of a patient based on changes in the patient’s vital signs. A number of studies demonstrate that changes or alterations in a patient’s vital signs are important indicators and predictors of the patient’s clinical deterioration (Chaboyer et al., 2008; Considine & Botti,
Throughout the interviews, the nurses in this study articulated that they valued the objective criteria that the EWS generated in relation to a patient’s physiological parameters. Participants activating the MET used these objective criteria to justify escalating care for the ward patient who was deteriorating. However, participants also identified that they questioned the appropriateness of the activation criteria and sometimes ignored these, this may have delayed activation of the MET and may have contributed to efferent limb failure.

In this case study a retrospective review of patients’ medical records was used to explore if a control group, patients not exposed to the APN after-hours service, experienced significantly different physiological abnormalities to an intervention group, patients exposed to the APN after-hours service. These physiological abnormalities are used to alert nursing, medical, and other allied health-care workers to the deteriorating patient. In accordance with the single parameter system used at the Gold Coast Hospital, if any of the activation criteria are met, the MET should be activated. There were significant differences between the two groups in relation to patients experiencing a respiratory rate above 25 or below 5 per minute, oxygen saturation less than 90%, a heart rate above 110 or less than 50 beats per minute, with patients in the intervention group more likely to experience these physiological abnormalities. One possible explanation for this finding is that the introduction of the APN after-hours service may have encouraged nursing staff to record and document patients’ vital signs and to be more vigilant in recognising patients at risk of clinical deterioration. The patients in the intervention group were also older, which increases the likelihood of abnormal vital signs in this group (Bucknall, Jones, Bellomo, & Staples; Considine & Botti, 2004; Harrison et al., 2004; Cretikos et al., 2008; DeVita et al., 2010; Harrison et al., 2006; Harrison et al., 2005; Hodgetts, Kenward, Vlackonikolis, et al., 2002; Jacques et al., 2006; Kyriacos, Jelsma, & Jordan, 2011; Trinkle & Flabouris, 2011).
The ability to recognise physiological abnormalities is a key factor in timely activation of a RRS. Recognition of physiological abnormalities is primarily a nursing role (Clarke, 2004; Considine, 2005; Massey & Meredith, 2010) and it is nurses who are responsible for recording vital signs. Nurses’ role in recording and documenting vital signs means they are ideally placed to recognise and respond to the deteriorating ward patient (Aiken et al., 2002; Clarke, 2004). Recently, however, there has been increasing concern that “doing the obs” has become ritualistic and task-oriented, and is often delegated to more junior staff that are over-reliant on technology (James, Butler-Williams, Hunt, & Cox, 2010; Wheatley, 2006). Failure to appreciate the importance of vital signs may lead to the loss of detailed and holistic patient assessment. Without basic observation data, a serious threat to patient safety exists as, without these data, a thorough and detailed patient assessment cannot take place. The nurses interviewed as part of this study identified that they use and value physiological parameters to recognise clinical deterioration and that this information was obtained via the patients vital signs.

Participants in this case study highlighted that subjective criteria were also important in recognising and responding to the deteriorating ward patient. The nurses interviewed acknowledged the importance of using “gut feelings”, and often used terms like “a hunch”, “a feeling”, or “a sixth sense” about the deteriorating patient. The labels “gut feeling”, “hunch”, “feeling”, or “sixth sense” are associated with the concept of intuition (Benner, 1991; Benner & Tanner, 1987; Kenward & Hodgetts, 2002; King & Appleton, 1997; Morrison & Symes, 2011). Intuition has been described as the use of rapid perception, lack of awareness of processes, and a holistic understanding of the problem or situation (Fernand Gobet & Philippe Chassy, 2008). A number of studies emphasise the role and value of intuition in
nursing (Benner, 1984; Benner et al., 1992; McCutcheon & Pincombe, 2001; Rew, 2000). However, intuition has also been the subject of considerable debate, with some theorists arguing that it should be subjected to more rigorous analysis or rejected as a legitimate form of knowledge (Altmann, 2007; Cash, 1995; English, 1993). Benner and Tanner (1997) argue that intuition is a legitimate and important aspect of nurses’ clinical judgment and other studies emphasise that nurses use intuition in their everyday clinical practice (Cioffi, 2000a, 2000b; Lyneham, Parkinson, & Denholm, 2008; Rew, 2000). The findings from this study suggest that the nurses interviewed use and value intuition in their everyday practice for recognising and responding to clinical deterioration.

Despite the subjective nature of intuition, the intuitive nurse is expected to operate within a continuum of competencies that require access to an explicit and empirical knowledge (Gobet & Chassy, 2008). For example, intuition requires nurses to assess and respond to clinical deterioration and justify these actions. These actions require explanation, communication skills, organisational skills, and problem-solving abilities (Gobet & Chassy, 2008) and, therefore, an explicit and empirical knowledge and understanding of the patient and the disease process is required (Ericsson, Whyte, & Ward, 2007). This was reflected in the findings chapter under the sub-theme, gut feeling.

In the example from this case study’s interview transcripts, participants talked about a patient not looking well, and then go on then to confirm that the patient was becoming unresponsive and diaphoretic. Clearly participants use both objective criteria and intuition to recognise and respond to the deteriorating patient. In relation to recognising and responding to the deteriorating patient using intuition, only one study (Williams, Newman, Jones, & Woodard, 2011) supports the finding of this case study. Deciding if a patient is at risk of clinical deterioration and requires escalation of care appears difficult and complex. When faced with complex decisions, the nurses in this study valued and used intuition, reasoning,
and clinical experience to recognise and respond to the deteriorating ward patient. The exploration of nurse’s perceptions of the RRS has only recently begun to be recognised as an important area that requires further investigation. Therefore, it is possible that, as more studies begin to examine nurse’s perceptions of the RRS, the concept of intuition as a valid and legitimate source of knowledge in recognising patient deterioration may emerge. Time has also been identified as an important factor in nurse’s decisions to activate a MET (Thompson et al., 2008). Although the nurses interviewed in this study did not identify that time was a factor in activating the MET, Thompson and colleagues’ work demonstrated that the positive effects of clinical experience were negated under time pressure.

Knowing the patient was identified by participants as important in recognising and responding to the deteriorating patient. The concept of knowing the patient was also linked to intuition because knowing the patient helped identify subtle and elusive changes in the patient’s clinical condition, which helped validate the decision to activate the RRT. The concept of knowing the patient was also identified by the participants in this study as one of the subjective criteria they used to identify and respond to the deteriorating ward patient; the nurses interviewed used phrases such as “I knew her; you call the home team first because they know the patient, and you get to know what’s normal for the patient.” Knowledge of the patients enabled the participants to interpret vital signs and physiological indicators in the context of each patient. The notion of knowing the patient has been documented elsewhere as important when assessing and evaluating a patient’s condition and providing holistic patient care (Cioffi, 2000a; Morrison & Symes, 2011). Knowing the patient leads to a sense of salience and an ability to recognise aspects of the patient’s clinical situation that stand out as important when guiding the nurse’s judgment and actions (Benner & Tanner 1987).

The nurses interviewed in this case study spoke about the importance of information gained from observing a patient, interpreting physiological parameters, knowing the patient,
and looking at and questioning previous data in order to provide an overall picture of the patient. This holistic view of a patient helped the participants in this study to recognise and respond to the deteriorating ward patient. The nurses interviewed identified that the ability to use both objective criteria—for example, data generated from the MET activation criteria and subjective criteria, such as knowing the patient and gut feelings developed from experience. However, the participants’ perceptions of the importance of experience in relation to recognising clinical deterioration were not consistent with the literature (Ericsson, 2008). A number of studies have demonstrated that experience and expertise are unrelated (Ericsson et al., 2007; Greenwood & King, 1995; Thompson et al., 2009) with both novice and more experienced practitioners making similar clinical judgments in relation to patient care and management. What does appear to influence patient outcomes, improve clinical reasoning, and judgment is not simply the product of experience but of deliberate clinical practice (Ericsson et al., 2007). Deliberate practice, according to Ericsson et al., (2007) includes activities that have been designed for the purpose of improving a specific area of performance. For example, the Acute Life-threatening Events: Recognition and Treatment (ALERT) course (Smith et al., 2002; Smith & Poplett, 2004) used deliberate practice in the form of stimulation and case studies to improve physicians’ knowledge and performance in recognising and responding to the deteriorating ward patient.

There is increasing evidence that that nurses value the MET (Bagshaw et al., 2010; Benin, Borgstrom, Jenq, Roumanis, & Horwitz, 2012; Galhotra et al., 2006; Jones et al., 2006; Salamonson, Heere, Everett, & Davidson, 2006). In this case study, however, the fear of “being reprimanded, looking like an idiot or being told off” was a powerful motivator used by the participants to justify delaying activation of a MET and the escalation of care. Nurses were anxious about making the wrong decision and looking foolish or stupid. This indicates that although nurses may value the MET as reported in the literature, they may not be
comfortable activating or using it. This confirms that activating a MET is an emotionally charged experience that can incite panic, anxiety, and fear (Considine & Botti, 2004; Jones et al., 2006; Shapiro et al., 2010). This finding implies that some nurses may actively resist activating a MET and escalating care for a deteriorating ward patient because they fear they will be subjected to negative reactions from the MET. There is an increasing body of literature supporting the view that nurses delay or actively resist activating an MET because of fear of being reprimanded (Cioffi, 2000a, 2000b; Donaldson, Shapiro, Scott, Foley, & Spetz, 2009; Shapiro et al., 2010). Although there is general consensus that a ‘no blame’ culture is an important element for implementing and operating a successful RRS (DeVita et al., 2006; Hillman, Parr, Flabouris, Bishop, & Stewart, 2001), this important message may not be translated into clinical practice.

Another important barrier to MET activation identified by the participants was misunderstanding of the function of the MET. A misunderstanding of the role and objectives of the MET contributed to under-utilisation or incorrect use of the MET. For example, in this case study participants talked about accessing the nurse in charge if the patient was deteriorating rather than activating the MET, identifying that they often felt they needed their decision to call the MET validated by a more senior staff member or colleague. This finding has also been reported in the literature (Shearer et al., 2012; Thompson et al., 2004). The nurses interviewed perceived that they and their colleagues did not see or view the MET as an early intervention strategy. Instead, the participants spoke about the MET as being a last resort, reflected in their actions of pushing the button, and only accessing the MET if the patient was in cardiac arrest. The button in this context was the emergency button that participants use during a cardiac arrest. A ‘true’ emergency, therefore, required the button to be pushed rather than calling the MET. This perception of the role of the MET being the same as a code blue or a cardiac arrest contributed to delays in activating the MET. In reality,
this means that the MET was not used as the early intervention strategy it was designed to be, but more so as an emergency response to a critical change in a patient’s clinical condition.

The ability to access advice may, in fact, hinder the use of the MET. Participants talked frequently about “going to the nurse in charge first” or “going to the next level”. This effectively bypassed the MET and prevented its use as an early intervention strategy. Previously, nurses and physicians have tended to operate in hierarchical silos of care and this model of practice may create professional barriers that need to be acknowledged and understood if the RRS is going to be absorbed and integrated successfully into the hospital culture. Jones and colleagues (2006) and Bagshaw and colleagues (2010) reported that nurses appeared to prefer to access help or support from among their team and “use the home team” rather than the MET because that was how they practiced historically. Arguably, this resistance to activating the MET further impacts on the MET’s effectiveness as an early intervention strategy. A ward nurse may identify clinical deterioration in a patient; then, when the clinical situation is deemed beyond the expertise of the ward nurse, ask a more senior nurse for advice. Then a junior doctor is consulted who responds based on their skills and their knowledge of the situation. When the junior doctor’s knowledge and skills are exhausted, another call is made, then another, and another, until all available resources have been exhausted. This knowledge and skills ladder is clearly hierarchical in nature and contributes to the delay in escalation of care.

The nurses interviewed in this study discussed how physicians also appeared to misunderstand the role and objectives of the MET and this potentially contributed to failure of the afferent limb. One senior nurse who was interviewed explained how a medical consultant had cancelled the MET because the patient was still breathing. This participant thought these types of clinical decisions by physicians contributed to nurses’ confusion or uncertainty about how and when to use the MET.
As well as misunderstanding the aims and objectives of the MET, participants also appeared to misunderstand the role of activation criteria. These criteria are used to alert nursing, medical and other allied health-care workers to clinical deterioration. In accordance with the single parameter system used at the Gold Coast Hospital, if any of the activation criteria are met, the MET should be activated. The nurses interviewed in this study highlighted that they ignored these activation criteria if they disagreed with the set parameters. Judy, an RN who had been qualified for more than two years, stated that she would not activate the MET for a patient who was pyrexial or who had a systolic blood pressure of less than 90mmHg. In Judy’s opinion, these parameters did not warrant MET intervention because she felt the patient was not sick enough for the MET. This finding is confirmed by other published studies (Bagshaw et al., 2010; Jones et al., 2006). By not responding to the predetermined activation criteria, nurses are failing to promote and use the RRS as an early intervention strategy and this may expose patients to suboptimal care (McGloin et al., 1999).

This case study evaluated if the introduction of an APN after-hours service decreased the number of patients who met the MET calling criteria and whether the introduction of the APN after-hours service affected the number of MET calls. Three hundred patients’ medical records comprised of 150 who were not exposed to the APN after-hours service and 150 who were exposed to the APN after-hours service, were reviewed retrospectively. In both groups, more than 40% of the patients met the criteria that should have resulted in the MET being activated, yet the MET was activated for only 1.6% of patients during the two time periods of data collection. There was no significant difference in the number of patients who met the MET activation criteria between the two groups. This finding demonstrates a substantial failure of the afferent limb of the RRS and is consistent with the findings of previous studies that RRSs are under-activated and under-utilised (Hillman et al., 2005; Ludikhuize et al.,
There is some evidence that the type of observation charts used to document patients' vital signs can significantly improve the recognition of the deteriorating patient and improve patient outcomes (Catterjee, Moon, Murphy & McCrea, 2005). A colour-coded chart that incorporates a TTS is a new initiative that is increasingly used in Australian hospitals and appears to improve recognition of the deteriorating patient (Elliott et al., 2011). However, the colour-coded observation chart was not implemented at the Gold Coast Hospital when the data for this study was collected. Therefore, it was not possible to assess if that patient safety initiative had improved the recognition of and response to patient deterioration.

The findings from this case study and other studies (Daffurn et al., 1994; Shearer et al., 2012; Tee, Calzavacca, Licari, Goldsmith, & Bellomo, 2008; Trinkle & Flabouris, 2011) suggest that nurses may choose to ignore the defined RRS activation criteria because they do not believe the patient is sick enough to warrant activating an RRS. With such a low utilisation rate, any potential benefit of the APN after-hour service is very difficult to assess. This is an important finding, because more than 20 years after the publication of the first papers on the antecedents of in-hospital cardiac arrest (Hazday, Pena, Ruben, Schein, & Sprung, 1990) and the negative outcomes associated with suboptimal ward care (McGloin et al., 1999; McLaughlin et al., 2007), afferent limb failure continues to be a major issue and is associated with negative patient outcomes (Calzavacca et al., 2010; Chen et al., 2009; Tee et al., 2008; Trinkle & Flabouris, 2011).

Improving the rate of RRS utilisation is therefore very important. By increasing nurses’ use of RRSs, the deteriorating patient should experience safer care and this should improve outcomes. Improving the use of RRSs by nurses will require reducing the barriers to RRS activation (DeVita et al., 2006, Jones 2010). This will be complex, and challenging due
to the multifaceted nature of nurses’ decision-making in recognising and responding to the deteriorating ward patient (Thompson et al., 2009).

Recent attempts to improve the use of RRSs have led to implementation of patient surveillance systems (PSS) (Sahandi, Noroozi, Roushan, Heaslip, & Liu, 2010). PSSs use continuous patient vital sign monitoring in the general care setting to facilitate early recognition of and appropriate responses to the deteriorating ward patient (Nangalia, Prytherch, & Smith, 2010; Sahandi et al., 2010). However, research on PSSs remains limited to investigating their role in recognising clinical deterioration rather than evaluating their effect on afferent limb failure.

The timing of the patient’s clinical deterioration influenced when the nurses in this study activated the RRS. The timing of the patient’s clinical deterioration is defined as the moment in time when the patient deteriorated during a 24-hour period. Out-of-hours is generally described in the literature as 5pm until 7am, with weekends defined as from 5pm on Friday until 7am on Monday (Pilcher et al., 2007). Out-of-hours is associated with a decrease in medical and nursing staff levels, and an increase in RRS activation (Jones, Bates, et al., 2005). The influence of timing and accessing the RRT was clearly identified by study participants with statements such as “I am 100 times more likely to activate the RRT at night because of the lack of support that was available”.

A number of factors may have been responsible for the increase in RRS activation in the hospital out-of-hours. First, participants in this study identified that the out-of-hours period was when they lacked support in recognising and responding to the deteriorating ward patient. Phrases like “it’s so scary at night” and “you feel like you are on your own” were used. Hospital activity is at its peak from 7am until 7pm, Monday through Friday. This is a time when maximum resources are available in nurses’ work environments. But these peak periods make up only 36% of the time hospital nurses actually work (Hamilton et al., 2010).
For the remaining 64% of the time, nurses work in out-of-hours environments with limited ancillary services, fewer support staff, reduced supervision, and strained communication with other on-call health-care providers (Hamilton et al., 2010). The nurses in this study emulated the findings of Hamilton et al. (2010) in that they identified feeling more isolated and vulnerable when caring for a deteriorating ward patient during the out-of-hours period, and this isolation and lack of support led to a decreased threshold to “push the button” and use the RRS.

The hospital after-hours is emerging as an important part of the patient safety agenda. It is increasingly recognised that the incidence of MAEs is increased during the hospital after-hours (Becker, 2007; Beckett et al., 2009; Bell & Redelmeier, 2001; Bhonagiri et al., 2011; Cavallazzi et al., 2010; Duke et al., 2004; Maggs & Mallet, 2010). This has important implications for practice and the ongoing development of RRSs. Currently, there are a number of different models and types of RRS (Devita et al, 2006). Not all RRSs operate as a 24-hour, seven-day-a-week service and the findings from both this case suggest that the hospital after-hours period is when the RRS is most often required and most likely to be used. To date, there has been minimal research exploring the hospital after-hours and types of MAEs and other adverse events, with most studies reporting on the relationship between admission and discharges from ICU and MAEs (Ala, Pakraven, & Ahmadi, 2011; Bhonagiri, Pilcher, & Bailey, 2011; Santamaria, 2007; Laupland et al., 2008).

The participants acknowledged that they often required advice and support regarding when to access the MET. In order to access this help and support, they sought advice and consultation from their peers, more senior nurses or medical staff. The nurses in this study spoke about how they required validation before activating the MET and they sought this validation by consulting with other RNs. A number of studies have established ward staff’s positive, supportive responses or behaviors towards their colleagues encouraged nurses’
subsequent activation of the MET (Jones, 2009, Cioffi 2000a, Galhotra et al., 2006, Santiano 2007). These findings highlight the importance of a supportive and collegiate clinical environment and how a cohesive and collegiate team can promote activation of the MET, thereby improving the care and management of the deteriorating ward patient.

In summary, the nurses interviewed in this single explanatory descriptive case study identified a number of factors that facilitated their use of the afferent limb. First, the predetermined activation criteria enabled them to objectively call for help, escalate care, and access the MET. Second, experience of the deteriorating ward patient and knowledge of the patient improve the use of the afferent limb because it improved confidence and this increase the likelihood that the nurse would activate the MET. Third, the timing of clinical deterioration was an important factor in activating the MET according to the participants interviewed in this study. Patients who deteriorated in the hospital after-hours more likely to experience the activation of a MET because the participants in this study identified that this was a time when they felt isolated, unsupported, and alone.

The study also identified a number of barriers identified by the interview participants in relation to the afferent limb. First, they articulated that at times they avoided or rejected escalating care because they felt they would be reprimanded. Second, the participants highlighted that they sometimes ignored the MET’s defined activation criteria because they felt that the patient was not sick enough or had not deteriorated enough to warrant activating the MET. Third, participants verbalised that the role, function, and objectives of the MET were misunderstood by both nurses and physicians, with the MET in this study often being viewed as a last resort rather than the early intervention strategy designed to recognise and respond to the deteriorating ward patient, which it was initially conceived as.
Exploration of whether the implementation of an APN after-hours service reduced the frequency of physiological abnormalities in medical ward patients was also undertaken. The findings from this study indicated that patients in the intervention group were more likely to experience physiological abnormalities in, respiratory rates above 25 or below 5, oxygen saturations less than 90% and heart rates above 110 or less than 50 BPM. However the patients in the intervention group were significantly older and were therefore more likely to experience physiological abnormalities. In both the control and the intervention group more than 40% of patients met the criteria that should have resulted in a MET being activated. A MET was activated in only 1.6% of cases across the two time periods of data collection. This finding demonstrates substantial failure of the afferent limb.

The aim of the second unit of analysis in this case study was to explore if the introduction of an APN after-hours service improves patient outcomes. The next section discusses the findings from this second unit of analysis.

**The efferent limb**

In the second unit of analysis, 300 medical records were reviewed retrospectively—150 before to the implementation of the APN after-hours service, and 150 after the introduction of the APN after-hours service. The aim of this unit of analysis was to explore the relationship between the APN after-hours service and the incidence of MAEs and adverse events, and the frequency of activation of the MET and the incidence of RRS use. The APN after-hours service was classed by the hospital as a nurse led RRS. The APN after-hours service operated as a two tier RRS within the Gold Coast hospital. The hospital also used the MET and the ICU liaison nurse as part of its response to the deteriorating ward patient. Ward nurses were responsible for alerting the APN after-hours service via the hospital pager system. The APN after-hours service responded to these concerns by assessing, monitoring, reviewing, treating
or escalating care as required and supporting and educating ward nurses via informal teaching opportunities (Williams et al., 2012). The current analysis was important because it was designed to determine the benefits, if any, of the APN after-hours service for patient outcomes. This is significant because health-care institutions are currently experiencing significant budget and spending restrictions, which limits the funds available to develop and support new and expanded nurse roles.

It was hypothesised that patients hospitalised after the implementation of the APN after-hours service would have significantly fewer MAEs and other adverse events than patients hospitalised before the introduction of the APN after-hours service. The results of this case study found no significant difference between the two groups in terms of the number of adverse events they experienced. A total of 23% of patients experienced an adverse event; this percentage is higher than that reported in literature (Baker & Norton, 2001; Brennan et al., 2004; Brennan et al., 1990; DeVries, Ramrattan, Smorenburg, Gouma, & Boermeester, 2008; Vincent et al., 2001; Wilson et al., 1999; Wilson, Runciman, Gibberd, Harrison, & Hamilton, 1995). The Harvard study of medical practice (Brennan et al., 1991) is considered the benchmark study for estimating the extent of adverse events in hospitals. Brennan and colleagues (1991) reviewed 30,121 medical records and reported that an adverse event occurred in 3.7% of hospital admissions. Wilson and colleagues (1995) used a population-based study design and reported that an adverse event occurred in 16.6% of all admissions. Baker and colleagues (2004) used the same study protocol as the Harvard study and reported an overall incidence of adverse events of 7.5%. DeVries and colleagues’s systematic review (2008) of eight studies and 74,485 patients found the incidence of adverse events was 9.2%. However, many of the studies on adverse events are now more than 10 years old; patients in hospital now are more likely to be sicker, older, and have more complex health-care needs. The care delivery models have also changed in the last 10 years, with more nurse assistants
now involved in direct care (Buchan & Dal Poz, 2002; Krapohl & Larson, 1996). The decreased ratio of RNs to patients may also explain the increased incidence of adverse events identified in the current study (Aiken, Clarke, Sloane, & Sochalski, 2001; Aiken et al., 2002; Needleman & Buerhaus, 2007).

In this study, 8.3% of the sample experienced an MAE. This is higher than other studies (Hillman et al., 2006; Chaboyer et al., 2008; Elliott et al., 2008). Hillman and colleagues (2006) reported the incidence of MAEs in their study as 6.8%; Chaboyer and colleagues reported that 5.7% of the patients in their study experienced an MAE. In their study, Elliott and colleagues found that 6% of patients were admitted to ICU as an unplanned admission. However, the patients in this study were older than the patients in other studies and were medical patients. The risk of adverse events increases with age and those patients over 65 years of age have been found to have an independent association with in-hospital mortality (Brennan et al., 1991; Wilson et al., 1995; Neal et al., 2001). Patients on medical wards tend to be older, have more complex health-care needs, and have an increasing number of co-morbidities. All of these factors are associated with an increased risk of adverse events (Duke et al., 1997; Brennan et al., 1991; Wilson et al., 1995; Neal et al., 2001; DeVries et al., 2008).

The most commonly occurring MAE in both groups was unplanned admission to ICU. Unplanned admission to ICU is the most frequently occurring MAE reported in previous studies (Bristow et al., 2000; Endacott, Chaboyer, Edington, & Thalib, 2010; Hillman et al., 2005). The introduction of the APN after-hours service role may have been associated with an increase in surveillance and an increase in the recognition of and response to clinical deterioration. This would lead to more patients being transferred to ICU and may explain the higher incidence of MAEs identified in the current study. The findings of the current study also suggest that the use of unplanned admission to ICU as a marker of the quality and effectiveness of a service may be flawed. Other studies have noted that following the
introduction of an RRS in a hospital, unplanned admission to ICU may increase as more deteriorating patients are identified and their care escalated (Chen et al., 2009; Garcea, Thomasset, McClelland, Leslie, & Berry, 2004; Naeem & Montenegro, 2005).

Multiple logistic regression was used in this case study to determine which of the potential predictors, along with APN intervention, were significantly and independently associated with MAEs. Multivariate analysis showed that an abnormal heart rate and a drop of 2 or more in the GCS were significant predictors of MAEs, while hypotension, low oxygen saturations, and a drop of 2 or more in the GCS were significant predictors of all other adverse events. Chaboyer and colleagues (2008) demonstrated that an abnormal heart rate was a significant predictor of an MAE. Other also found that a drop of 2 or more in the GCS, abnormal blood pressure, and low oxygen saturations significantly predicted serious adverse events (Buist et al., 2004; Jacques et al., 2006; Harrison et al., 2005). Although these studies have a diversity of patient populations, aims, and outcomes, they do share some important characteristics. Each relied on chart data, whether collected prospectively or retrospectively. Each found evidence that serious adverse events and clinical deterioration can be predicted. The findings from this study and other published research (Chaboyer et al., 2008; Jacques et al., 2006; Harrison et al., 2005) highlight the importance of vital signs in predicting patient deterioration and preventing serious adverse events. Nurses are primarily responsible for taking and recording vital signs and, therefore, play a pivotal role in recognising and responding to the deteriorating patient and promoting positive outcomes. However, recording and documentation of vital signs remains infrequent and incomplete (Hillman et al., 2006; Cuthbertson et al., 2007). Infrequent or incorrect monitoring or documentation of vital signs may prevent timely activation of an RRS and appropriate escalation of care, and predisposes patients to suboptimal care (Massey et al., 2009). In this case study, an important predictor of clinical deterioration, the GCS (Jacques, et al 2006), was frequently not documented. A
possible explanation for the lack GCS documentation in this study was that patients did not present with or demonstrate any clinical signs that warranted assessment of their level of consciousness. However, suboptimal care is recognised as a failure to monitor basic clinical and physiological parameters involving the patient’s airway, breathing, and circulation (Massey et al., 2009; McGloin et al., 1999), and level of consciousness is an important predictor of deterioration. Thus, failure to correctly record and document the GCS may impact negatively on patient outcomes.

In summary, this second unit of analysis involved a retrospective chart review to explore the impact of an APN after-hours service on patient outcomes. The incidence of MAEs and other adverse events experienced by patients in this study was higher than that found in previously published studies. However, patients in this study were older and were medical patients, both of which are associated with an increased risk of MAEs and other adverse events. Patients in the intervention group experienced significantly more MAEs than patients in the control group. Unplanned admission to ICU was the most commonly occurring MAE, and the introduction of the after-hours APN role may have been associated with an increase in surveillance and more patients being transferred to ICU. Multiple logistic analysis revealed that changes in heart rates and a drop in the GCS were significant predictors of patients’ experiencing an adverse event. Based on the findings of this study, significant predictors of an MAE were low urine output and a drop of 2 or more in the GCS. In both the intervention and the control group, a patient’s GCS and urine output, both of which appear to be significant and important predictors of clinical deterioration and yet were frequently not recorded.

While the findings of the study presented in this thesis have clearly answered the research questions detailed in chapter 2 and contributed to the existing knowledge and understanding of recognising and responding to patient deterioration within the framework of
an RRS, this research has several limitations. These limitations relate to the study design, the sampling strategies, and the data collection methods used. These limitations may threaten the construct, internal, and external validity of study. These limitations, along with the strengths of the study, are explored in the following section.

**Strengths and limitations of the study**

This study used Yin’s (2003) framework and has demonstrated that its application enabled the use of both quantitative and qualitative methods to explore a complex clinical phenomenon within its real life setting. The use of case study for research, Yin (2003) claims, “remains one of the most challenging of all social science endeavors” (p.1). In this single exploratory case study, there were two embedded units of analysis: (1) the practices of nurses using a MET; and (2) the effect of an APN after-hours service on patient outcomes. Each of these embedded units of analysis were explored separately, to yield an in-depth understanding of the phenomenon of interest. A previous case study explored the deteriorating patient within the context of suboptimal care (Quirke, 2011); however, this is the first time a case study has investigated the deteriorating ward patient in the setting of an RRS. This study contributes to the existing knowledge and understanding of this important and clinically challenging concept, and adds new insight into how nurses use RRSs and how these systems may impact on patient outcomes.

In this study, a detailed exploration of a complex clinical phenomenon was undertaken, which resulted in new insight into, and a better understanding of, how nurses use RRSs. This is a sensitive clinical issue that impacts on patient care, patient outcomes, and the quality of care. The current study also evaluated a new and innovative after-hours nursing service that formed part of the Gold Coast Hospital’s RRS. Thus, the study illustrates the value of using a
case study research design in clinical practice. The strength of this case study lies in its in-depth exploration and analysis of the phenomena of interest in its real-life context.

The phenomenon of interest, the deteriorating ward patient in the context of an emerging new nurse-led after-hours RRS to respond to these patients, was studied in a specific clinical setting and location, thereby fulfilling the conditions outlined by Yin (2006) for an exploratory case study. Although case study was ideally suited to investigating the phenomenon of interest, it does have some limitations. The main limitation of this current study was that a single case was studied. The inclusion of multiple case sites may have presented a more comprehensive understanding of the phenomenon of interest and provided findings that were more transferable and generalisable to other settings. Yin (2009) suggests, however, that the single case study design is appropriate when exploring the typical case and the objective is to capture the circumstances and conditions of this everyday practice, so a single case study was appropriate to meet the aims of this study. The Gold Coast Hospital’s RRS was classed as a typical case because it represented a two tier RRS within a standard Australian public hospital. Two tier RRS are used increasingly in Australian hospitals (Elliot, Chaboyer, Ernest, Doric, Endacott, 2012). When high capability teams and ramp-up systems operate together they are refereed to as a two-tier system. The Gold Coast hospital has adopted this two tier RRS and the ANP after-hours service was integrated into the hospitals existing RRS which consisted of the MET and the ICU liaison service. The Gold Coast Hospital’s explicit function is to provide health care including emergency services and complex procedures, as well as perform clinical research and clinical teaching, and the MET situated within it is well established.

Construct validity is especially problematic in case study research because the researcher is regarded as a research instrument (Poggenpoel & Myburgh, 2003). Yin (2006) offers three solutions to improve the construct validity of a study: (1) using multiple sources
of evidence; (2) establishing clear chain of evidence, which involved ensuring that research process was clear; and (3) having a draft case study report reviewed by key informants. In this case study, unstructured interviews of nurses and patient medical records were used to collect data. A clear chain of evidence was outlined in chapter 3 and included specific definitions of key terms, outcomes, and detailed research questions, and a detailed rationale for the data analysis techniques used. Research participants reviewed their interview transcripts, and two very experienced research supervisors oversaw the research design, the data collection, and data analysis stages of the case study and this strengthened the construct validity of the study.

A strength of this research project arises from undertaking the research in a clinical environment. Nurses who had cared for a patient who had experienced an MAE were interviewed, shortly after this event had occurred. The strength of this strategy is that frontline staff were the most appropriate to access to ensure a correct description of the issues, challenges, barriers, and opportunities that an RRS may offer them. However, the participants were interviewed retrospectively about a patient they had cared for who had experienced an MAE and it is arguable that the interview data could have been contaminated in part by the knowledge that the patient that the participant had cared for had suffered an MAE following a period of physiological instability. Interviews were not conducted if more than 48 hours had elapsed following the MAE, which helped to ensure that events were fresh in the participants’ minds.

A limitation of undertaking the research in the clinical environment is that the hospital wards were extremely busy, which may have impacted on the participants’ availability to participate in the study. Some of participants were busy or tired after a long shift and this may have impacted on the quality of data. For example, the information given by the participants
may not have been as deep or detailed as it could have been because participants wanted to finish their shift or return to the clinical area.

Adverse events were identified through retrospective data using the patients’ medical records. Retrospective record review has been criticised for a number of reasons, including that their reliability and usefulness is dependent on the quality of documentation. If adverse events are not documented properly, looking at the records will not identify them. Also, the data may have been inaccurate, incomplete, or missing. It is possible that some MAEs may not have been charted and, therefore, were not identified, which would have an impact on the overall results. However, it is unlikely that cardiac arrest, death, or unplanned admission to ICU would go uncharted, so it is unlikely that this would have had an impact on the main outcomes recorded in this study. This threat to internal validity was managed by using a data collection tool and the data dictionary used by Woloshynowycz and colleagues (2003). Woloshynowycz and colleague’s data collection tool and data dictionary have been used previously in other studies that have examined adverse events (Chaboy et al., 2008). This descriptive case study has demonstrated how the use of a recognised data collection tool and data dictionary can be used to evaluate local clinical issues.

Another potential threat to the internal validity of the study was history. In this study it was not possible to know or control every event that could potentially impact on the outcome of the study. For example, changes in staffing levels on the wards or an increase in the number of educational programs delivered. Evidence of these threats to the internal validity of the study were considered, and the researcher found no evidence of these potential threats to the internal validity of the study.

Although the data following the implementation of the APN after-hours service produced some important results, these findings did not demonstrate statistically significant differences between the control and the intervention groups in relation to the outcomes of
MAEs and other adverse events. There are a number of possible explanations for this. First, the outcome measures used in the current study may have been insensitive to the APN after-hours service intervention. These outcome measures may have been influenced by other confounders that were not controlled for—for example, patient acuity, staffing or skill mix. Thus, there may have been important variables surrounding MAEs and adverse events that were not measured or controlled for in the study. Many of these contextual variables would not be suitable for collection from chart audit or it is not possible to measure them via chart audit; however, chart audit remains an important research method to examine adverse events (Endacott et al., 2010). Second, a number of studies have reported that the ICU admission rates increase following the introduction of an RRS because more deteriorating patients were identified and transferred to ICU for required treatment (Doric et al., 2008; Green & Edmonds, 2004). Third, the dose (or frequency of use) of the RRS is thought to be important for effect (Jones, Bellomo R, & DeVita, 2009; Santamaria, Tobin, & Holmes, 2010), with an inverse relationship between the length of time an RRS has been in place and reduction in cardiac arrests. As the dose of the RRS increases over time (Jones, Bellomo & Devita, 2009), there is often a delay between the implementation of the RRS and a reduction in MAEs and adverse events. Thus, it is possible that a longer time frame was required to see the true effect of the APN after-hours service. Fourth, the power for the regression analysis of adverse events was adequate based on the results of a post hoc power analysis. However, the power for the regression analysis of major adverse events was low and it is possible in this analysis that a type II may have occurred. Therefore it is not possible to determine if the lack of statistically significant result was due to the lack of power. Future investigators should consider larger sample sizes. Fifth, only medical patients’ records were reviewed; inclusion of other patient groups—for example, surgical patients—may have impacted on the results of the study. Perhaps, greater resources for both implementation of the service and subsequent
evaluation would have enabled a longer intervention period, a more concentrated intervention
dose, the recruitment of more wards, and more diverse patient populations and/or larger
samples.

Despite the limitations outlined above, this study has contributed to the body of
knowledge on the phenomenon of the deteriorating patient in the context of an RRS. This
case study revealed that recognition and response to patient deterioration is primarily a
nursing responsibility that is complex and often challenging for nurses. It has raised some
important issues that would benefit from further exploration. The issues raised in this
exploratory case study provide the foundation for the following section, which outlines the
recommendations for practice, education, and research that have emerged from this study.

**Recommendations for clinical practice**

The effect of the APN after-hours service may still not be evident in clinical practice
because of the lag time for any effect of the service to be evident. Thus, one of the
recommendations of this case study is that the APN after-hours service continues. Health-
care providers who are considering developing and implementing an APN after-hours service
should also explore how these services will be operationalised and how the role will be
integrated with any other existing RRS. They should also consider the scope of practice of the
APN after-hours service. It may be appropriate that this service is developed and run by
Nurse Practitioners, rather than APNs. Nurse Practitioners have an extended and expanded
scope of practice, which includes prescribing and ordering diagnostic tests (Gardner et al.,
2007), compared to the APN whose scope of practice is generally limited to advising nurses
and medical staff in the treatment and management plans for the deteriorating patient.

The APN after-hours service was introduced by the senior management team at the
Gold Coast Hospital in 2008 in response to a perceived decreased skill mix and reduced
staffing in the hospital after-hours (Willamset al., 2012). Implemented as a patient safety initiative, the service should have been accepted and embraced by nursing staff. However, behavioral change is perhaps one of the most complex problems when trying to understand the effects of an intervention (French et.al, 2012). Arguably successful behavioral change is the key to any successful intervention, i.e. the correct use of the APN after-hours service (Francis, O’Connor, & Curran, 2012). It has been acknowledged in the literature that one of the key reasons for failure of an intervention is resistance to change among health-care professionals (Francis et al., 2012). Many different approaches have been implemented to improve recognition of the deteriorating patient, such as audits, evidence-based guidelines, colour-coded observations charts, and EWSs. Research on the effectiveness of these strategies is only just emerging but the evidence shows that even well developed improvement programs are often only partially effective, potentially as a result of the implementation strategy that has been used (French et al., 2012). The Gold Coast Hospital implemented the APN after-hours service without a clear implementation strategy and this may explain why the service was not effectively utilised by nursing staff. Any new intervention requires a systematic approach with a strong rationale for the change in practice and a clear and transparent reporting of the intervention implementation strategy (French et al., 2012). Therefore hospitals may wish to consider using implementation theories to underpin their implementation strategy and subsequently promote behavior change when developing any new interventions aimed at improving the care and management of the deteriorating patient.

Formal quality improvement processes should be developed to ensure the continued development, support, and review of RRSs. These processes should include a clear evaluative strategy. This evaluative strategy should include the use of clinical audits and feedback as a means of identifying afferent limb failure and promoting the correct use of the RRSs.
Previous research has shown that both clinical audits and feedback can be effective in changing clinicians’ behavior (Ivers et al., 2012).

Hospitals using or considering implementing an RRS should ensure that they have systems in place to ensure that the resources required to successfully escalate care for the deteriorating patient are identified, operational, and available for example, support in terms of administrative staff and access to appropriate information technologies are important.

The nurses interviewed in this case study identified that they were reluctant to use the RRS. This reluctance was linked to the hierarchal nature of clinical practice and a fear that they would be reprimanded for calling the RRS, and these issues clearly acted as a barrier to nurses activating the RRS. Activities that promote collaborative practices and a ‘no blame’ culture are required to promote a culture that prioritises patient safety. It is recommended that new and existing members of RRTs encourage staff to react positively to their presence. Hospitals need to continue to explore strategies and solutions that can be developed and implemented to minimise the chances of ward nurses experiencing these kinds of negative emotions when they are considering using the RRS. The implementation of team training interactions may be a possible solution to address this issue (Robertson, et al., 2010).

The underlying philosophy of the RRS is that any health-care worker can activate it. Given that nurses appear reluctant to use these systems, it may be appropriate to extend activation privileges to patients or family members (Gerdik et al., 2010; Hueckel, Mericle, Frush, Martin, & Champagne, 2012). This is a contentious issue because recognising and responding to clinical deterioration is clearly complex and difficult. There remains a question regarding the capability of untrained individuals to correctly recognise and respond to clinical deterioration. However, family activation of RRSs is becoming increasingly common, especially in the area of paediatrics (Hueckel et al., 2010). The Australian Commission on Safety and Quality in Health Care are currently developing a standard to review family
activation of RRSs. Consequently, it is likely this initiative will be implemented in the general ward environment. When this happens, a clear, robust implementation and evaluation strategy will need to be developed for example, how will this initiative be implemented and how will the impact of this practice change on patient outcomes, numbers of RRTs activation calls, and process of care be assessed and measured.

**Recommendations for future research**

Research exploring and evaluating nurse’s responses, perceptions and beliefs about RRSs is beginning to emerge (Bagshaw et al., 2010; Jones et al., 2006; Shapiro et al., 2010). What is lacking is an understanding of medical staff opinions about the role, and barriers to activation, of RRSs. The findings from this study indicate that nurses delayed activating an RRS because they were frightened of being reprimanded by the members of the RRS and/or medical staff. It is important that future research examines and explores physicians’ perceptions, values, and beliefs about their exposure to and use of RRSs.

The results from this and previous studies (Bucknall, 2000; Hillman et al., 2005; Trinkle & Flabouris, 2011) indicate that, at times, despite abnormal vital signs being present the RRT is not activated. Technology will play an increasingly important role in the recognition of clinical deterioration. PSSs are currently being developed and implemented to recognise clinical deterioration. These PSSs are gathering momentum in the clinical area and future research must be conducted to assess these systems ability to safely and appropriately recognise the deteriorating ward patient. The impact of the newly implemented colour-coded patient observations charts in Queensland will also require continued evaluation.

The hospital after-hours is increasingly being highlighted as a priority area that requires urgent attention. Currently, hospitals operate a two-tier level of health care with a much lower level of staffing and diagnostic services available to patients and staff after-hours (Beckett et
al., 2009; Hamilton et al., 2010), which impacts on patient safety (Bhonagiri et al., 2011; Duke et al., 2004; Hamilton et al., 2010; Pilcher et al., 2007; Tobin & Santamaria, 2006). The true extent of the incidence of adverse events on patient deterioration in the hospital after-hours is not yet known. Based on the findings from this case study, it is recommended that future research examine the epidemiology of MAEs and adverse events in the hospital after-hours and their impact on patient outcomes.

Previous research on RRSs has used MAEs as the outcome measure (Chan et al., 2010; Hillman et al., 2005; Buist et al., 2008; Winters et al., 2007; Kenward et al., 2005) to evaluate the effectiveness of the RRSs. Findings from this study and others (Kenward et al., 2005; Doric et al., 2008; Hillman et al., 2005) indicate that the use of MAEs as the outcome measure may be insensitive to the true effect of the RRS. It is recommended that future research explore using other predictors as a means of evaluating RRSs, such as the influence of teamwork, collaboration, and culture, and the ‘do not resuscitate’ status of the patient.

Behavioral change is perhaps one of the most challenging aspects of introducing a new intervention into a health-care system (Francis et al., 2012). The acceptance of any new system depends on how the system is perceived by its users. The results of this study indicate that the RRS at the Gold Coast Hospital may not have been fully integrated into ward nurses’ clinical practice and this led to under-utilisation. Given that a delay in activating an RRT worsens patient outcomes (Bucknall et al., 2012; Tee, 2008; Downey, 2008; Quach, 2008), research is needed to better understand how ward nurses accept implement and integrate new patient safety initiatives into their everyday clinical practice (Francis et al., 2012). Using behavior change and knowledge transfer theories to underpin this research may be benefical.
Recommendations for education

In this study, participants identified that they lacked the confidence or experience to activate a MET. It is therefore recommended that health-care providers and educators develop a skilled and qualified workforce that is able to deliver safe care to the deteriorating ward patient. This should include appropriate education programs that could be offered at orientation or as part of an in-service suite of courses. These educational activities should include knowledge of observations and how to recognise and respond to the deteriorating ward patient.

Participants in this case study identified that they resisted activating the MET because they felt the patient was not sick enough. This occurred even when the patient’s vital signs indicated that the patient was clearly deteriorating and the MET activation criteria were present. Arguably, this exposes patients to suboptimal ward care (McGloin et al., 1999) and negative outcomes (Bucknall et al., 2012). This finding indicates that ward nurses may not have the knowledge or skills to care for, recognise, or respond to the deteriorating ward patient (McGloin et al., 1999). The finding that GCS and urine output were frequently not recorded also indicates that some nurses may lack knowledge and understanding about the importance of these two physiological parameters in alerting nurses and other health-care workers to patient deterioration. Health-care providers, educational providers, and policy makers clearly need to re-examine the content, the learning outcomes, and the assessment strategies of undergraduate and postgraduate programs and ensure they incorporate the recognition of, response to, and management of the deteriorating ward patient. A range of different educational models of methods should be developed to meet these objectives. These may include case studies, stimulation training, on-line education, and scenario-based examples.
Concluding statement

This single exploratory case study aimed to develop a detailed and in-depth understanding of the phenomenon of the deteriorating patient within the context of an RRS. It was anticipated that the study would contribute to the existing knowledge and understanding of the impact of an RRS on the incidence of MAEs and adverse events experienced by deteriorating ward patients. This was the first known study to explore both the afferent and efferent limb of an RRS.

The study presented in this thesis confirms that the deteriorating patient and RRSs are complex and multidimensional and cannot be separated from their context—the clinical environment. By interviewing nurses who had cared for a patient who had deteriorated, this study was able to develop unique insight into nurses’ perceptions, values, and beliefs about an RRS. A retrospective review of medical ward patient’s records was undertaken as part of this in-depth exploration of the phenomenon of interest with the aim of exploring an innovative and newly developed nurse-led RRS—the APN after-hours service. The APN after-hours service has not yet been formally evaluated, so recommendations and suggestions for future directions in relation to the scope of practice and development of this advanced practice role are offered in this thesis.

The findings from this study indicate that generally nurses value the MET activation criteria and use them to recognise and respond to the deteriorating ward patient and activate the MET. However, the findings of this study also revealed that nurses were often reluctant to use the RRS and resist activating the RRS either because they were concerned that they would be reprimanded or they did not recognise patient deterioration. It also appears from the findings of this case study that the hospital after-hours is a time when nurses feel isolated and unsupported and thus may be more likely to access the APN after-hours service. This is an
important finding, because previous studies on the deteriorating patient and RRS have not examined or explored the effect of the hospital after-hours in relation to the use of the RRS.

The findings from this study confirm that RRSs remain under-utilised by nurses and this contributes to efferent limb failure. This exposes ward patients to suboptimal care and this is associated with negative outcomes. Important and significant predictors of clinical deterioration for example, a decrease in urine output or a drop of 2 or more in the GCS were frequently not recorded and this also predisposed ward patients to suboptimal care. Recommendations for how these deficits in the care and management of the deteriorating ward patient can be proactively addressed by researchers, educationalists, and clinicians are presented in the thesis.

In conclusion, recognising, and managing the deteriorating patient is complex, challenging, and multifaceted. Patient acuity will continue to increase in hospital wards as the inpatient population becomes older and sicker with more complex clinical care needs. RRSs have been embraced as part of the patient safety agenda by leaders and organisations both nationally and internationally, and appear to be here to stay. There are, however, challenges in relation to how RRSs are integrated, adopted, and used by nurses and other health-care workers. It is clearly important that RRSs and the deteriorating patient remain a high priority for researcher, clinicians, and educators.
## Appendix 1: Causes of suboptimal ward care

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<th>Category</th>
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<th>Study description</th>
<th>Key findings</th>
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| **Failure to appreciate clinical urgency** | Buist (2004), Australia. | Retrospective review of medical records of all patients prior to a “Critical event (CE)” over 12 months. To investigate the nature and duration of clinical instability in hospital patients before a “critical event”. Retrospective survey of medical records of all patients having critical events (CEs) over 12 months. | • 122 CEs were identified in 112 patients.  
• Each CE was preceded by a median of 2 (range, 0–9) criteria for clinical instability.  
• The median duration of instability before a CE was 6.5 hours.  
• During the instability a median of 2 (range, 0–13) medical reviews took place.  
• The incidence of CEs in the total hospital population (122 CEs/19,853 admissions) respectively.  
• There were 70 deaths (62%) among the 112 patients, compared with a total of 392 deaths (2% of admissions) in the hospital. |
| Franklin & Matthew (1994), USA. | Retrospective record review of consecutive patients who had an in-hospital cardiac arrest over a 20-month period. The frequency of premonitory signs and symptoms before cardiac arrest in patients on the general medical wards of a hospital and characteristic patterns in nurse and physician responses | • 150 cardiac arrests (CA) on the medical wards (CA rate: 7.0/1,000 patients) with a hospital mortality rate of 91%.  
• In 99 of 150 cases, a nurse or physician documented deterioration in the patient’s condition within 6 hrs of CA. |
<p>| McGloin, Adam &amp; Singer (1999), England. | Six-month audit in teaching hospital. Chart review to determine (i) the incidence of unexpected deaths occurring on general wards, and whether any were potentially avoidable; (ii) to | • Common findings included: a) failure of the nurse to notify a physician of deterioration in the patient’s mental status; b) failure of the physician to obtain or interpret an arterial blood |</p>
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|                   |                         | assess whether the quality of care on general wards prior to admission to intensive care affected subsequent outcome. | - gas measurement in the setting of respiratory distress; and c) failure of the ICU triage physician to stabilise the patient’s condition before transferring the patient to the ICU.  
- Former ICU patients (cardiac arrest rate: 14.7/1,000 patients) were more likely to suffer CA than other patients (CA: 6.8/1,000 patients).  
- 13 unexpected deaths were considered potentially avoidable: gradual deterioration was observed in physiological and/or biochemical variables.  
- In the same period, 86 hospital inpatients were admitted on 98 occasions to the ICU, 31 of whom received suboptimal care pre-ICU. Both ICU (52% vs 35%) and hospital (65% vs. 42%) mortality was significantly higher in patients receiving suboptimal ward care compared to well managed patients.  
- 54 of the 200 patients in the study were assessed as receiving suboptimal care.  
- Admission to ICU was considered late in 37 patients in the suboptimal group. |
| Failure to seek advice. | Cioffi (2000(a)), Australia. | Descriptive study explored the experiences of RN activating a MET using unstructured interviews with 32 registered nurses. | - Nurses questioned whether they were doing the ‘right thing’ calling the emergency team.  
- Collaborated with others prior to calling and most felt... |
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<td>nervous and anxious.</td>
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<td>- Nurses recognised patient deterioration from feelings they had that something was wrong. However, they were not able ‘to put their finger on it’.</td>
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<td>Cioffi (2000(b)), Australia.</td>
<td>Qualitative, exploratory, and descriptive study, using in-depth interviews and a purposive sample. Participants included registered nurses (N = 32) with 5 or more years of experience and a history of calling the medical emergency team (MET).</td>
<td>- Findings showed that nurses relied on 4 patient characteristics to apply the MET criterion, “seriously worried about a patient.” (1) feeling “not right”, (2) colour, (3) agitation, and (4) observations marginally changed or not changed at all.</td>
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<td>Andrews &amp; Waterman (2005), Ireland.</td>
<td>Study investigating the practical problems faced by general ward staff in detecting physiological deterioration. Interviews and observations were carried out using a grounded theory approach, and a total of 44 participants were interviewed (30 nurses, 7 doctors, and 7 healthcare support workers).</td>
<td>- Participants reported that quantifiable evidence was the most effective means of referring patients to doctors, and the Early Warning Score achieves this by improving communication between professionals.</td>
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<td>Daffurn (1994), Australia.</td>
<td>A study was conducted 2 years following implementation of the MET system, to determine registered nurses’ (RNs’) opinions, knowledge and use of the system. A questionnaire distributed to 141 nurses rostered on the chosen study.</td>
<td>- 53% of nurses had called the MET in the last 3 months; all would call the team again in the same circumstances.</td>
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<td>- The correct response in three of four hypothetical situations presented was to call the MET.</td>
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<td>- In the hypothetical responses provided for MET activations 17–73 of nurses responded appropriately.</td>
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<td>- Hypotension did not appear</td>
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<td>to alert nurses to summon emergency assistance.</td>
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<td>- Some nurses, despite the presence of severe deterioration and patient distress, called the resident rather than the MET.</td>
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<td>Smith &amp; Poplett (2002), England.</td>
<td>A questionnaire concerning aspects of basic, acute care was distributed to all pre-registration house officers (PRHOs) and Senior House Officers (SHOs) attending hospital orientation programmes in six different UK hospitals.</td>
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<td>- Many were unaware of the signs of total airway obstruction, confusing them with those of partial obstruction PRHOs 11%, SHOs 14%.</td>
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<td>- Knowledge about the use of non-rebreathing oxygen masks was poor; 23% of trainees could not describe the purpose of the reservoir bag or gave answers that were unclear or incorrect.</td>
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<td>- 17% of trainees could not quote the maximum deliverable inspired oxygen concentration provided by these masks or gave values below the normal range.</td>
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<td>- 31% trainees thought that the lower end of the normal range for pulse oximetry was below 95%; nine (5%) believed it to be below 90%.</td>
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<td>- Similar deficits in knowledge and understanding existed in relation to the normal capillary refill time, minimum hourly urine output, and the use of the AVPU scale and the role of blood glucose testing in unconscious adults.</td>
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<td>- Only 22% of PRHOs and 21% of SHOs identified the correct percentage hospital</td>
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</table>
| Lack of knowledge | Smith & Poplett, (2004) England. | Using a questionnaire the knowledge of basic aspects of acute care amongst 118 senior house officers was assessed, 36 of had previously attended an ALERT course. | - The mean knowledge score was significantly higher for those who had completed an ALERT course (9.44 +/- 1.63 points versus 7.45 +/- 2.32 points; p < 0.05).  
- Those in the post-ALERT group also showed significantly better knowledge of the signs of complete airway obstruction, normal capillary refill time, percentage survival after in-hospital cardiac arrest, consent arrangements for operation in unconscious patients, minimum hourly urine output, the need to inflate the reservoir bag on a high concentration oxygen mask and the role of the reservoir. |
|                   | Cox James Hunt, (2006) England. | To explore the factors that influence the experiences of trained nurses caring for critically ill patients within a general ward setting. This was an exploratory, descriptive study combining an interview and questionnaire methodology. A purposive sample of seven trained nurses reflecting a range of grades and experience, from one medical ward were selected. | - Following analysis five key themes emerged:  
  (1) clinical environment,  
  (2) professional relationships,  
  (3) patient assessment,  
  (4) nurse's feelings, and  
  (5) educational needs.  
- These themes suggest that addressing nurses’ knowledge deficits in relation to caring for critically ill ward patients requires a focus on nurse’s knowledge skills and attitudes. |
<p>| Failure of the    | Clarke &amp; Aiken et       | Study designed to determine the association between the                             | - After adjusting for patient and hospital characteristics                                                                                                                                                                                                                                                                                  |</p>
<table>
<thead>
<tr>
<th>Category</th>
<th>Author, date &amp; location</th>
<th>Study description</th>
<th>Key findings</th>
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</table>
| organisation | al. (2003), USA. | patient-to-nurse ratio and patient mortality, failure-to-rescue (deaths following complications) among surgical patients, and factors related to nurse retention. Cross-sectional analyses of linked data from 10,184 staff nurses surveyed; 232,342 general, orthopaedic, and vascular surgery patients discharged from the hospital. | (size, teaching status, and technology), each additional patient per nurse was associated with a 7% (odds ratio [OR], 1.07; 95% confidence interval [CI], 1.03-1.12) increase in the likelihood of dying within 30 days of admission and a 7% (OR, 1.07; 95% CI, 1.02-1.11) increase in the odds of failure-to-rescue.  
- After adjusting for nurse and hospital characteristics, each additional patient per nurse was associated with a 23% (OR, 1.23; 95% CI, 1.13-1.34) increase in the odds of burnout and a 15% (OR, 1.15; 95% CI, 1.07-1.25) increase in the odds of job dissatisfaction.  
- In hospitals with high patient-to-nurse ratios, surgical patients experience higher risk-adjusted 30-day mortality and failure-to-rescue rates, and nurses are more likely to experience burnout. |
| Aiken et al. (2001), USA. | This paper presents reports from 43,000 nurses from more than 700 hospitals in the United States, Canada, England, Scotland, and Germany in 1998-1999. Study aim was to obtain information on organisational climates, nurse staffing, and patient outcomes. | • Nurses in countries with distinctly different health-care systems report similar shortcomings in their work environments and the quality of hospital care.  
• While the competence of and relation between nurses and physicians appear satisfactory, core problems in work design and workforce management threaten the provision of care.  
• Resolving these issues, |
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<td></td>
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<td>which are amenable to managerial intervention, is essential to preserving patient safety and care of consistently high quality.</td>
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|          | Needleman et al. (2001), USA. | Retrospective analysis of databases to examine the relation between the amount of care provided by nurses at the hospital and patients’ outcomes. A regression analysis was used to control for patients’ risk of adverse outcomes differences in the nursing care needed for each hospital's patients, and other variables. | - The mean number of hours of nursing care per patient-day was 11.4, of which 7.8 hours were provided by registered nurses, 1.2 hours by licensed practical nurses, and 2.4 hours by nurses’ aides.  
- Among medical patients, a higher proportion of hours of care per day provided by registered nurses and a greater absolute number of hours of care per day provided by registered nurses were associated with a shorter length of stay and lower rates of both urinary tract infections and upper gastrointestinal bleeding.  
- A higher proportion of hours of care provided by registered nurses were also associated with lower rates of pneumonia shock or cardiac arrest and “failure to rescue”.  
- Among surgical patients, a higher proportion of care provided by registered nurses was associated with lower rates of urinary tract infections, and a greater number of hours of care per day provided by registered nurses were associated with lower rates of “failure to rescue”.  
- A higher proportion of hours of nursing care provided by... |
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<td></td>
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<td>registered nurses and a greater number of hours of care by registered nurses per day are associated with better care for hospitalised patients.</td>
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</table>
# Appendix 2: The Efferent Limb

<table>
<thead>
<tr>
<th>Study</th>
<th>Research question and aims</th>
<th>Sample</th>
<th>Design</th>
<th>Outcome Measure</th>
<th>Data analysis and results</th>
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<tbody>
<tr>
<td>Effect of introducing the MEWS (Subbe et al., 2003).</td>
<td>Does the MEWS identify medical patients at risk of catastrophic deterioration?</td>
<td>Prospectively studied 1695 acute medical admissions.</td>
<td>Single center cohort study with historical controls.</td>
<td>Cardio-pulmonary arrests and intensive care utilisation.</td>
<td>There was no change in mortality of patients with low, intermediate or high MEWS. Rates of cardio-pulmonary arrest, ICU/HDU admission was similar. The respiratory rate was best discriminator in identifying high-risk patient groups.</td>
</tr>
<tr>
<td>The value of (MEWS) in surgical inpatients: (Gardner-Thorpe et al., 2006).</td>
<td>Does the MEWS improve the quality and safety of care provided surgical to ward patients?</td>
<td>A total of 334 consecutive ward patients were prospectively studied. MEWS were recorded on all patients.</td>
<td>Single center observational study with prospective controls.</td>
<td>Transfer to ITU or HDU.</td>
<td>17% ward patients triggered the call-out algorithm by scoring four or more on MEWS. Emergency patients were more likely to trigger the system than elective patients. 5% of the total patients were admitted to the ITU or HDU. MEWS with a threshold of four or more was 75% sensitive and 83% specific for patients who required transfer to ITU or HDU.</td>
</tr>
<tr>
<td>Study</td>
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<tr>
<td>Validation of physiological scoring systems in the Accident and Emergency department (Subbe et al., 2006).</td>
<td>To establish a frequency distribution of physiological scoring systems and to establish the potential benefit of adding these to an existing triage system in A&amp;E.</td>
<td>Physiological data collected from 53 unselected emergency department admissions, from 50 patients admitted from the ED to ICU and from 50 patients admitted from ED to general wards and then to ICU.</td>
<td>Single centre cohort study with historical controls.</td>
<td>Three different physiological scores were calculated from the data. Identification of sick patients by the scores was compared with triage information from the MTS.</td>
<td>Most patients admitted to the emergency department would not be identified as critically ill with the aid of physiological scoring systems. Only in 0–8% of patients did the scores indicate increased risk.</td>
</tr>
<tr>
<td>Validation of a MEWS in medical admissions (Subbe et al., 2001).</td>
<td>Does the MEWS correctly identify medical ward patients at risk of clinical deterioration.</td>
<td>Data on 709 medical emergency admissions were collected during March 2000.</td>
<td>Single centre cohort study with prospective controls.</td>
<td>Death, ICU admission, HDU admission, cardiac arrest, survival and hospital discharge at 60 days.</td>
<td>Scores of 5 or more were associated with increased risk of death MEWS can be applied easily in a DGH medical admission unit, and identifies patients at risk of deterioration.</td>
</tr>
<tr>
<td>Identification of risk factors for cardiac arrest and formulation of activation criteria to alert a medical emergency team (Hodgetts et al., 2002).</td>
<td>To identify risk factors for in-hospital cardiac arrest; (2) to formulate activation criteria to alert a clinical response (3) to evaluate the sensitivity and specificity of the scoring system.</td>
<td>118 consecutive adult patients suffering primary cardiac arrest in-hospital and 132 non-arrest patients, randomly selected according to stratified randomisation by gender and age.</td>
<td>Single centre quasi-experimental design with historical controls.</td>
<td>Cardiac arrest inhospital</td>
<td>Risk factors for cardiac arrest include: abnormal respiratory rate ($p = 0.013$), abnormal breathing indicator (abnormal rate or documented shortness of breath) ($p &lt;0.001$), abnormal pulse ($p$</td>
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<td>Study</td>
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<tr>
<td>Worthing physiological scoring system (PPS) (Duckitt et al., 2007)</td>
<td>To derive and validate a PPS for medical admissions.</td>
<td>Patients admitted to the emergency care unit at Worthing general hospital during an initial study period between July and November 2003 ($n = 3184$) and a further validation period between October and November 2005</td>
<td>An observational, population-based single centre study.</td>
<td>Investigate the relative contributions of the RR, HR, BP, temperature, oxygen saturation, and conscious level to mortality</td>
<td>Multivariate logistic regression analysis demonstrated that a ventilatory frequency $\geq$ 20 min ($–1$), heart rate $\geq$ 102 min ($–1$), systolic blood pressure $\leq$ 99 mm Hg, temperature $&lt;35.3$ degrees C, oxygen saturation $&lt;0.001$), reduced systolic blood pressure ($p &lt;0.001$), abnormal temperature ($p &lt;0.001$), reduced pulse oximetry ($p &lt;0.001$), chest pain ($p &lt;0.001$) and nurse or doctor concern ($p &lt;0.001$). Multivariate analysis of cardiac arrest cases identified three positive associations for cardiac arrest: abnormal breathing indicator (OR 3.49; 95% CI: 1.69–7.21), abnormal pulse (OR 4.07; 95% CI: 2.0–8.31) and abnormal systolic blood pressure (OR 19.92; 95% CI: 9.48–41.84).</td>
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<tr>
<td>Study</td>
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<td>Design</td>
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<td>The objective medical emergency team activation criteria (Cretikos et al., 2007).</td>
<td>Evaluated the ability of pre-defined clinical criteria to identify patients who subsequently suffer MAE’s to determine the ability of modified criteria to identify these patients.</td>
<td>(n = 1102) were included.</td>
<td>in order to devise a robust scoring system.</td>
<td>&lt; or = 96%, and disturbed consciousness were associated with an increase in mortality.</td>
<td>Combining a HR greater than 140, RR greater than 36, a SB/P less than 90 mmHg and a greater than two point reduction in the GSC identified adverse events with a sensitivity of 49.1% (44.4–53.8%), specificity of 93.7% (91.2–95.6%), and positive predictive value of 9.8% (8.7–11.1%). Adding threatened airway, seizures, low respiratory rate and low heart rate did not substantially improve sensitivity (50.4%; 45.7–55.2%). In combination, the RR, HR, SB/P, and GCS identify patients at risk of MAEs.</td>
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## Appendix 3: The Afferent Limb of RRS

<table>
<thead>
<tr>
<th>Study</th>
<th>Research questions and aims</th>
<th>Sample</th>
<th>Outcome Measure</th>
<th>Design</th>
<th>Data analysis and results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introducing Critical Care Outreach (Priestley et al., 2004).</td>
<td>The effects of introducing a critical care outreach service.</td>
<td>Admissions to the 16 surgical, medical and elderly care wards during 32-week study period were included (7,450 patients in total).</td>
<td>In-hospital mortality and length of stay in a general acute hospital.</td>
<td>Single centre clustered randomised control trial.</td>
<td>A possible increased length of stay associated with outreach was not fully supported by confirmatory and sensitivity analyses.</td>
</tr>
<tr>
<td>MET: a cluster-randomised controlled trial (Hillman et al., 2005).</td>
<td>Does the medical emergency team (MET) system reduce the incidence of cardiac arrests, unplanned admissions to intensive care units (ICU), and deaths.</td>
<td>Randomised 23 hospitals in Australia to continue functioning as usual (n=11) or to introduce a MET system (i=12).</td>
<td>Cardiac arrests, unplanned admissions ICU and deaths.</td>
<td>Multi-centered randomised control trial.</td>
<td>Introduction of the MET increased the overall calling incidence for an emergency team (3.1 vs 8.7 per 1000 admissions, p=0.0001). The MET was called to 30% of patients who fulfilled the calling criteria and who were subsequently admitted to the ICU. A reduction in the rate of cardiac arrests (p=0.003) and unexpected deaths (p=0.01) was seen from baseline to the study period for both groups combined.</td>
</tr>
</tbody>
</table>
| Evaluation of a medical emergency team one year after implementation | Evaluated the activity and impact of a MET one year after implementation. | A 700-bed District General Hospital (DGH) in Southeast England with approximately | Routinely collected hospital data for admissions, discharges and deaths was used | Single centre cohort with historical controls. | There were 136 activations of MET over 1-year. Mean age of patients was 73 years (range 20–
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<th>Design</th>
<th>Data analysis and results</th>
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<td>on (Kenward et al., 2004).</td>
<td></td>
<td>53,500 adult admissions per annum.</td>
<td>to compare outcomes for the 12 months before and after the introduction of the MET.</td>
<td>97 years). 40% survived to discharge following MET intervention. Of those who died 22% were designated 'not for resuscitation'. Patients that died were more likely to have three or more physiological abnormalities present.</td>
<td></td>
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<tr>
<td>Rates of inhospital arrests, deaths and intensive care admissions: the effect of a medical emergency team (Bristow et al., 2000).</td>
<td>Evaluated the effectiveness of a team MET in reducing the rates of selected adverse events.</td>
<td>All adult (&gt; or = 14 years) patients admitted to three Australian public hospitals from 8 July to 31 December 1996.</td>
<td>Rates of cardiac arrest, unanticipated admission to intensive care unit (ICU), death.</td>
<td>None; randomised cohort with concurrent controls.</td>
<td>There were 1,510 adverse events identified among 50,942 admissions. The rate of unanticipated ICU admissions was less at the intervention hospital in total (casemix-adjusted odds ratios: Hospital 1, 1.00; Hospital 2, 1.59 [95% CI, 1.24–2.04]; Hospital 3, 1.73 [95% CI, 1.37–2.16]). There was no significant difference in the rates of cardiac arrest or total deaths between the three hospitals.</td>
</tr>
<tr>
<td>The effect of a RRT on</td>
<td>The effect of an RRT led by</td>
<td>A 350-bed nonteaching</td>
<td>Cardiac arrests, total intensive</td>
<td>There were 344 RRT calls during</td>
<td></td>
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<tr>
<td>Study</td>
<td>Research questions and aims</td>
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<td>major clinical outcome measures in a community hospital (Dacey et al., 2007).</td>
<td>physician assistants.</td>
<td>community hospital. All adult patients admitted to the hospital from May 1, 2005, to October 1, 2006.</td>
<td>care unit admissions, unplanned intensive care unit admissions, intensive care unit length of stay, and the total hospital mortality rate occurring over the study period</td>
<td>the study period. In the 5 months before the rapid response system began, there were an average of 7.6 cardiac arrests per 1,000 discharges per month. In the subsequent 13 months, that figure decreased to 3.0 cardiac arrests per 1,000 discharges per month. Overall hospital mortality the year before the rapid response system was 2.82% and decreased to 2.35% by the end of the RRT year. The percentage of intensive care unit admissions that were unplanned decreased from 45% to 29%.</td>
<td></td>
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<tr>
<td>Use of medical emergency team responses to reduce hospital cardiopulmonary arrests (DeVita, et al., 2004).</td>
<td>How the incidence and outcomes of cardiac arrests have changed following increased use of MET.</td>
<td>Objective criteria for MET activation were created and disseminated as part of a crisis management program, after which there was a rapid and sustained increase in the use of MET.</td>
<td>Compared the incidence and mortality of cardiopulmonary arrest before and after the increased use of MET.</td>
<td>Single centre cohort study with historical controls. 3,269 MET responses and 1,220 cardiopulmonary arrests over 6.8 years showed an increase in MET responses from 13.7 to 25.8 per 1000 admissions ($p &lt;0.0001$) after instituting objective activation criteria. There was a coincident 17%...</td>
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<td>Effects of a MET on reduction of incidence of and mortality from unexpected cardiac arrests in hospital (Buist, Moore et al. 2002).</td>
<td>Does intervention by a MET reduce the incidence of and mortality from unexpected cardiac arrest in hospital.</td>
<td>All patients admitted to the hospital in 1996 ($n=19,317$) and 1999 ($n=22,847$).</td>
<td>Unexpected cardiac arrest.</td>
<td>Single centre cohort study with historical controls.</td>
<td>The incidence of unexpected cardiac arrest was 3.77 per 1000 hospital admissions (73 cases) in 1996 (before intervention) and 2.05 per 1000 admissions (47 cases) in 1999 (after intervention), with mortality being 77% (56 patients) and 55% (26 patients), respectively. After adjustment for case mix the intervention was associated with a 50% reduction in the incidence of unexpected cardiac arrest (odds ratio 0.50, 95% confidence interval 0.35 to 0.73).</td>
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<td>A prospective before-and-</td>
<td>To determine the effect on cardiac</td>
<td>Consecutive patients admitted</td>
<td>Number of cardiac arrests.</td>
<td>Single centre</td>
<td>There were 63 cardiac arrests in</td>
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<td>Study</td>
<td>Research questions and aims</td>
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<td>after trial of a MET (Bellomo et al., 2003).</td>
<td>arrests and overall hospital mortality of an intensive care-based medical emergency team.</td>
<td>to hospital during a 4-month &quot;before&quot; period (May–August 1999) (n=21,090) and a 4-month intervention period (November 2000 –February 2001) (n=20,921).</td>
<td>number of patients dying after cardiac arrest, number of postcardiac-arrest bed-days and overall number of in-hospital deaths.</td>
<td>cohort study with historical controls.</td>
<td>the “before” period and 22 in the intervention period (relative risk reduction, RRR: 65%; p &lt; 0.001). 37 deaths were attributed to cardiac arrests in the “before” period and 16 in the intervention period (RRR: 56%; p&lt;0.005). Survivors of cardiac arrest in the “before” period required 163 ICU bed-days versus 33 in the intervention period (RRR: 80%; p &lt;0.001), and 1353 hospital bed-days versus 159 in the intervention period (RRR: 88%; p &lt;0.001). There were 302 deaths in the “before” period and 222 in the intervention period (RRR: 26%; p=0.004).</td>
</tr>
<tr>
<td>Long term effect of a medical emergency team on cardiac arrests in a teaching hospital (Jones et al., 1999)</td>
<td>Effect of a MET system on the long-term incidence of cardiac arrests.</td>
<td>The period 1 January 1999 to 31 August 1999 was the control period. September 1999 to 31 August 2000 was the interventional phase. Study included over</td>
<td>Cardiac arrests.</td>
<td>Single centre cohort study with concurrent controls.</td>
<td>Before the introduction of the MET system there were 66 cardiac arrests and 16,246 admissions (4.06 cardiac arrests per 1,000 admissions).</td>
</tr>
</tbody>
</table>
### Study Questions and Aims

2005).

#### Sample

145,000 admissions.

#### Design and Results

During the education period, the incidence of cardiac arrests decreased to 2.45 per 1,000 admissions (odds ratio (OR) for cardiac arrest 0.60; 95% confidence interval (CI) 0.43-0.86; \( p = 0.004 \)). After the implementation of the MET system, the incidence of cardiac arrests further decreased to 1.90 per 1,000 admissions (OR for cardiac arrest 0.47; 95% CI 0.35-0.62; \( p < 0.0001 \)).
Appendix 4: Participant information sheet

Gold Coast Health Service District and Griffith University participants’ information sheet.

Project Title: An Explanatory case study design evaluating Rapid Response Systems

Investigators
Debbie Massey
Professor Leanne Aitken
Professor Wendy Chaboyer

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Debbie Massey

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Nathan
Queensland
4111

Phone
(07) 373 55221

Email
d.massey@griffith.edu.au

Introduction.
As a nurse, you have been involved in providing care to patients who recently experienced unplanned admission to the Intensive Care Unit. Your experiences about the events leading up to the patient’s admission are of interest to the Gold Coast Health Service District. As part of my PhD I wish to invite you to be a participant in this research so that your experiences of caring for this patient can be understood.

Background.
This study is being conducted to explore nurses’ experiences, attitudes and utilisation of Rapid Response Systems. Rapid Response Systems are an innovative and proactive strategy aimed at improving the care and management of acutely ill ward patients at risk of clinical deterioration. Evidence highlights that nurses are integral to the success of these systems and are the health care providers that are primarily responsible for the activation of these systems.
Evidence also highlights however that these systems are frequently underutilised by nursing staff and the reasons behind this are unclear. This research is being conducted to explore some of the reasons behind the underutilisation of these systems. You have been selected to participate in this study because you have cared for a ward patient who experienced clinical deterioration.

**Description of procedure.**
You will be interviewed and this will be audiotaped. It is anticipated that this interview will take between 40-60 minutes. You will be briefed as to the purpose of the study and the interview and you will be given the opportunity to have questions answered.
A summary of the research findings will be available to you on completion of this study in 2010.

**Risks and discomfort.**
There are no risks anticipated as a result of taking part in the interviews. You may however experience some discomfort in relating your experiences about caring for a patient who experienced unplanned admission to Intensive Care.

**Benefits.**
There may be no direct benefit to you from your participation in this study but the results generated from this study will enable enhanced insight and understanding of nurses’ experiences of Rapid Response Systems. Its is acknowledged that, whilst confidentiality will be maintained your views and experiences will be used to enhance understanding of these complex systems.

**Withdrawing from the study.**
Your decision whether or not to participate in this study will not prejudice your future relations or employment with Gold Coast District Health Service or Griffith University. If you decide to participate, you are free to withdraw your consent and to discontinue your participation in the study at any time. You do not have to give any reasons for your withdrawal or your discontinuation in the study.

**Confidentially.**
The information provided by you in this interview will be de-identified so that only the researcher and her supervisors know the identity of the participant. The research data however, may be accessed by auditors, ethics committees or regulatory authorities. Research data gathered from the results of the study may be published; however any identifying data will not be used.

**Privacy statement.**
The information collected during the interview is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements.

**Contact.**
In the event that you have any further queries in relation to any aspects of this study please contact Debbie Massey on telephone (07) 3735 5221 or email d.massey@griffith.edu.au. Professor Leanne Aitken on (07) 3240 7256 or Professor Wendy Chaboyer on (07) 5552 8518 may also be contacted. If you have any concerns about conduct of this research study please contact the Griffith University research ethics officer on (07) 373 5651.
Thank you for your time and assistance with this project.

Debbie Massey
Appendix 5: Information and consent form

Rapid Response Systems: An Explanatory case study design evaluating Rapid Response Systems

Information and Consent form

I have read the information and understand that:

1. This research aims to investigate Rapid Response Systems, their use and their effectiveness in clinical practice.
2. My participation in the study will involve a formal interview.
3. Participation in this formal interview may take between 40-60 minutes and will be audiotape.
4. My participation is voluntary and I may discontinue my involvement at any time without penalty or explanation.
5. Any reports or publications from this study will be reported to ensure that all identifiers (names, hospital, and date of birth) will be removed and replaced with pseudonyms.
6. The data will be kept confidential at all times and in a locked filing cabinet in the chief investigators office for a period of seven years before being destroyed.
7. A summary of the study’s findings will be made available to me.

I have read the information sheet and the consent form. I agree to participate in this study and give my consent freely. I understand that the study will be carried out as described in the information sheet, a copy of which I have retained. I realise that whether or not I decide to participate is my decision and will not effect my employment. I also realise that I can withdraw form the study at any time and that I do not have to give any reasons for doing so. I have all my questions answered to my satisfaction.

Name and Signature __________________________ Date ________
Participant

Names and Signature __________________________ Date ________
Investigator
Appendix 6: Contact summary sheet

Interview
Date 16/4/2010

Experienced Nurse: Duration of interview 45 minutes

What were the main themes or issues emerged during this contact
- Experience appears to be a factor in MET activation
- Time of day appears to be an important aspect of MET activation
- Experience of MET is generally positive
- Communication is an important issue related to MET and the deteriorating patient
- There is a difference between gradual and sudden deterioration. MET more likely to be activated if patient suddenly deteriorates.
- Knowing the patient important
- CTC is seen as a support system for managing the deteriorating ward patient
- METS activated when unable to get hold of referral team
- When ref team present then MET unlikely to be called even if patient continues to deteriorate

Which research Questions and variables emerged
- Activation of MET appears dependent on the presence of referral team
- The speed of clinical deterioration
- MET activation is a positive
- MET is seen as a last resort rather than an early intervention strategy
- The speed of the response is positive
- The fact that the team take over the care is positive
- Experience is seen as important in relation to confidence in activating a MET
- More senior nursing staff would make the management of the deteriorating ward patient easier.
- The new forms are a useful tool for helping less experience staff identify the deteriorating patient
- Protocols and polices would be useful to help more junior staff
- Simulation would be a useful strategy to help promote early activation MET

What new themes emerged that need to be considered for next interview
- Time of day is important
- Gradual versus sudden deterioration
- NFR and issues surrounding this
- Making a the wrong decision is seen as a factor in relation to MET activation
- MET seen as a last resort rather than an early intervention strategy. What can be done to improve this?
- Knowing the patient and what is normal for them
- Knowledge and understanding of how a deteriorating patient appears is important.
- Simulation would help to promote early activation of MET
Appendix 7: Data dictionary

Data Dictionary

Adverse Event Determination: The Nurse Reviewer is asked to make a judgement as to whether or not they believe an Adverse Event occurred. A "yes" response will indicate the RN reviewer judged that there was an unintended injury, which resulted in a temporary or permanent disability including disfigurement an increased length of stay and/or financial loss caused by clinical care, rather than the disease process.

An adverse event is an unintended **injury** that results in temporary or permanent **disability**, including increased length of stay and/or financial loss, which is **caused** by health care management rather than the disease process.

a) **Unintended Injury:** refers to all additional morbidity that results from complications in health care management. This definition is unrelated to the standard or quality of care. Even when there is a clear-cut error in management, if there is NO injury, there is no adverse event.

b) **Disability:** refers to temporary or permanent impairment of physical (including disfigurement) or mental function or increased length of stay and/or economic loss (even in the absence of such impairment).

If no disability occurred, still complete the form but identify this in the appropriate section (page 8 questions)

**UNEXPECTED EVENT:** Any untoward event that is not a natural consequence of disease or treatment, regardless of the health outcome.

**PREVENTABILITY:** Refers to an adverse event resulting from an error, either negligent or non-negligent, or failure to follow accepted practices.

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Hospital incurred patient accident or injury.

**DEFINITION:**

Hospital incurred trauma. This includes **falls**, burns, patient medication errors, procedural errors, threatened or new decubitus ulcers, etc.

**EXCEPTIONS:**

Accidents where there is no evidence of **ANY** injury; e.g. A patient was assisted to bed by two nurses and fell to knees. No injury was apparent.

**DISCUSSION AND DATE RETRIEVAL:**

The RN reviewer will need to look in the progress notes for evidence of trauma as documented by nursing, medical or allied health staff. Hospital incident/accident forms will also be useful in identifying accidents or injury. The RN reviewer is looking for evidence of recognition, assessment and follow up of injury - including delayed diagnoses. e.g. fractures and intracerebral haemorrhage, etc.

The RN reviewer should describe the events including a brief description of the accident/injury, the date and the outcome if available.

**EXAMPLES OF WHAT TO WRITE:**

Fractures, burns, lacerations requiring sutures, loss or damage to teeth, and disabilities with loss of motion of extremities **not** present on admission.


2. 17 mls of methadone administered instead of 17 mgs (3.5 mls). Patient required a gastric lavage and a nurse special for 24 hours.

3. Patient receiving naso-gastric feeds developed aspiration pneumonia. It was noted the patient was over sedated at the time of the incident.

4. Patient developed pulmonary oedema secondary to rapid infusion of intravenous fluids.
Adverse drug reaction.

**DEFINITION:**

All adverse medication reactions.

**EXCEPTIONS:**

When the drug in question is known *always* to cause a specific reaction – e.g., neutropaenia following chemotherapy.

**DISCUSSION AND DATA RETRIEVAL:**

The RN reviewer, needs to look in the progress notes for evidence of treatment for adverse drug reactions. Other places to look will be anaesthetic charts for intra-operative drug reactions. These will often manifest themselves as an unplanned transfer to an acute care ward. The RN reviewer should describe the event including the date, the drug, and the nature of the reaction and outcome if available.

Types of adverse drug reactions to be included:

1. Toxic drug levels leading to morbidity, such as seizure and fractures following theophylline overdose.

2. Iatrogenic acute tubular necrosis following iatrogenic antibiotic treatment, e.g., gentamicin

3. Gastrointestinal bleeding following aspirin administration.

4. Severe hypoglycaemic reaction in a patient on insulin or oral hypoglycaemics.

5. Anaphylaxis or adverse reactions to antibiotics.

**EXAMPLE OF WHAT TO WRITE:**

1. Following administration of penicillin patient developed acute respiratory distress requiring administration of adrenaline and steroids. Antibiotics were altered. Patient was noted to be allergic to penicillin.
Unplanned transfer from general care to intensive care or higher dependency.

DEFINITION:
Includes patients who are transferred from the general wards (medical, surgical, orthopaedic, renal, nuclear medicine, radiology, etc.) and CCU into ICU. Patients who are excluded from this definition include patients transferred to an ICU from another ICU/HDU, operating theatre, Recovery or ED

EXCEPTIONS:

1. Transfers scheduled prior to surgery as a part of routine post operative management.

2. Intensive care routinely used as a recovery room (found to occur in the smaller institutions).

3. Intensive care used as an admitting or holding area until a general ward bed becomes available.

DISCUSSION AND DATA RETRIEVAL:
The RN reviewer will need to check the progress notes for evidence of delays in treatment, inappropriate treatment, or diagnosis delay prior to the transfer, etc.

Patients admitted to Intensive Care via the Accident and Emergency department to be recorded as "YES". If in doubt as to whether the transfer was planned or unplanned, always record a "YES".

The RN reviewer should describe the event including the date, the reason for transfer, the management immediately prior to the transfer, and the outcome if available.

EXAMPLES OF WHAT TO WRITE:

1. Patient fell at home with no loss of consciousness admitted to A&E. 5 hours later the patient became unconscious. CT revealed an extra dural haematoma. Patient transferred to ICU via theatre. No neurological observations noted since admission.

2. Asthmatic patient transferred to ICU with respiratory failure. No peak flows recorded since admission and a 4 hour delay notifying medical staff was noted. Patient returned to the ward 2 days later.
Other patient complications e.g., DVT, PE, CVA, MI, etc.

DEFINITION:

Other complications that are not related to any other criterion. The RN reviewer is looking for complications that have no direct causal relationship to either, procedures or treatment performed.

EXCEPTIONS:

When the complication is due exclusively to the patient’s disease process.

DISCUSSION AND DATA RETRIEVAL:

The progress notes, laboratory reports, X-ray reports, nuclear medicine reports and consultation notes and discharge summaries need to be reviewed.

This criterion is designed to capture other unexpected events that are not expected outcomes of disease or treatment. e.g.: DVT, PE and CVA etc. There is often no single causal event but the fact that the complication has occurred during hospital admission requires a YES (1) to be recorded. The RN reviewer should review the notes carefully for evidence of prophylaxis to prevent a known complication, and adequacy of preoperative assessment for recognition and treatment of any complications.

The RN reviewer should describe the event including the date and nature of the complication.

EXAMPLES OF WHAT TO WRITE:

1. Patient admitted with pneumonia. The patient developed a DVT. This was treated with IV heparin and the patient discharged 7 days later on warfarin and followed up in the consultant's rooms.

2. Patient with known cardiac history and MI 2 months prior to admission underwent elective surgery for an ulnar nerve decompression. 8 hours post operation the patient developed acute chest pain and was transferred to CCU and diagnosed with a further MI.
Unplanned transfer to another acute care hospital.

DEFINITION:

Transfers to other hospitals for ongoing, continuous hospital care. i.e. - there is no evidence that the patient was discharged home or to rehabilitation, etc.

EXCEPTIONS:

Transfer for tests, procedures or specialised care not available at the index hospital. This is provided that the transfer for the test or procedure was obviously not precipitated by an unexpected deterioration in the patient’s condition.

DISCUSSION AND DATA RETRIEVAL:

The RN reviewer will need to check the progress notes, discharge summaries and referral letters to other hospitals (if photocopied and remain in the record) for evidence of reasons for transfer.

The RN reviewer should describe the event including an admission diagnosis, discharge diagnosis, reason for transfer, and where transferred to, if available.

EXAMPLES OF WHAT TO WRITE:

1. 12 hours following admission, patient went into shock and was transferred to ICU. Review disclosed that the ETT was passed with difficulty. 3 hours later a nurse noted blood in the patients mouth. X-Ray result reported a haemopneumothorax.

2. The patient had an anaphylactic reaction during induction of anaesthetic for an oesophageal dilatation and required transfer to a tertiary referral centre for intensive care management.
Unplanned removal, injury or repair of organ or structure during surgery, invasive procedure.

DEFINITION:

A patient requiring medical treatment or subjected to an operation for repair of a laceration, perforation, tear or puncture of an organ, subsequent to or as a result of performance of an invasive procedure. This may manifest as:

a) Immediate injury. i.e.; dissected coronary artery following angioplasty requiring cardiac surgery.

b) Late complication. i.e.; post biopsy bleeding as the result of damage to another organ requiring surgery later to repair the damaged organ.

DISCUSSION AND DATA RETRIEVAL:

Invasive procedures include: intubations (tracheal, oesophageal, gastric etc.), percutaneous aspirations (thoracentesis, paracentesis, bladder aspiration, lumbar punctures etc.), percutaneous biopsies (breast, thyroid kidney and liver etc.), endoscopies, X-Ray procedures (angiograms etc.), and miscellaneous (pacemakers shunts etc.).

In this criterion, the original procedure is usually both justified and appropriate; however, if an inadvertent injury occurs at the time of the surgery or procedure record YES. The RN reviewer should look at the operation report, anaesthetic report, nurses’ operation report, recovery room observation chart, , and any other documentation that related to other invasive procedures i.e. angiograms. It is also necessary to check consent forms against procedures performed and pathology reports against the specimen taken etc.

The RN reviewer should describe the event including the date, the procedure and the nature of the injury.

EXAMPLES OF WHAT TO WRITE:

1. Intra-operatively during elective caesarean section, the bladder was lacerated requiring repair.

2. Uncomplicated kidney biopsy. The pathology report indicates splenic tissue.

3. Patient required a central venous catheter for long term IVAB’S. Post insertion X-Ray revealed a pneumothorax.
Unplanned admission (including readmission) as a result of any health care management within 12 months.

DEFINITION:
Hospitalisation at this or any other hospital prior to the index (current) admission identified.

EXCEPTIONS:
1. Planned or booked admissions for secondary procedures needed to complete treatment.
2. When the index admission is for a normal delivery.
3. If the prior hospitalisation is not related to the index hospitalisation,

DISCUSSION AND DATA RETRIEVAL:
This criterion identifies an admission or re-admission for complications or incomplete management of problems identified on previous hospitalisation, or as a consequence of healthcare management (unless any of the exceptions are found). This criterion also includes admission as a consequence of management at other healthcare facilities including General Practices, medical centres, private rooms, allied and alternative health professional care, etc.

On review of the index (current) admission, it is important to check the admission notes, including referral letters and transfer letters from other hospitals, history and physical examination reports, and sometimes even discharge summaries for evidence of previous admissions or problems due to health care management. Things to look for are:-

(a) Recurrence of a presumably cured disease
(b) Complications of previous procedures
(c) Inadequate follow up of a previously treated problem
(d) Premature discharge on 1st admission, etc.

For all admissions as a result of health care management within the 12 months prior to the INDEX admission, record YES (1).

EXAMPLES OF WHAT TO WRITE:

1. Patient admitted with a flare up of lupus febrile blood cultures taken. Patient treated with steroids and discharged home. Review of blood cultures confirms presence of gram-negative bacteria. Patient readmitted

2. Patient admitted in a diabetic coma. Patient was previously discharged 2 weeks ago, no evidence of follow-up, or instructions for continued outpatient care appeared in the medical record.

3. Patient admitted with decreased sensation in the right leg. The patient had recently undergone a back manipulation by an osteopath for recurrent lumbar pain.
Development of a neurological deficit not present on admission.

DEFINITION:

New neurological deficit unresolved at time of discharge.

DISCUSSION AND DATA RETRIEVAL:

The RN reviewer must first ascertain the patients neurological function on admission so as to compare the initial assessment with any new changes noted.

All neurological deficits not present at the time of admission to be recorded as YES (1). RN reviewers should be alert to patients undergoing any procedures (procedures and x-rays etc.) or plaster applications where potential for neurological damage can occur. Particular attention should be paid to neurosurgery, orthopaedic and vascular procedures. Damage to nerves following anaesthesia should also be looked for, e.g.: laryngeal nerve palsy etc. Any neurological deficits which are unrelated directly to procedures or investigations should be recorded under Criterion 9: Other patient complications.

The RN reviewer should screen the entire medical record including the progress notes, consultation notes, operative reports, nursing notes, physiotherapy notes, observation charts, and discharge summaries.

The RN reviewer should describe the event including the date, the nature of the neurological deficit, and the outcome if known.

EXAMPLES OF WHAT TO WRITE:

1. Patient noted to be limping and had a right leg weakness. Intra muscular injections had been given in the right buttock resulting in damage to the sciatic nerve.

2. Patient admitted on bedrest for management of lumbar back pain. The patient developed right footdrop requiring intensive physio and a foot splint following discharge.

3. Patient underwent elective cardiac angiogram. 12 hours post operatively the patient was found to have a dense hemiplegia. CT revealed a large cerebral infarct and the patient was transferred for rehabilitation 3 weeks later.
Unexpected death, i.e. not an expected outcome of the disease during this hospitalisation.

**DEFINITION:** As above

**EXCEPTIONS:** All expected deaths

An expected death needs to fulfil both clinical and pathological evidence of the expected nature of the death. An expected death occurs with a diagnosis of end stage disease supported by pathological or radiological evidence, with documentation of initiation of palliative care measures, withdrawal of care or a not for resuscitation order.

**DISCUSSION AND DATA RETRIEVAL:**

For all unexpected deaths record YES (1)

An unexpected death usually does not fulfil clinical, pathological, radiological or documentary evidence that the death was expected.

The RN reviewer should look for any signs that the patient's condition was deteriorating, e.g., biochemical parameters, physical signs of deterioration, whether a medical officer was notified and attended in a timely fashion and what treatment, if any, was initiated.

In the case of death following cardiac arrest look for documentation relating to the resuscitation and any drugs administered, including both those prior to the arrest and those administered during the arrest. E.g., over narcotised patient resulting in a respiratory arrest etc.

All of the following are examples of an unexpected death:

- Death following elective surgery or procedure
- Death during or post active resuscitation
- Death within 24 hours of admission
- Death without a definitive diagnosis
- Death following an incident or accident
- Suicide
- Death under suspicious circumstances

The RN reviewer should describe the events to include the date and the circumstances surrounding the unexpected death.

**EXAMPLES OF WHAT TO WRITE:**

1. A patient admitted via Emergency in atrial fibrillation on digoxin. Digoxin level was reported as 5.2, there was no evidence that a medical officer was notified. The patient suffered a fatal cardiac arrest one day following admission.

2. Patient admitted to the Medical ward with confusion. Haloperidols administered via intravenous (IV) push 5 mg every 20 minutes until sedation was achieved. After 3 doses of haloperidol, the patient’s face turned pale and
she started gasping for air. The patient was connected to a cardiac monitor on a crash cart, which showed polymorphic ventricular tachycardia. CPR was unsuccessful.
Inappropriate discharge home.

**DEFINITION:**

Discharge to home whilst patient clinically unstable. i.e.

- Temperature > 38° within 24 hours prior to discharge
- Evidence that wound(s) were not healing
- Not passing urine, flatus, or faecal material
- Not tolerating prescribed diet
- Requiring parenteral analgesics.

**EXCEPTIONS:**

Diseases in which any of the above is a symptom or condition related to the diagnosis. E.g., oncology patient managed by the palliative care team on home narcotics, etc.

**DISCUSSION AND DATA RETRIEVAL:**

For any of the above elements, persisting on the day of discharge, record YES (1). The RN reviewer needs to check the progress notes including nursing and medical documentation prior to discharge, the observation and medication charts and discharge summary, looking for an unrecorded or unrecognised complication. Often patients not meeting the discharge screen will represent to the hospital as a readmission and therefore will fall under Criterion 2 as well.

The RN reviewer should describe the events to include the date, and the nature of the inappropriate discharge.

**EXAMPLES OF WHAT TO WRITE:**

1. Patient admitted for drainage of pleural effusion via chest drain. discharged with a temperature of 38.2. Nurses note that the chest drain site was erythematous. The patient was readmitted with a severe infection.

2. Patient admitted with renal stones pain was treated with opiates and patient discharged with no analgesia. There is no evidence that the patient was reviewed by the pain management team. The patient was readmitted 1 day later with uncontrolled pain.
Cardiac/Respiratory Arrest

DEFINITION:

Cardiac/Respiratory arrest, defined as
Lack of palpable pulses
Unresponsive
Documented initiation of basic life support
Lack of palpable pulses
Unresponsive
Documented initiation of basic life support

EXCEPTIONS:

None

DISCUSSION AND DATA RETRIEVAL:

The RN reviewer should screen the medical record for evidence of cardiac or respiratory or Rapid Response calls. For all cardiac or respiratory arrests YES (1). The RN reviewer should look for documentation of the arrest, or a resuscitation form in the progress notes. An arrest will often precede a transfer to an ICU or acute care ward. In reviewing the medical record the RN reviewer should assume arrest when cardiac or pulmonary resuscitation is performed.

The RN reviewer should assess the events leading to and immediately prior to the arrest. Things to look for are evidence of haemorrhage or falling Hb, deteriorating neurological status, falling oxygen levels, administration of drugs (including narcotics and fluids), etc.

This criterion is used when patients are successfully resuscitated or survive at least for a period of time. Criteria 11 "death" is used if the resuscitation is unsuccessful.

The RN reviewer should describe the event including the date, time and outcome, if known. Patients who survive the arrest (even for a short period of time) and subsequently die, need to be recorded as a Criterion 13 "cardiac arrest" and an 11 "unexpected death".

EXAMPLES OF WHAT TO WRITE:

1. 3 hours following an open lung biopsy the patient was found to be cyanosed and had an arrest. The blood loss in the thoracic drains was found to be 3000 mls and the post operative Hb was 5.7. No medical assessment had been made.

2. Patient admitted to the accident and emergency department unconscious and diagnosed as intoxicated. 4 hours later the patient had a cardiac arrest. Further examination revealed the patient had an extensive extradural haematoma. The patient underwent surgery and was discharged 3 weeks later.
Hospital acquired infection or sepsis.

**DEFINITION:**

An infection is considered to be hospital acquired once the patient has been in hospital for 72 hours or more. The evidence of infection may be clinical (local or systemic evidence) or combined with a positive microbiological culture.

**EXCEPTIONS:**

Infections acquired prior to admission to hospital unrelated to health care management. E.g. a patient admitted with a chest infection with no previous health care intervention.

**DISCUSSION AND DATA RETRIEVAL:**

For patients admitted with infections check for evidence of prior health care management and where infection may have been acquired. E.g., a patient transferred from one hospital to another for ongoing management of a wound infection acquired during hospitalisation should be recorded as YES (1).

The RN reviewer needs to look at the microbiology reports and the corresponding dates in the progress notes to identify both clinical and laboratory evidence of infection.

What to look for as confirmation of infections:

1. Urine microbiological reports; look at the WCC for clues of contamination verses infection. WCC > 100 suggests infection. Epithelial cells > 100 suggests a high probability of contamination. Positive nitrates suggest possible infection.

Therefore a result that shows:

   a) WCC > 100
   b) Epithelial cells < 10
   c) Nitrates positive

These are all good indications of infection. > than 3 organisms cultured generally indicates a contaminated specimen.

2. Wound infections will have:
   - Clinical evidence i.e. redness, discharge, etc.
   - Systemic evidence i.e. fever > 38°C for more than two days following a procedure and an increased WCC with a positive wound culture reported as microbiological evidence.

3. Other infections include blood, chest, etc. will appear with similar signs and symptoms and microbiological confirmation.

The RN reviewer should describe the event to include the date, the nature of the infection, and the treatment.

**EXAMPLES OF WHAT TO WRITE:**
1. Elective admission for cardiac surgery. Post-operatively the patient's sternal wound developed an infection requiring return to theatre for debridement and resuturing.

2. Patient admitted for management of cellulitis. The patient had recently undergone a minor procedure at a private hospital and the cellulitis was secondary to an infected IV cannula site.
Patient or family dissatisfaction with the care received.

**DEFINITION:**
Correspondence from a hospital administrator, an attorney, patient or relative that suggests patient or family is dissatisfied with the care received.

**DISCUSSION AND DATA RETRIEVAL.**

If there is any documented evidence of patient or family dissatisfaction record YES (1). Check the progress notes for documentation relating to any patient or family complaint or conflict as recorded by medical, nursing, social work or the patient representative. Discharges against medical advice are recorded under this criterion.

The RN reviewer should describe the event to include the date and nature of the dissatisfaction recorded.

**EXAMPLES OF WHAT TO WRITE:**

1. Progress note on the 2/11 states, “*some family members are angry because of the life support systems instituted.*” Previous entry in the record indicated that the wife requested all support measures to be instituted.

2. Nursing notes 6/12 state, “*the patient is very angry that repeat X-Rays were required because the first series were lost.*”
Documentation of correspondence indicating litigation, either contemplated or actual (e.g. a letter from a solicitor, etc.)

DEFENITION:

Correspondence from a hospital administrator, an attorney, patient or relative that suggests litigation is pending or contemplated.

EXCEPTIONS:

This criterion does not include correspondence relating to workers compensation claims or 3rd party insurance.

DISCUSSION AND DATA RETRIEVAL:

Occasionally, the medical record will contain correspondence from a patient, an attorney, or a liability insurer, suggesting the patient is dissatisfied with the quality of health care management or has suffered some injury or disability as a consequence or health care management. At some institutions the record will be stamped legal on the cover. In other institutions, the correspondence is in a separate file outside the medical record department. When in doubt, answer YES.

The RN reviewer should describe the event to include the date, the nature of correspondence and where in the record the information was found.

EXAMPLE OF WHAT TO WRITE:

1. Patient admitted for routine surgery. Intraoperatively the patient sustained a burn on his buttock from the diathermy plate requiring skin grafting. A solicitor's letter is filed in the OPD notes indicating legal proceedings are being undertaken.
Any other undesirable outcomes (not covered by any other criterion).

DISCUSSION AND DATA RETRIEVAL:

Review documented complications and all other unexplained major significant diagnostic, therapeutic manoeuvres, or organ failures not present at admission.

This criterion allows the RN reviewers to exercise judgement in reporting any complications or questionable outcomes not addressed by other criteria. Imagination, past experience, common sense and signal events are likely to play a role here. Often errors of omission are recognised under this criterion.

The RN reviewer should describe the event to include details of the date and nature of the outcome described.

EXAMPLES OF WHAT TO WRITE:

1. Failures or delays in appropriate treatment of pneumonia in immunosuppressed patients

2. No documentation of patients bowel management for 10 days. The patient subsequently developed an acute bowel obstruction requiring surgical intervention.
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