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Rapid Response Team Utilization of Modified Early Warning Scores to Improve Patient Outcomes

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RAPID RESPONSE TEAM UTILIZATION OF MODIFIED EARLY WARNING SCORES TO IMPROVE PATIENT OUTCOMES

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This retrospective, descriptive study was designed to (a) determine if the Modified Early Warning Score risk assessment tool identified moderate to high risk patients prior to the activation of the Rapid Response Team (b) determine how much time occurred from the onset of clinical deterioration until activation of the Rapid Response Team. A Modified Early Warning Score (MEWS) was applied to the documented vital signs in the medical records of a convenience sample of 108 adult patients between the ages of 19 and 99 years of age who had experienced an activation of the Rapid Response Team (RRT). A risk assessment score was given for the time of the RRT activation as well as every previously documented instance of vital signs prior to the RRT call until the MEWS score reached a low risk score of 0 to 1. Of the 108 subjects, 36 subjects had a low risk (score 0 to 1) MEWS at the time of the RRT activation; 72 subjects had a moderate (score of 2 to 3) or high (score 4 or greater) risk MEWS score at the time of the RRT activation. Ten (10.14) hours was the average amount of time earlier deterioration could have been detected if a MEWS system had been in place. The data from this study indicate a need for more frequent observation and documentation of vital signs by nursing staff as the overall average length of time between vital signs collected (MEWS applied) was 291.60 minutes (4.86 hours) when clinical deterioration was evident. These data show that there is a delay in activation of the Rapid Response Team and that implementation of the MEWS system would increase RRT awareness of patients with

critically abnormal vital signs so that they can be assessed and clinical deterioration treated to prevent a catastrophic event from occurring.

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CHAPTER I

INTRODUCTION

Current research supports the fact that early recognition of vital sign deterioration provides the opportunity for early intervention and subsequent reduction of cardiac and respiratory arrest risk for non-ICU patients. Effective observation of general medical surgical patients by floor staff is the first key step in identifying the deteriorating patient and effectively managing their care. Rapid Response Teams (RRTs) have been implemented to address the problems of managing deteriorating general medical surgical patients. These RRTs are activated when predetermined ranges for physiologic signs are breached. Activation brings the critical care skills of the RRT to the bedside of the non-ICU patient for assessment and intervention. Studies have shown that in many cases these detectable physiologic signs and symptoms have been overlooked, neglected, or poorly managed by floor staff (Odell, Victor, & Oliver, 2009). One way to identify and treat patients who are deteriorating is to introduce the use of an early warning risk assessment that includes the recording of physiological parameters such as pulse, blood pressure, temperature, respirations, and level of consciousness. An early warning risk assessment would use periodic observation and documentation of selected basic vital signs with predetermined criteria for requesting the attendance of more experienced staff such as RRTs.

Problem Statement

Many hospitals have instituted RRTs to prevent potentially avoidable deaths in general medical surgical unit patients. However, studies to date have not found

consistent improvement in clinical outcomes as a result of these RRTs. This may be due to the RRT activation relying primarily upon recognition of critically abnormal vital signs by floor staff, a process that is not always reliable. As a result, some patients may not receive timely lifesaving interventions resulting in potentially avoidable deaths. The Modified Early Warning Score (MEWS) is a physiological scoring system that may be used by nurses. The MEWS assigns risk for clinical deterioration based on vital signs and clinical observation. By incorporating the use of the MEWS, non-ICU patients' clinical deterioration will be recognized earlier resulting in a proactive referral to the RRT to investigate and intervene.

Background

Observational studies suggest that clinical deterioration of patients on general medical surgical units is often preceded by changes in physiologic observations that are recorded by clinical staff 6 to 24 hours prior to a serious adverse event (McGaughey, Alderdice, Fowler, Kapila, Mayhew, & Moutray, 2009). The most common physiologic abnormalities are changes in the basic vital signs of respiration, pulse, oxygenation, and mental function; however, these changes in clinical signs are often missed, misinterpreted, or mismanaged (McGaughey et al., 2009). The main reasons for staff failing to manage basic vital signs can be attributed to delays in seeking advice, failure to recognize clinical urgency, lack of knowledge and skills in resuscitation, inadequate supervision, or organizational problems within the hospital setting (McGaughey et al., 2009).

It is clear that the failure to respond to patient deterioration promptly and appropriately can lead to increased morbidity and mortality, increased requirements for intensive care, and elevated costs (Tarassenko, Hann, & Young, 2006). As a result, strategies for detecting at-risk patients in order to trigger the timely intervention of a rapid response team have been developed (Tarassenko et al., 2006). These approaches are based on the premise that early recognition of physiologic abnormalities coupled with rapid intervention of suitably trained staff may result in an improvement in functional outcome or mortality rate (Tarassenko et al., 2006).

Rapid response teams are composed of multidisciplinary teams of intensive care-trained staff, who are available 24-hours per day, 7 days per week, and who are separate from the primary team that is caring for the patient at the time of the deterioration (Moldenhauer, Sabel, Chu, & Mehler, 2009). Although the concept of a team responding to the deteriorating patient is intuitively sound, more recent trials as well as meta-analyses have called into question the effectiveness of the common forms of rapid response teams (Moldenhauer et al., 2009). Concerns about cost, resource utilization, fragmentation of care due to increased handoffs, and patient satisfaction have been broached in regard to RRTs (Moldenhauer et al., 2009). Therefore, to decrease costs and increase patient satisfaction, a variety of automated risk assessment tools to identify patients at risk for deterioration have been proposed (Moldenhauer et al., 2009).

The effectiveness of RRTs is reliant on the key initial step of robust monitoring of a patient's condition and vital signs at the bedside, and this important element has been shown to be lacking (Odell et al., 2009). The Modified Early Warning Score is a

physiologic scoring system that can be used as a predictive tool to assess and facilitate interventions with patients at increased susceptibility to clinical deterioration (Odell et al., 2009). The five physiologic parameters identified by Subbe, Kruger, Rutherford, and Gemmel (2001) are systolic blood pressure (SBP), heart rate (HR), respiratory rate (RR), temperature, and an AVPU score; "A" stands for alert, "V" stands for response to verbal stimuli, "P" stands for response to painful stimuli, and "U" stands for unresponsive. The MEWS is a simple bedside tool that can be calculated by anyone and can be used to identify clinical deterioration earlier.

At Immanuel St. Joseph's – Mayo Health System the Rapid Response Team (RRT) is currently only activated by the nurse, the patient, or a family member of the patient when the patient is exhibiting signs of clinical deterioration or there is concern expressed. Failure to rescue, or the inability to intervene successfully after complications have developed, has been cited as the most frequent cause of preventable hospital death (Hatler et al., 2009). Utilizing a risk assessment tool such as the Modified Early Warning Score to activate the Rapid Response Team at an earlier point of patient deterioration has the potential to result in earlier identification, assessment, and intervention resulting in improved patient care and outcomes.

Purpose

The purpose of this descriptive study utilizing retrospective analysis of patients' medical records was to (a) determine if the Modified Early Warning Score risk assessment tool identified moderate to high risk patients prior to the activation of the Rapid Response Team and (b) determine how much time occurred from the onset of

clinical deterioration until Rapid Response Team activation. A Modified Early Warning Score (MEWS) was applied to the medical records of a convenience sample of 128 adult patients between the ages of 19 and 99 years of age who had experienced an activation of the Rapid Response Team at Immanuel St. Joseph's – Mayo Health System hospital between October 1, 2009 and September 30, 2010. A risk assessment score was given for the time of the RRT activation as well as every prior documented instance of vital signs prior to the RRT call until the MEWS score reached a low risk score of 0 to 1.

Significance

This study has the potential to improve patient care and outcomes. By proactively assessing the Modified Early Warning Score of non-intensive care unit patients, the potential exists to decrease the number of underdetected critically ill hospital patients. Additionally, the potential exists to improve Rapid Response Team awareness of patients with critically abnormal vital signs in order to quickly identify, assess, and intervene with patients at risk of clinical deterioration prior to the occurrence of catastrophic events.

Assumption

One assumption was made prior to implementation of the research that there was a lack of recognition and/or activation of the RRT by floor nurses when critically abnormal vital signs were detected. In other words, staff nurses were not detecting patient deterioration in a timely manner resulting in a lack of or delays in the activation of the Rapid Response Team. Ultimately, due to lack of recognition and/or activation of the

RRT, some patients may not have received timely and potentially lifesaving interventions.

Research Hypothesis

The research hypothesis for this study was: Applying Modified Early Warning Scores prior to Rapid Response Team activation results in earlier detection of patient deterioration and decreased Rapid Response Team activation time.

Definition of Terms

The following terms have been defined for the purpose of this study.

Clinical deterioration - a decline in physiologic parameters resulting in potential instability of the patient requiring intervention.

Failure to rescue - inability to successfully intervene after deterioration has developed.

Modified Early Warning Score (MEWS) - a quick and simple physiologic scoring system that assigns risk for clinical deterioration based on specific vital signs (systolic blood pressure, heart rate, respiratory rate, temperature, and an AVPU assessment) and clinical observation.

Physiologic parameters - clinical observations such as systolic blood pressure, heart rate, respiratory rate, temperature, and an AVPU score used to determine patient stability and deterioration.

Rapid Response Team (RRT) - a multidisciplinary team consisting of ICU-trained nurses, respiratory therapists, and nursing supervisors that respond when summoned to non-ICU patients experiencing clinical deterioration.

Limitations

Two limitations may affect the generalizability of the research. The limitations are:

1. A limited number of subjects were included in the study in relation to the total number of Rapid Response Team activations within the time frame studied. Twenty-one percent of available charts were abstracted.
2. This study is only as accurate as the monitored and documented physiologic parameters which may have been inaccurate and/or insufficient.

CHAPTER II

REVIEW OF LITERATURE

There is a robust body of evidence indicating that most hospitalized patients display clinical evidence of their deteriorating physical condition for 6 to 8 hours before experiencing an acute cardiopulmonary arrest (Moldenhauer et al., 2009). Because these arrests generally are associated with a grave prognosis, significant effort has been expended in developing and implementing systems to intervene at the earliest point possible in a patient's deteriorating clinical course. The most common intervention has been the Rapid Response System (RRS), usually in the form of a Rapid Response Team (RRT). The first section of this chapter will focus on a review of the literature on Rapid Response Teams. The second section of this chapter will focus on a review of literature for Modified Early Warning Scores (MEWS).

Findings from the research suggested that the number of preventable deaths and unanticipated ICU admissions could be reduced if deteriorating patients on general hospital units were identified earlier (McGaughey et al., 2009). This led to a number of innovations for early detection and treatment of deterioration in non-ICU patients, such as Early Warning Systems (EWS) (McGaughey et al., 2009). A number of EWSs exist that are either based on exceeding any one of a set of criteria or on the allocation of points based on physiologic observations that trigger a mechanism, such as alerting the Rapid Response Team, to initiate early intervention and treatment (McGaughey et al., 2009).

The search strategy for the selection of the articles analyzed for this study was performed utilizing electronic databases including peer reviewed articles from CINHAL and OVID. The searches used a variety of combinations of search words including rapid response team, rapid response systems, RRT, medical emergency teams, MET, early warning scores, modified early warning scores, and MEWS. A review of the reference lists from previous studies was also conducted. The search resulted in hundreds of studies when only one concept was selected, however, the selection was narrowed when combining concepts. Approximately 43 studies were selected for review because they specifically addressed the combination of the MEWS utilization and RRTs.

Rapid Response Teams

Effective observation of patients is the first key step in identifying the deteriorating patient and effectively managing their care (Odell et al., 2009). Studies in the United States have shown that in many cases these detectable physiological signs and symptoms of deterioration can be overlooked, neglected, or poorly managed (Odell et al., 2009). Studies conducted in England have shown that poor vital sign recoding, lack of knowledge, failure to respond to abnormal signs, lack of supervision, and failure to respond to deterioration or seek advice have all contributed to the suboptimal care of patients (Odell et al., 2009). Failure to rescue, or the inability to intervene successfully after complications have developed, has been cited as the most frequent cause of preventable hospital death (Hatler et al., 2009).

Rapid Response Systems (RRSs) have been implemented to address the problems of managing deteriorating patients (Odell et al., 2009). These RRSs essentially consist of

one or more physiologic signs being "tracked" which, when predetermined ranges were breached, "triggered" a referral to a team with critical care skills that would then attend to the patient and treat them accordingly (Odell et al., 2009). Although slightly different models of RRSs and track and trigger systems have evolved, all contain common elements of vital sign tracking, such as respiratory rate, heart rate, and blood pressure ranges (Odell et al., 2009). There have been numerous studies attempting to establish the effectiveness of these systems, but the evidence lacks sufficient reliability, validity, and utility to draw conclusions regarding their effectiveness (Odell et al., 2009).

RRT Study One

According to a study completed by Hatler et al. (2009), delays in diagnosis are reported as a contributing factor to preventable in-hospital cardiac arrests. Investigators suggested that delays in emergency treatment occurred when (a) there was failure to recognize or to act on a patient's change in status, (b) critical change was noted but interventions were not started or were started too late, (c) providers did not possess adequate knowledge, or (d) needed technology was not available (Hatler et al., 2009). One study found that the impact of a greater than 4-hour delay in transferring a critically ill patient to the intensive care unit (ICU) resulted in an increase in morbidity, mortality, and costs (Hatler et al., 2009). Physiologic instability, such as changes in heart rate, respiratory rate, and oxygen saturation, was present within 6 to 8 hours of the event in more than half of the in-hospital cardiac arrests (Hatler et al., 2009). Early identification of health status changes and appropriate intervention were critical because survival-to-

discharge rates after hospital cardiopulmonary arrest were low, with survival estimates of only 15% (Hatler et al., 2009).

The purpose of this study by Hatler et al. (2009) was to implement Rapid Response Team (RRT) to enhance recognition and timely response to patients' deteriorating conditions. The setting was a 620 bed, not-for-profit hospital in an urban area of Arizona (Hatler et al., 2009). Hospital leaders took part in the non-profit Institute for Healthcare Improvement (IHI) collaborative efforts to reduce non-ICU cardiac arrests with emphasis on reducing in-hospital deaths (Hatler et al., 2009). The RRT was conceptualized as a consultative service bringing critical care experts to the medical-surgical patient's bedside (Hatler et al., 2009). Initiation of the RRT was designed to occur with one phone call to the house manager, a seasoned registered nurse, who would then activate the paging system for RRT responders (Hatler et al., 2009). RRT members provided necessary interventions and, if needed, assisted with the patient transfer to a higher level of care (Hatler et al., 2009). Drawing from reports in the literature, the design team determined that the RRT would include a registered nurse and a respiratory therapist with well-documented clinical expertise, especially related to cardiopulmonary assessment and intervention (Hatler et al., 2009). In addition, RRT members needed to be free of routine patient care responsibilities in order to respond in 5 minutes or less when summoned (Hatler et al., 2009). Additionally, RRT members required well-developed communication skills in order to interact with staff members in a professional and non-threatening manner and elicit concerns and observations in a non-judgmental manner (Hatler et al., 2009).

Criteria for a RRT request were built in 2003 following the guidelines outlined by the IHI. The physiologic parameters identified to initiate a RRT call were:

1. Heart rate less than 45 or greater than 120
2. Systolic blood pressure less than 90mmhg
3. Respiratory rate less than 10 or greater than 28
4. Oxygen saturation less than 90%
5. Decreased level of consciousness
6. Failure to respond to treatment for acute problem/symptom
7. Caregiver intuition
8. "It's better to call than not."

Information needed by the RRT members included the patient's medical history, medications received within the last 24 hours, results of the previous nursing assessment, and a description of recent events leading to the RRT call (Hatler et al., 2009).

Evaluation of the effectiveness of RRT deployment showed that the year before full implementation (May 2005 to April 2006) there were 23 adult cardiac arrests outside of ICU. After implementation (May 2006 to April 2007) only 16 adult cardiac arrests outside of ICU occurred; this represented a 32% decrease in non-ICU adult codes after implementation of the RRT (Hatler et al., 2009). Upon further evaluation, it was found that at the beginning of the pilot the RRT received an average of 8 calls per month; a year after implementation this number increased to approximately 15 calls per month (Hatler et al., 2009). Additionally, an 8-item survey was used to evaluate staff members' satisfaction with RRT response. The survey showed an overall staff satisfaction of 97%

in the pilot phase (Hatler et al., 2009). A next step identified by Halter et al. (2009) was the need to develop a more proactive method for identifying potential problems.

RRT Study Two

Despite strong theoretical benefit of the RRT concept, a recent review concluded that RRTs had not yet been shown to improve patient outcomes (Prado, Albert, Mehler, & Chu, 2009). In October 2006, Denver Health Medical Center, an academic safety net hospital, initiated a rapid response system – clinical triggers program [RRS-CTP] (Prado et al., 2009). In this RRS-CPT, an abrupt change in patient status triggered a mandatory call by the patient's nurse to the primary team, which was then required to perform an immediate bedside evaluation (Prado et al., 2009).

Prado et al. (2009) presented a case that illustrates the challenges to both implementing an RRS and measuring its potential benefits:

> A 59-year-old woman with a history of bipolar mood disorder was admitted for altered mental status. At presentation, she had signs of acute mania with normal vital signs. After initial laboratory workup, her altered mental status was felt to be multifactorial due to urinary tract infection, hypernatremia (attributed to lithium-induced nephrogenic diabetes insipidus), and acute mania (attributed to medication discontinuation). Because she was slow to recover from the acute mania, her hospital stay was prolonged. From admission, the patient was treated with heparin 5000 units subcutaneously twice daily for venous thromboembolism prophylaxis.

> On hospital day 7, at 21:32, the patient was noted to have asymptomatic tachycardia at 149 beats per minute and a new oxygen requirement of 3 L/min. The cross-cover team was called and although criteria were met, the RRS-CTP was not activated and a bedside evaluation was not performed. A chest X-ray was found to be normal and, with the exception of the oxygen requirements, her vital signs normalized by 23:45. No further diagnostic testing was performed at the time.
>
> The next morning at 11:58, the patient was found to have a blood pressure of 60/40 mmHg and heart rate of 42 beats per minute. The RRS-CTP was activated. The primary team arrived at the bedside at 12:00 and found the patient to be alert, oriented, and without complaints. Her respiratory rate was 30/minute, and her oxygen saturation was 86% on 3 L/min. An arterial blood gas analysis demonstrated acute respiratory alkalosis with hypoxemia and an electrocardiogram showed sinus tachycardia with a new S1Q3T3 pattern. A computed tomography angiogram revealed a large, nearly occlusive pulmonary embolus (PE) filling an enlarged right pulmonary artery. She was transferred to the medical ICU and alteplase was administered. The patient survived and was discharged in good clinical condition (p. 255).

If one considers a Rapid Response System (RRS) to include both "criteria recognition" and "RRT response" the "criteria recognition" must be consistently activated in order to obtain the "RRT response." The greatest opportunities to improve

RRSs are thought to lie in the "criteria recognition" (Prado et al., 2009). The RRS-CTP was not triggered in 1 of 2 instances in which criteria for mandatory initiation of the system were met; this is consistent with the findings for the Medical Early Response Intervention and Therapy (MERIT) trial, in which RRTs were called for only 41% of the patients meeting criteria and subsequently having adverse events (Prado et al., 2009). While rapid response criteria were originally based upon published sensitivity analyses, more recent studies have suggested that these criteria lack diagnostic accuracy (Prado et al., 2009). Given that the incidence of adverse events in the MERIT trial was only 0.6%, the resulting positive predictive value (PPV) of rapid response call criteria was 3%; accordingly, 33 calls would be needed to prevent one unplanned ICU transfer, cardiac arrest, or death (Prado et al., 2009). Nurses' attempts to minimize false-positive calls may help explain the low call rates for patients meeting RRT criteria (Prado et al., 2009). Regarding the RRT response, the case demonstrated that the primary team, when alerted appropriately, can respond effectively to critical change in patient status (Prado et al., 2009). Accordingly, the data showed that since the inception of the program, cardiopulmonary arrests have significantly decreased from a mean of 4.1 per month to a mean of 2.3 per month [$P \leq 0.03$] (Prado et al., 2009). While local needs should inform the type of RRS implemented, this case illustrated one of the major obstacles ubiquitous to RRS effectiveness: failure of system activation (Prado et al., 2009).

RRT Study Three

A study by Wynn, Engelke, and Swanson (2009) stated that although staff nurses played a critical role in recognizing the need for the RRT and initiating the call, little was

known about actions and perceptions of staff nurses in relation to the RRT. The purpose of the descriptive study was to examine the relationship between nurse educational preparation, years of experience, degree of engagement, and RRT call status (Wynn et al., 2009).

The population was staff nurses on adult general and intermediate care units at a large academic medical center in eastern North Carolina (Wynn et al., 2009). The sample was drawn from all staff nurses who participated in RRT calls on general or intermediate care units during a consecutive time period from September 2006 to February 2007 (Wynn et al., 2009). Data collection was conducted using four tools: (a) Manifestations of Early Recognition Scale; this scale represents three dimensions: (1) knowing the patient/family, (2) knowing the system/institution and pushing the boundaries of practice to obtain what patients need, and (3) knowing the skills of self; (b) the RRT Questionnaire, used to collect information about the pertinent nurse factors (educational preparation, years of experience, etc.) and pertinent work environment factors (nurse staffing rations, model of care, etc.); (c) the Pre-RRT Patient Condition Tool, a one-page instrument to collect pertinent data regarding patient condition in the hours before the RRT call; and (d) the RRT Documentation Tool, a two-page tool to collect information on the events that occurred during the RRT intervention with the patient (Wynn et al., 2009).

The main reason given when asked to identify the top three reasons for calling the RRT was "sudden change in patient condition," with 78% of the respondents having selected this as one of their top three reasons (Wynn et al., 2009). The second highest

reason was “steady decline in patient condition” at 56%, followed by “inadequate response from the physician” at 35% (Wynn et al., 2009). The majority of patients (73%, n = 55) had clinical changes documented at some time before the RRT call; in some cases (16%, n = 12), as long as 8 hours before the RRT was called (Wynn et al., 2009). In 37% (n = 28) of the calls, more than 2 hours passed between the time when the clinical changes were documented that the patient met RRT call criteria and when the RRT was actually notified (Wynn et al., 2009).

Data analysis showed independent callers were almost five times more likely to have a BSN degree and almost four times more likely to have more than 3 years of experience than did RNs who called because someone asked them to call (Wynn et al., 2009). Data analysis also showed caring was manifested by an involved stance by the nurse and was contrasted with situations where nurses were detached from their patients; in the detached relationship between the nurse and the patient, there were delays in recognizing patient problems, or recognition never occurred (Wynn et al., 2009). High levels of engagement were also significantly associated with call status but after controlling for educational level and nursing experience the relationship was not significant (Wynn et al., 2009). While engagement scores were related to independent calling in the bivariate analysis, the logistic regression suggests that education and experience were the most important predictors of independent calling of the RRT (Wynn et al., 2009).

A debriefing after the RRT response may help nurses understand the clinical antecedents in this type of patient situation (Wynn et al., 2009). Discussion could be

framed around categories of failure to plan, failure to communicate, and/or failure to recognize. This method of debriefing was supported by the Institute of Healthcare Improvement and can be used to identify missed opportunities for RRT activation and to educate staff about signs and symptoms to look for in future patient situations (Wynn et al., 2009).

Modified Early Warning Scores

MEWS Study One

According to Subbe, Kruger, Rutherford, & Gemmel, (2001) the Early Warning Score (EWS) is a simple physiological scoring system suitable for bedside application. The ability of the MEWS to identify medical patients at risk of catastrophic deterioration in a busy clinical area was investigated (Subbe et al., 2001). The EWS is a tool based on five physiological parameters: systolic blood pressure, pulse rate, respiratory rate, temperature, and AVPU score (Subbe et al., 2001). The ability of a modified EWS, including relative deviation from patients' normal blood pressure and urine output, to identify surgical patients who would potentially benefit from intensive care had been demonstrated (Subbe et al., 2001). However, none of the existing physiologic scoring systems had been validated in patients admitted on an unselected medical intake population (Subbe et al., 2001). The aims of this study were twofold: (a) to evaluate the ability of a modified EWS to identify medical patients at risk and (b) to examine the feasibility of MEWS as a screening tool to trigger early assessment and admission to a high dependency unit (HDU) or intensive care unit (ICU) (Subbe et al., 2001).

In a prospective cohort study, Subbe et al. (2001) applied MEWS to patients admitted to the 56-bed acute Medical Admissions Unit (MAU) of a District General Hospital (DGH). Data on 709 medical emergency admissions admitted to the MAU were collected during March 2000; patients admitted directly to Coronary Care, Medical HDU or ICU, and patients re-admitted during the observation period were not included in this study (Subbe et al., 2001). After appropriate training, nursing staff collected data (demographic details, systolic blood pressure, pulse rate, temperature, respiratory rate, and AVPU score) twice daily while performing routine duties. Data were recorded on a dedicated data collection sheet from admission up to 5 days post-admission (Subbe et al., 2001). Completeness of the data was checked daily at the bedside by two of the investigators (Subbe et al., 2001).

The collected data by Subbe et al. (2001) were used to calculate a Modified Early Warning Score [MEWS] (see Table 1). It was determined from previous experience that a MEWS of five or more was a "critical score" and the highest score reached during admission was labeled "ScoreMax" (Subbe et al., 2001). Primary endpoints were HDU admission, ICU admission, attendance of the cardiac arrest team at a cardiorespiratory emergency, and death at 60 days (Subbe et al., 2001).

Table 1

Modified Early Warning Score

	3	2	1	0	1	2	3
Systolic Blood Pressure (mmHg)	<70	71-80	81-100	101-199		≥200	
Heart Rate (bpm)		<40	41-50	51-100	101-110	111-129	≥130
Respiratory Rate (bpm)		<9		9-14	15-20	21-29	≥130
Temperature (°C)		<35		35-38.4		≥38.5	
AVPU Score				**A**lert	Reacting to **V**oice	Reacting to **P**ain	**U**nres-ponsive

The majority of patients in the study scored 0 on admission for blood pressure (91%), pulse rate (78%), temperature (95%), and AVPU score (92%); the median score for respiratory rate was 1 (55% of admissions) (Subbe et al., 2001). Admission scores ranged from 0 to 9 (Subbe et al., 2001). The percentage of patients with critical scores (5 or greater) was highest on the day of admission and gradually decreased over the period of stay from 7.1% on admission to 4.8% on Day 1, 3.9% on Day 2, and 1.8% on Day 3 (Subbe et al., 2001). In the 81 patients who remained in the MAU for a minimum of 3 days, scores stayed unchanged for 42, deteriorated in 12, and improved in 28 patients

(Subbe et al., 2001). During the observation period, the mean of the highest score reached was 2.29 [SD 1.51] (Subbe et al., 2001).

A ScoreMax of 5 or more was associated with an increased risk of death (OR 5.4, 95% CI 2.8–10.7), ICU admission (OR 10.9, 95% CI 2.2–55.6), and HDU admission (OR 3.3, 95% CI 1.2–9.2 (Subbe et al., 2001). Endpoints happened at a median of 4 days (0–45 days) after transfer from the MAU; 22 of the endpoints were reached while patients were in the MAU (Subbe et al., 2001). Endpoints were reached by 7.9% of patients with ScoreMax of 0 to 2, 12.7% of patients with a ScoreMax of 3 to 4, and 30% of patients with a ScoreMax of 5 to 9 (Subbe et al., 2001). Patients who reached predefined endpoints were significantly older and, on admission, had lower systolic blood pressure, higher pulse rate, and a higher respiratory rate (Subbe et al., 2001). Whereas high MEWS scores were associated with increased risk to reach endpoints, increased scores for single parameters did not always translate into an increased overall risk (Subbe et al., 2001). Modified Early Warning Score was best regarded as a defined judgment on routinely recorded physiological data (Subbe et al., 2001). Using previously published scoring criteria, this study demonstrated that higher MEWS scores were associated with increased mortality in a group of medical emergency patient admissions (Subbe et al., 2001). There were limited previous data concerning other scoring systems and patients admitted via a general medical ‘take’ (Subbe et al., 2001). For example, the Acute Physiology and Chronic Health Evaluation (APACHE) II Score and Mortality Prediction Model (MDM) have only been tested for subgroups of medical patients with acute renal and congestive heart failure (Subbe et al., 2001). The Simplified Acute Physiology Score

(SAPS) was introduced in 1984 to estimate the risk of death for patients in intensive care, and has since been improved and tested in patients with myocardial infarction (Subbe et al., 2001). A reduced version (SAPS.R) has been shown to predict outcome accurately in ICU patients but has not been applied to general medical patients (Subbe et al., 2001). None of the available scoring systems appeared to be suitable for bedside assessment of medical surgical patients in a routine fashion (Subbe et al., 2001). MEWS is likely to present a more versatile tool in this context, since it simply collates the results of routinely collected variables (Subbe et al., 2001). MEWS can be applied easily in a DGH medical admission unit and identifies patients at risk of deterioration who require increased levels of care in the HDU or ICU (Subbe et al., 2001).

MEWS Study Two

A study by Odell et al. (2009) was completed to identify and critically evaluate research investigating nursing practice to detect and manage deteriorating general patients. Failure to recognize or act on deterioration of medical surgical patients has resulted in the implementation of early warning scoring systems and critical care outreach teams; however, the effectiveness of these systems has remained unclear (Odell et al., 2009). Literature was searched between 1990 and 2007; 14 studies met the inclusion and quality criteria, and the findings were grouped into four main themes: recognition, recording and reviewing, reporting, and responding and rescuing (Odell et al., 2009).

The findings from the theme of "recognition" suggested that nurses were key players in detecting deteriorating patients. Deterioration was reported as uncommon and inherently difficult to detect and nurses were not used to acute emergencies (Odell et al.,

2009). The evidence suggested that deteriorating medical surgical patients were recognized by nurses through three processes: intuition or knowing that something was not right; patient and/or family raising concerns; and coming across the patient through routine observation (Odell et al., 2009).

The findings from the theme of "recording and reviewing" were that routine recording of vital signs was a ritualistic practice that has become task oriented and was often delegated to healthcare assistants (Odell et al., 2009). The result was an absence or infrequency of vital sign recording, and lack of the required skill and knowledge to determine actions when vital signs deviated from the norm (Odell et al., 2009). Equipment played an important role in nurses' assessment of patients (Odell et al., 2009). Issues with equipment, such as limited access, missing accessories, broken equipment, and lack of maintenance and quality control of the equipment were reported (Odell et al., 2009). Equipment issues were also seen to reduce the time and contact nurses had with patients (Odell et al., 2009).

The findings from the theme of "reporting" were that it was unclear as to which sites had a Rapid Response System in place (Odell et al., 2009). However, when the RRS was in place, nurses reported confidence and authority to call for help (Odell et al., 2009). However, nurses reported that the decision to call for help was not lightly taken (Odell et al., 2009). Feeling worried about doing the right thing and looking stupid in front of medical colleagues, nurses sought the opinions of others and may have waited to see if the patient's condition worsened before calling the medical team (Odell et al., 2009). Additionally, data found delays in calling for help, non-compliance with calling criteria,

and lack of knowledge about the hospital's RRSs were found (Odell et al., 2009). Nurses had difficulty in articulating subtle changes in a patient's condition but recognized the need to persuade doctors to review their patients by using medical language. More experienced nurses were more likely to use medical language and were more assertive while less experience nurses waited for assistance (Odell et al., 2009).

The findings from the theme of "responding and rescuing" were that nurses may initiate treatment measures such as increasing oxygen levels and fluid rates before calling the doctor (Odell et al., 2009). This sometimes was construed as stepping outside medical prescriptions but was justified with reference to the perceived difficulties in getting a doctor to attend and the seeming lack of knowledge and experience of junior medical staff (Odell et al., 2009).

The results of this study showed that nursing staff on medical surgical units were struggling to detect and manage deteriorating patients adequately but were hampered by inexperience, lack of skill, and excessive workloads (Odell et al., 2009). Nurses failed to detect, respond to, and reported abnormal vital signs and patient deterioration (Odell et al., 2009). The main findings suggested that intuition played an important part in nurses' detection of deterioration, and vital signs were used to validate intuitive feelings (Odell et al., 2009). There was an understanding that deterioration of medical surgical patients was commonly detected through routine vital sign observations (Odell et al., 2009).

MEWS Study Three

Wolfenden, Dunn, Holmes, Davies, and Buchan (2010) performed a study in Powys which is the largest county in Wales, covering more than 2,000 square miles. It is

a rural community and one of the least sparsely populated local authority areas in England and Wales. The literature review from this study reported that numerous systems for physiologic observations at the bedside exist and have been reviewed (Wolfenden et al., 2010). There was evidence that simpler systems have better reliability and reproducibility (Wolfenden et al., 2010). However, early warning systems were not always used to their full potential and considerations needed to be given as to how the system best met local requirements (Wolfenden et al., 2010). Some systems used only late signs of a deteriorating clinical condition, but research results supported the inclusion of early signs (Wolfenden et al., 2010). The aim of this study by Wolfenden et al. (2010) was to develop and promote a track and trigger system appropriate for the needs of Powys rural community hospitals based on existing MEWS. A senior doctor and a member of the senior nursing staff assessed the MEWS that were being used in each of the five surrounding district general hospitals (Wolfenden et al., 2010). Respiratory rate was regarded as the most sensitive marker for clinical deterioration, but it was also the most poorly monitored (Wolfenden et al., 2010). The authors' initial observations confirmed that respiratory rate was the least accurately and least regularly recorded physiological variable (Wolfenden et al., 2010). There was concern that small changes in respiratory rate, for example an increase caused by anxiety, would result in 'false' triggers; therefore, small changes in respiratory rate were not scored (Wolfenden et al., 2010).

The piloted version of the MEWS form was simplified and the scoring criteria were adapted so that all stable patients would score 0 and a score of 3 or more would

trigger an 'action' but any score above 0 would raise nursing concern (Wolfenden et al., 2010). Adapting and simplifying the scoring system was aimed at flagging those patients who were deteriorating to empower staff to make decisions and, by having a meaningful system, to avoid complacency (Wolfenden et al., 2010). There would not, however, be complete reliance on the scoring system; common sense was not to be abandoned (Wolfenden et al., 2010). The form, therefore, emphasized that the scores did not replace clinical judgment, but informed and supported decision-making (Wolfenden et al., 2010).

An initial pilot study was carried out in one community hospital; a senior nurse and doctor reviewed the physiologic variables on 150 patients (Wolfenden et al., 2010). Using PDSA (Plan, Do, Study, Act) methodology, different versions of the track and trigger form were drafted; it was important that patients who were believed by the nursing and medical staff to be clinically stable were always scored as 'stable' (Wolfenden et al., 2010). Following the pilot studies, the form was rolled out to all community hospitals in Powys and a subsequent audit was carried out to check form completion as a further incentive to encourage its use (Wolfenden et al., 2010). The modified form was called 'track and trigger' to differentiate it from other versions of MEWS (Wolfenden et al., 2010). The track and trigger scoring system algorithm form included directions such as a “Score 8 or more, repeat after 3 to 5 minutes and have urgent conversation with doctor to decide if urgent transfer required” and “Score 4 to 7, repeat after 5 to 10 minutes and call doctor, ask to visit within an hour,” and “Score 3, hourly observation and tell nurse in charge, if still scores 3 after one hour call doctor to visit” and “Score less than 3 but causing concern, hourly observation, tell nurse in charge,

if score increases or remains 2 and still concerned after two hours call doctor to visit" (Wolfenden et al., 2010).

The scoring system has proven useful in the assessment of patients and has ensured timely, appropriate, and safe transfer to a district general hospital (Wolfenden et al., 2010). The use of the track and trigger scoring system has been extended; hospitals wishing to transfer patients back to a Powys community hospital were asked to provide an up-to-date set of observations and from these data a score was deduced. If the score was 3 or more, transfer may be deemed inappropriate (Wolfenden et al., 2010). Consideration was being given to using this system in the community to determine the suitability of direct inpatient admissions and an audit program has now been agreed upon to ensure the appropriate use of the forms (Wolfenden et al., 2010).

MEWS Study Four

Rapid Response Teams (RRTs) responded to critically ill patients in the hospital, however, activation of RRTs was highly subjective and missed a proportion of at-risk patients (Kho et al., 2007). The study by Kho et al. (2007) created an automated scoring system for non-ICU inpatients based on readily available electronic vital signs data, age, and body mass index. The Modified Early Warning Score has been proposed as a simple bedside scoring system to identify patients at risk for subsequent deterioration (Kho et al., 2007). The MEWS took into account five physiologic parameters: systolic blood pressure, pulse rate, respiratory rate, temperature, and mental status (Kho et al., 2007). At Northwestern Memorial Hospital (NMH), bedside nurses piloted a paper data collection form of the MEWS over 2 weeks, but abandoned this approach due to

excessive burden on nursing staff (Kho et al., 2007). It was hypothesized that an automatically generated score based on readily available data from an electronic medical record would accurately detect patients at risk for cardiopulmonary collapse, death, or transfer to an intensive care unit (Kho et al., 2007). The RRT at NMH consisted of five nurses with a collective 79 years of ICU experience and could be activated by any patient care provider (nurses or physicians) concerned about the state of any patient admitted to NMH (Kho et al., 2007). In place since 2006, the RRT at NMH responded to an average of three to five calls per day (Kho et al., 2007). The scoring system was based on the previously validated MEWS (Kho et al., 2007). Within the EMR, patient mental status was infrequently recorded, so AVPU was removed (Kho et al., 2007). A retrospective analysis of prior RRT calls was performed to determine the common data elements that triggered a call to the RRT in the population (Kho et al., 2007). Experienced clinicians have excellent ability to identify a deteriorating patient based on subtle signs and symptoms not easily captured electronically (Kho et al., 2007). The scoring system detected a greater number of at-risk patients (54% sensitivity compared with 22% for standard medical surgical initiated RRT calls), at the tradeoff of numerous false positives (Kho et al., 2007). One patient who progressed to cardiopulmonary arrest did so without preceding vital sign abnormalities (Kho et al., 2007). No detection system is perfect, although a combination of the two systems, automated surveillance with human adjudication of suspected at-risk patients, may ideally balance sensitivity and specificity better than either system alone (Kho et al., 2007).

Summary

According to the literature, effective observation of patients experiencing clinical deterioration was the first key step in identification prior to effectively managing their care; however, many times these detectable physiologic signs and symptoms can be overlooked, neglected, and/or poorly managed. To reduce the occurrence of suboptimal care in adults, systems for identifying patients at risk of critical events have been developed, including Rapid Response Teams and the use of the Modified Early Warning Score.

CHAPTER III

METHODOLOGY

This retrospective, descriptive study was designed to (a) determine if the Modified Early Warning Score risk assessment tool identified moderate to high risk patients prior to the activation of the Rapid Response Team; and (b) to determine how much time occurred from the onset of clinical deterioration until activation of the Rapid Response Team. A Modified Early Warning Score was given at the time of the Rapid Response Team activation as well as every prior documented instance of vital signs prior to the Rapid Response Team call until the Modified Early Warning Score reached a low risk score of 0 to 1.

Setting

The setting of this study was Immanuel St. Joseph's – Mayo Health System which is a 200-bed regional medical center in rural southern Minnesota. Immanuel St. Joseph's - Mayo Health System is a not-for-profit health care system comprised of 4 hospitals and 17 clinics, providing chronic, urgent, and preventive services to a regional population of over 260,000 people in 13 south central Minnesota counties. The majority of the Subjects included in the study were from the in-patient setting at Immanuel St. Joseph's – Mayo Health System hospital however, some subjects were from ambulatory settings such as the dialysis unit and attached clinics that are within the hospital structure.

Population and Sample

Subjects were patients from multiple medical surgical units including 2MS (second floor), a unit with the majority of ortho, neuro, and trauma patients; 3MS (third

floor), a unit with the majority of cardiac and pulmonary patients; 4MS (fourth floor), a post-surgical unit; and the Women's unit (fifth floor) with the majority of patients hospitalized after having post-gynecological procedures/surgeries. An approximate average of two Rapid Response Team activations occurred daily with a total of 598 activations within the 12 month timeframe of this study. The convenience sample was selected from patients between the ages of 18 and 99 years of age who had experienced a Rapid Response Team activation between October 1, 2009 and September 30, 2010. These data were obtained from Rapid Response Record forms. A total of 128 subjects were recruited for this study but after elimination of subjects declining authorization for medical record data to be used for research, 20 were eliminated leaving a total sample size of 108.

Protection of Human Subjects

An Application for the Conduct of Research Involving Human Subjects was submitted to the Minnesota State University, Mankato Institutional Review Board as well as the Immanuel St. Joseph's – Mayo Health System Institutional Review Board with approvals granted at both institutions (see Appendix A). Arrangements were made with the Patient Care Manager of the Intensive Care Unit to obtain subjects from the Rapid Response Records. Subjects whose charts are included in the research had signed and authorized a form titled, "Authorization for Immanuel St. Joseph's – Mayo Health System to Use Medical Information for Medical Research" (see Appendix B). Confidentiality of subjects was preserved by assigning a number to each subject so no

names were extracted from reviewed patient charts. No information that would permit identification of specific individuals was collected.

Instruments

Data were collected using the Modified Early Warning Score Data Collection Tool (see Appendix C). The Modified Early Warning Score Data Collection Tool consisted of an Excel spreadsheet containing data fields for:

1. Demographic information including date and time of RRT activation, the unit in which the RRT activation occurred, and the age and gender of subject.
2. "Rationale for the RRT activation" which was categorized into four body systems including (a) respiratory, (b) cardiac, (c) neurologic, and (d) other.
3. "Outcome of the RRT activation" with four options including, (a) remain on unit, (b) transfer to higher level of care, (c) transfer to ICU, and (d) death.
4. Primary admitting diagnosis.
5. Modified Early Warning Score data including systolic blood pressure, heart rate, respiratory rate, temperature, and AVPU (**A**lert, responds to **V**erbal stimuli, responds to **P**ainful stimuli, and **U**nresponsive).
6. Long-term outcome of death identified: upon review of the subject's medical records a communication appeared stating that the subject was deceased and a date of expiration was documented.

Data Collection

At the completion of every Rapid Response Team activation, the Rapid Response Nurse filled out a form titled, "Rapid Response Record," which included pertinent patient

information regarding the rationale for the activation. Arrangements were made with the Patient Care Manager of the Intensive Care Unit to obtain subjects from the Rapid Response Records between October 1, 2009 and September 30, 2010. Approximately 10 to 12 Rapid Response Records were chosen each month for 12 months for a total of 128 subjects. After review of authorization from subjects, 20 subjects were eliminated leaving a total sample size of 108.

Treatment of Data

All subject data will be stored in a locked file cabinet in the principal investigator's office for 3 years, and all information will be disposed of in a confidential manner after this timeframe has passed.

CHAPTER IV

ANALYSIS OF DATA

This chapter contains a report of the results of the data analysis. A description of the sample and the findings are presented, concluding with a summary of the findings.

Description of Sample

There was a total of 108 subjects studied ranging in age from 21 years old to 96 years old with an average age of 65.57 years of age. There were 54.6% (n = 59) female subjects and 45.4% (n = 49) male subjects. The 2MS unit (ortho, neuro, trauma) had 35.2% (n = 38) of the total RRT calls studied; the 3MS unit (cardiac and pulmonary) had 28.7% (n = 31) of the total RRT calls studied; the 4MS unit (surgical) had 30.6% (n = 33) of the total RRT calls studied; the Women's unit (post-gynecological/surgical) had 3.7% (n = 4) of the total RRT calls studied; the Dialysis unit had 0.9% (n = 1) of the total RRT calls studied; and the Endoscopy unit had 0.9% (n = 1) of the total RRT calls studied (see Table 2).

Table 2

RRT Calls Per Unit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dialysis	1	.9	.9	.9
	2MS	38	35.2	35.2	36.1
	3 MS	31	28.7	28.7	64.8
	4 MS	33	30.6	30.6	95.4
	Women's Unit	4	3.7	3.7	99.1
	Endo	1	.9	.9	100.0
	Total	108	100.0	100.0	

Findings/Results

This section discusses the most frequent times/shifts in which the RRT was activated. The most frequent time for RRT activations was between the hours of 1500 and 2300 with 41.76% (n = 45) of the RRT calls; however, between 1500 and 1900 there were 25% (n = 27) of the total RRT activations, whereas between 1900 and 2300 there were 16.67% (n = 18) of the RRT activations. The second most frequent time for the RRT activation was between the hours of 0700 and 1500 with 38.89% (n = 42) of the total RRT calls; however, between 0700 and 1100 there were 23.15% (n = 25) of the total RRT activations, whereas between 1100 and 1500 there were 15.74% (n = 17) of the RRT calls. The least frequent time for the RRT activation was between 2300 and 0700 with a total of 19.44% (n = 21) of the RRT activations.

Table 3

RRT Call Times

Day Shift 0700-1500	**42 (38.89%)**
0700-1100	25 (23.15%)
1100-1500	17 (15.74%)
Evening Shift 1500-2300	**45 (41.67%)**
1500-1900	27 (25.00%)
1900-2300	18 (16.67%)
Night Shift 2300-0700	**21 (19.44%)**
2300-0300	11 (10.19%)
0300-0700	10 (9.26%)

The results showed the most frequent reason for an activation of the RRT was "cardiac" in nature with 44.4% (n = 48); the second most frequent reason for activation of the RRT was "respiratory" in nature with 27.8% (n = 30), however, there were two RRT calls activated for both "cardiac" and "respiratory" which accounted for 1.9% (n = 2) of the total RRT calls. The third most frequent reason for activating the RRT was "neurologic" with 18.5% (n = 20). The fourth most frequent reason for activating the RRT was "other" with 5.6% (n= 6), and the fifth most frequent reason for activating the RRT was "metabolic" with 1.9% (n = 2) of the activations.

The majority of subjects, 75.9% (n = 82), remained on the unit to which the RRT was called. Seven subjects were transferred to a higher level of non-ICU care (6.5%), while 16 were transferred to the intensive care unit (14.8%). Only one subject (0.9%) was transferred to a different facility for a higher level of care. The outcome of two (1.9%) subjects after the RRT was initiated was death.

This section summarizes the MEWS at the time of the RRT call, which reflects the most frequent scores of deterioration when the RRT was activated (see Table 4). The MEWS ranged from 0 to 10 with 10 being the highest score. Of the 108 subjects studied, the most frequent MEWS was a 1 with 31.5% (n = 34) of the subjects; the second most frequent MEWS was a score of 2 with 22.2% (n = 24); the third most frequent MEWS was a score of 4 with 19% (n = 19); the fourth most frequent score was a 3 with 11.1% (n = 12); the fifth most frequent score was a 5 with 6.5% (n = 7); the sixth most frequent score was a 6 with 4.6% (n = 5); the next three most frequent scores were 0, 7, and 8 each with 1.9% (n = 2); and the least frequent score of a 10 was given to one subject (0.9%).

Table 4

MEWS at Time of RRT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	2	1.9	1.9	1.9
	1	34	31.5	31.5	33.3
	2	24	22.2	22.2	55.6
	3	12	11.1	11.1	66.7
	4	19	17.6	17.6	84.3
	5	7	6.5	6.5	90.7
	6	5	4.6	4.6	95.4
	7	2	1.9	1.9	97.2
	8	2	1.9	1.9	99.1
	10	1	.9	.9	100.0
	Total	108	100.0	100.0	

The next section shows the MEWS at the time of the RRT with further data per unit. This information will be useful to determine volume and acuity of RRT activations (see Table 5). Unit 2MS experienced 38 RRT activations, ten RRT activations had a score of 1; ten RRT activations had a score of 2; four RRT activations had a score of 3; seven RRT activations had a score of 4; two RRT activations had a score of 5; three RRT activations had a score of 6; one RRT activation had a score of 7; and one RRT activation had a score of 8. Unit 3MS experienced 31 RRT activations during the study period. One subject had a score of 1; seven subjects with RRT activations had a score of 2; eight subjects had a score of 3; three subjects had a score of 4; eight subjects had a score of 5;

two subjects had a score of 6; one subject had a score of 8; and one subject had a score of 9. Unit 4MS experienced 33 RRT activations during the study period, one subject had a score of 1; twelve subjects had score of 2; eight subjects had a score of 3; five subjects had a score of 4; four subjects had a score of 5; three subjects had a score of 6; two subjects had a score of 7; and one subject had a score of 10. The Women's Unit experienced 4 RRT activations during the study period, three subjects had a score of 2; one subject had a score of 3. The Dialysis unit experienced one RRT activation, which had a score of 1. The Endoscopy unit experienced one RRT activation, which had a score of 1.

Table 5

MEWS at Time of RRT Per Unit

		MEWS at Time of RRT										
Count		0	1	2	3	4	5	6	7	8	10	Total
RRT	Dialysis	0	1	0	0	0	0	0	0	0	0	1
MEWS	2MS	0	10	10	4	7	2	3	1	1	0	38
Per	3MS	1	7	8	3	8	2	0	1	1	0	31
Unit	4MS	1	12	5	5	4	3	2	0	0	1	33
	Women's U	0	3	1	0	0	0	0	0	0	0	4
	Endo	0	1	0	0	0	0	0	0	0	0	1
Total		2	34	24	12	19	7	5	2	2	1	108

Note: This table shows the unit on which the RRT was initiated and the MEWS score at the time of the RRT call.

The next section shows the average length of time from the MEWS at the time of the RRT activation to previous MEWS retrospectively until a low risk score of 0 to1 or the lowest score possible was assigned (see Table 6). This represents the amount of time deterioration could have potentially been detected earlier if a MEWS system had existed. Out of the 108 subjects, 36 subjects had a low risk (score 0 to 1) MEWS at the time of the RRT activation; one subject had a high risk score of 4, however, this score was given at the time of admission which left no previous vitals/MEWS to be assessed; the remaining 71 subjects had a moderate (score of 2 to 3) or high (score 4 or greater) risk MEWS at the time of the RRT activation. The average amount of time for all 71 subjects to reach their lowest MEWS was 608.15 minutes (10.14 hours). Table 5 shows further breakdown for the 71 subjects, including their lowest MEWS and average time to achieve this score. Three subjects had an average time of 651.00 minutes (10.85 hours) before their lowest MEWS was 0. There was an average of 610.50 minutes (10.18 hours) before 60 subjects reached their lowest MEWS of a 1; there was an average of 539.00 minutes (8.98 hours) before 2 subjects reached their lowest MEWS of 2; there was an average of 149.00 minutes (2.48 hours) before 2 subjects reached their lowest MEWS of 3; and there was an average of 805.00 minutes (13.42 hours) before 4 subjects reached their lowest MEWS of 4.

Table 6

MEWS at RRT Activation Time to Previous MEWS Retrospectively until a Low Risk Score of 0 to 1 or Lowest Score Possible Assigned

MEWS	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
0	3	651.00	423.210	244.341	173	978
1	60	610.50	682.332	88.089	89	4926
2	2	539.00	294.156	208.000	331	747
3	2	149.00	32.527	23.000	126	172
4	4	805.00	491.435	245.718	227	1354
Total	71	608.15	646.214	76.691	89	4926

This section discusses the frequency of vital signs/MEWS tabulated from the 71 subjects that had a MEWS of 2 or greater at the time of the RRT activation and represents the average amount of time between vital signs/MEWS collected. The average length of time was tabulated from the initial time of the RRT activation. The first previous set of vital signs was labeled Pre1 MEWS and had an average time of 277.04 minutes (4.62 hours) between the Pre1 MEWS and the MEWS at the time of the RRT activation (see Table 7).

Table 7

Pre1 MEWS to MEWS Times

Pre1	MEWS at Time of RRT	Mean	Std. Deviation	N
0	3	173.00		1
	8	172.00		1
	Total	172.50	.707	2
1	2	230.64	92.780	11
	3	281.20	159.547	5
	4	296.90	131.403	10
	5	281.00		1
	6	436.50	193.040	2
	7	158.50	98.288	2
	8	504.00		1
	Total	277.72	133.007	32
2	2	273.57	100.427	7
	3	239.40	70.833	5
	4	326.25	141.507	4
	5	158.00	62.225	2
	6	269.50	71.418	2
	Total	263.60	100.348	20
3	2	228.33	28.868	3
	3	469.00		1
	4	407.50	321.734	2
	5	663.50	164.756	2

Table 7 *(continued)*

Pre1	MEWS at Time of RRT	Mean	Std. Deviation	N
	Total	412.00	227.821	8
4	4	204.00		1
	5	247.00	33.941	2
	6	320.00		1
	Total	254.50	51.978	4
5	3	44.00		1
	4	104.00		1
	Total	74.00	42.426	2
6	10	150.00		1
	Total	150.00		1
Total	2	244.62	88.621	21
	3	253.00	136.482	13
	4	299.83	151.964	18
	5	345.43	233.914	7
	6	346.40	133.347	5
	7	158.50	98.288	2
	8	338.00	234.759	2
	10	150.00		1
	Total	277.04	142.704	69

The previous set of vital signs taken before the Pre1 MEWS was called the Pre2 MEWS with an average time of 316.78 minutes (5.28 hours) between the Pre2 MEWS and the Pre1 MEWS (see Table 8).

Table 8

Pre2 MEWS to Pre1 MEWS Times

Pre2	Pre1	Mean	Std. Deviation	N
1	1	521.00		1
	2	332.18	141.950	11
	3	564.50	99.702	2
	4	226.00		1
	5	502.00		1
	Total	377.00	155.565	16
2	2	279.67	149.108	6
	3	253.67	75.115	3
	4	415.00		1
	Total	285.40	125.815	10
3	2	260.50	4.950	2
	3	337.00		1
	4	241.50	34.648	2
	6	339.00		1
	Total	280.00	48.332	6
4	2	219.00		1
	3	238.00		1
	5	123.00		1

Table 8 (continued)

Pre1	MEWS at Time of RRT	Mean	Std. Deviation	N
	Total	193.33	61.647	3
7	3	258.00		1
	Total	258.00		1
Total	1	521.00		1
	2	303.60	132.979	20
	3	340.37	151.903	8
	4	281.00	91.837	4
	5	312.50	267.993	2
	6	339.00		1
	Total	316.78	136.268	36

The previous set of vital signs taken before the Pre2 MEWS was labeled the Pre3 MEWS with an average time of 304.44 minutes (5.07 hours) between the Pre3 MEWS and the Pre2 MEWS (see Table 9).

Table 9

Pre3 MEWS to Pre2 MEWS Times

Pre3	Pre2	Mean	Std. Deviation	N
0	2	466.00		1
	Total	466.00		1
1	2	452.33	92.425	3
	4	231.00		1
	Total	397.00	133.948	4
2	2	127.00		1
	3	215.25	33.140	4
	Total	197.60	48.799	5
3	2	295.33	140.015	3
	4	251.00		1
	Total	284.25	116.451	4
4	2	739.00		1
	3	203.00	80.610	2
	7	156.00		1
	Total	325.25	280.608	4
Total	2	397.22	190.759	9
	3	211.17	44.705	6
	4	241.00	14.142	2
	7	156.00		1
	Total	304.44	164.686	18

The previous set of vital signs taken before the Pre3 MEWS was labeled the Pre4 MEWS with an average time of 267.44 minutes (4.46 hours) between the Pre3 MEWS and the Pre4 MEWS (see Table 10).

Table 10

Pre4 MEWS to Pre3 MEWS Times

Pre4	Pre3	Mean	Std. Deviation	N
0	2	218.00		1
	Total	218.00		1
1	2	237.50	10.607	2
	3	260.67	50.023	3
	Total	251.40	37.951	5
3	2	213.00		1
	3	473.00		1
	Total	343.00	183.848	2
4	4	246.00		1
	Total	246.00		1
Total	2	226.50	14.248	4
	3	313.75	113.752	4
	4	246.00		1
	Total	267.44	83.044	9

The final section discusses the average time elapsed from the time of the RRT activation to previous retrospective MEWS scores and is differentiated by low, moderate, or high risk MEWS. A score of 0 to 1 indicated a low risk MEWS, a score of 2 to 3 indicated a moderate risk MEWS, and a score of 4 or higher indicated a high risk MEWS. These data represent the amount of time deterioration could have potentially been detected and differentiated by risk levels. When a low risk MEWS was tabulated, there was an average of 583.31 minutes (9.72 hours) prior to the activation of the RRT team (see Table 11).

Table 11

Low Risk MEWS Timeframe Prior to the RRT Activation

MEWS from 0 or 1	MEWS at Time of RRT	Mean	Std. Deviation	N
0	2	802.00		1
	3	575.50	569.221	2
	Total	651.00	423.210	3
1	2	414.80	306.801	20
	3	529.64	331.622	11
	4	538.76	436.508	17
	5	746.75	510.316	4
	6	1546.40	1922.128	5
	7	158.50	98.288	2
	8	338.00	234.759	2
	10	969.00		1
	Total	580.03	672.265	62

Table 11 (continued)

MEWS from 0 or 1	MEWS at Time of RRT	Mean	Std. Deviation	N
Total	2	433.24	310.741	21
	3	536.69	344.880	13
	4	538.76	436.508	17
	5	746.75	510.316	4
	6	1546.40	1922.128	5
	7	158.50	98.288	2
	8	338.00	234.759	2
	10	969.00		1
	Total	583.31	660.741	65

When a moderate risk MEWS was tabulated, there was an average of 365.33 minutes (6.09 hours) prior to the activation of the RRT team (see Table 12).

Table 12

Moderate Risk MEWS Timeframe Prior to the RRT Activation

MEWS from 2 or 3	MEWS at Time of RRT	Mean	Std. Deviation	N
2	3	271.00	12.728	2
	4	326.25	141.507	4
	5	158.00	62.225	2
	6	424.67	273.460	3
	Total	312.45	174.170	11

Table 12 (continued)

MEWS from 2 or 3	MEWS at Time of RRT	Mean	Std. Deviation	N
3	4	262.00	137.721	3
	5	621.33	137.500	3
	10	489.00		1
	Total	448.43	212.661	7
Total	3	271.00	12.728	2
	4	298.71	132.340	7
	5	436.00	273.541	5
	6	424.67	273.460	3
	10	489.00		1
	Total	365.33	196.108	18

When a high risk MEWS was tabulated, there was an average of 238.20 minutes (3.97 hours) prior to the activation of the RRT team (see Table 13).

Table 13

High Risk MEWS Timeframe Prior to the RRT Activation

MEWS from 4 or 5	MEWS at Time of RRT	Mean	Std. Deviation	N
4	4	227.00		1
	5	247.00	33.941	2
	6	320.00		1
	Total	260.25	45.383	4

Table 13 (continued)

MEWS from 2 or 3	MEWS at Time of RRT	Mean	Std. Deviation	N
6	10	150.00		1
	Total	150.00		1
Total	4	227.00		1
	5	247.00	33.941	2
	6	320.00		1
	10	150.00		1
	Total	238.20	63.053	5

Summary of Findings

This chapter contained a report of the results of the data analysis including subject's age and gender, times of most frequent RRT activations, frequency of RRT activations per unit, reason and outcomes for the RRT activations, an overall summary and unit breakdown of MEWS at the time of the RRT activation, and the average time deterioration could have potentially been detected and differentiated by low, moderate, and high risk levels.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

This study was designed to determine if the Modified Early Warning Score risk assessment tool identified moderate to high risk patients prior to the activation of the Rapid Response Team. The second goal of this study was to determine how much time elapsed between the onset of clinical deterioration and activation of the Rapid Response Team activation. A Modified Early Warning Score (MEWS) was applied to a convenience sample of 108 adult patients between the ages of 21 and 96 years of age who had experienced an activation of the Rapid Response Team at Immanuel St. Joseph's – Mayo Health System hospital in the time period between October 1, 2009, and September 30, 2010. A risk assessment score was given at the time of the RRT activation as well as at every documented instance of vital signs prior to the RRT activation call until the MEWS score reached a low risk score of 0 to 1. This chapter details the conclusions based on the research findings and recommendations for nursing practice research, and education.

Discussion of Findings

The average age of the subjects was 65.6 years, with a relatively equal split between females (54.6%) and males (45.4%). The units that activated the RRT most frequently were the medical surgical units (see Table 2); the 2MS unit (ortho, neuro, and trauma) had 35.2% (n = 38) of the total RRT calls studied; the 3MS unit (cardiac and pulmonary) had 28.7% (n = 31) of the total RRT calls studied; and the 4MS unit (surgical) had 30.6% (n = 33) of the total RRT calls. The Women's unit had very few

RRT activations with only 3.7% (n = 4) of the total RRT activations, which may represent its generally healthier patient population. It could also signify the RRT was not utilized to its potential. However, both the Dialysis and Endoscopy units only had one RRT activation, which likely signifies a clinically stable patient population.

The RRT was activated most frequently between the hours of 1500 and 1900 with 25% (n = 27) of the total RRT activations (see Table 3). The second most frequent RRT activation time was between the hours of 0700 and 1100 with 23.15% (n = 25) of the total RRT activations. These data show the RRT was activated within the first hours of an on-coming shift. This may be secondary to a lack of recognition of clinical deterioration by the off-going nurse and/or a fresh perspective of assessment and interpretation by the on-coming nurse. A study by Prado et al., (2009), similarly found that the greatest opportunities to improve Rapid Response Systems are thought to lie in the "criteria recognition." Another study concluded that one of the major obstacles ubiquitous to Rapid Response Systems effectiveness was failure of system activation (Prado et al., 2009). An additional consideration for RRTs activated within the first hours of an on-coming shift may be lack of optimal nurse-to-nurse communication during shift report resulting in sub-optimal nursing care.

The most frequent reason for activating the RRT was cardiac in nature (44.4%) with respiratory events (27.8%) as the second most frequently cited reason. The majority of subjects (75.9%) remained on the unit; this signifies that RRT activation was successful, as the patient did not require a higher level of care. This finding is similar to a finding from a study completed by Prado et al., (2009) which concluded that when the

RRT was alerted appropriately, the team can respond effectively to critical change in patient status.

There were seven subjects (6.5%) that required a higher level of non-ICU care. These patients typically had some sort of cardiac event that required medications only administered on the 3MS unit. There were 16 subjects (14.8%) requiring a higher level of ICU care; these transfers to the ICU may have been due to a late activation of the RRT requiring more rapid and aggressive interventions. Two subjects (1.9%) died after the activation of the RRT; one subject's status was DNR and the other subject experienced flash pulmonary edema requiring intubation. Secondary to the measures necessary to stabilize the subject, the decision was made to change the subject to a DNR status.

The MEWS at the time of the RRT call reflected the most frequent scores of deterioration when the RRT was activated (see Table 4). The MEWS ranged from 0 to 10 with 10 being the highest score. Out of 108 subjects studied, the most frequent MEWS was a 1 with 31.5% (n = 34); there were also 2 MEWS of 0 at the time of the RRT activation. This finding means that 33.4% (n = 36) of RRT activations had a MEWS of 0 or 1, which is a low risk score signifying minimal to no clinical deterioration. The low risk score data was viewed by unit and showed that 2MS had 10 (9.26%) low risk MEWS, 3MS had 8 (7.40%) low risk MEWS, and 4MS had 13 (12.04%) low risk MEWS. This likely reflects a young nursing staff having sought guidance and reassurance from the RRT. This reflection is supported in a study that concluded education and experiences were the most important predictors of independent call of the RRT (Wynn et al., 2009). In another study completed by Odell et al., (2009),

the data indicated that more experienced nurses were more likely to use medical language and were more assertive, while less experience nurses waited for assistance. One of the RRT activation criteria is "caregiver intuition" and "it's better to call than not." However, the number of low risk RRT activations signifies an opportunity to increase decision-making and critical thinking skills of nursing staff members. This opportunity was similarly recognized in a study completed by Wynn et al. (2009), which recommended a method of debriefing, also supported by the Institute for Healthcare Improvements, which can be used to identify missed opportunities for RRT activation and to provide education to staff about signs and symptoms to look for in future patient situations.

A moderate risk score of 2 or 3 was found in 33.3 % (n = 36) of the total RRT activations. The moderate risk score data were viewed by unit and showed 2MS had 14 (12.96%) moderate risk MEWS, 3MS had 11 (10.19%) moderate risk MEWS, and 4MS had 10 (9.26%) moderate risk MEWS. A high risk score of 4 or higher contributed to 34.8% (n = 36) of the RRT activations. The high risk score data were viewed by unit and showed 2MS had 14 (12.96%) high risk MEWS, 3MS had 12 (11.11%) high risk MEWS, and 4MS had 10 (9.26%) high risk MEWS. These data showed that 68.1% of the total RRT activations were activated for a moderate or high risk of clinical deterioration (see Table 5).

The data are only as good as what is documented; this section discusses the frequency of vital signs in the medicals records of 71 subjects that had a MEWS of 2 or greater at the time of the RRT activation and represents the average time between vital

signs collection. The average time from the RRT activation back to the first previous set of vitals (labeled Pre1 MEWS) was 277.04 minutes (4.62 hours) (see Table 7). The average time between the Pre1 MEWS and the second previous set of vitals (labeled Pre2 MEWS) was 316.78 minutes (5.28 hours) (see Table 8). The average time between the Pre2 MEWS and the third previous set of vitals (labeled Pre3 MEWS) was 304.44 minutes (5.07 hours) (see Table 9). The average time between Pre3 MEWS and the fourth previous set of vitals (labeled Pre4 MEWS) was 267.44 minutes (4.46 hours). The overall average length of time between vital signs collection was 291.60 minutes (4.86 hours) (see Table 10). These findings indicated that the vital signs could be taken more frequently, especially for patients exhibiting signs of clinical deterioration. There is also the possibility that the vital signs were taken more frequently but were not documented.

The average length of time from the MEWS score at the time of the RRT activation to previous MEWS scores retrospectively until a low risk score of 0 or 1 or the lowest score possible was assigned were displayed in Table 6. These data represent the amount of time earlier that deterioration potentially could have been detected if a MEWS system had been in place. These data are similarly supported within a study by Kho et al. (2007), which concluded the scoring system detected a greater number of at-risk patients. Ten (10.14) hours was the average amount of time earlier that deterioration could have been detected if a MEWS system had been in place. This is valuable information because studies have shown physiologic instability, such as changes in heart rate, respiratory rate, and oxygen saturation, was present within 6 to 8 hours of the event in more than half of in-hospital cardiac arrests (Hatler et al., 2009). Similar results were found in a study by

Wynn et al. (2009), in which the majority of patients (73%, n = 55) had clinical changes documented at some time before the RRT call; in some cases (16%, n = 12), as long as 8 hours before the RRT was called, which is consistent with the findings of this study. The scoring system has proven useful in the assessment of patients and has ensured timely, appropriate, and safe transfer to a higher level of care (Wolfenden et al., 2010).

The average amount of time elapsed from the time of the RRT activation to previous retrospective MEWS scores differentiated by low (MEWS 0 or 1), moderate (MEWS 2 or 3), or high (4 or greater) risk MEWS represents the amount of time deterioration potentially could have been detected and differentiated by risk levels. When a low risk MEWS was tabulated, there was an average of 583.31 minutes (9.72 hours) prior to the activation of the RRT team (see Table 11); when a moderate risk MEWS was tabulated, there was an average of 365.33 minutes (6.09 hours) prior to the activation of the RRT team; and when a high risk MEWS was tabulated there was an average of 238.20 minutes (3.97 hours) prior to the activation of the RRT team (see Table 13). These data suggest that it would be beneficial to increase the frequency of vital sign measurements and to apply the MEWS each time, especially for patients exhibiting signs of clinical deterioration. These data are similar to the results of a study by Odell et al. (2009), in which the findings from the theme of "recording and reviewing" was an absence or infrequency of vital sign recording, and lack of the required skill and knowledge to determine actions when vital signs deviated from the norm (Odell et al., 2009).

Conclusions

The following conclusions can be drawn based on the findings:

1. The most frequent times that the RRT was activated was between the hours of 1500 -1900 with 25% (n = 27) of the total RRT activations; this signifies that the majority of the RRT activations happened within the first few hours of shift change (see Table 3).
2. The most frequent reason for activating the RRT was cardiac (44.4%) and respiratory (27.8%) in nature. Knowing more than 70% of RRT calls were secondary to cardiac and respiratory issues is valuable information as additional education on early warning signs, identification, assessment, and appropriate interventions could be emphasized on these two body systems.
3. Of the total RRT activations, 24.1% (n = 26) of patients required a higher level of nursing care or expired; these data indicate a need to identify patient deterioration earlier in efforts to prevent a negative outcome.
4. Approximately one-third of RRT activations (33.4%, n = 36) had a low risk MEWS indicating minimal to no clinical deterioration (see Table 4). Many of the nursing staff was considered "new graduates" with less than 2 years of nursing experience. This information is valuable as it indicates a need for additional education to identify, and established unit resources and advance critical thinking skills. Whereas, criteria to activate the RRT are "nurse intuition" and the concept of "better to call the RRT than not," it would benefit the nurses calling RRT for low risk MEWS to provide "just in time

training" for the nurses and use the RRT activation as a learning experience. Educating the staff about utilizing unit resources, such as the charge nurse, as well as additional seasoned experienced nurses could provide insight and reassurance when a nurse is questioning the patient's status. One way to determine if providing "just in time" education, communication of additional unit resources to staff nurses, and critical thinking skills training would be to observe a subsequent decline in RRT activations for low risk MEWS.

5. A moderate risk score of 2 or 3 contributed to 33.3% (n = 36) of the total RRT activations. A high risk score of 4 or higher contributed to 34.8% (n = 36) (see Table 5). These data signify that the RRT is being activated appropriately in response to clinical deterioration in nearly 70% of the cases.
6. The overall average length of time between vital signs collection (MEWS applied) was 291.60 minutes (4.86 hours); the frequency of vital sign measurements should be increased especially for patients exhibiting signs of clinical deterioration.
7. The average time for 71 subjects (MEWS 2 or greater) to reach their lowest MEWS was 608.15 minutes (10.14 hours) (see Table 6). Ten (10.14) hours is the average amount of time earlier that deterioration could have been detected if a MEWS system were in place.
8. When a low risk MEWS was tabulated, there was an average of 583.31 minutes (9.72 hours) prior to the activation of the RRT team (see Table 11); when a moderate risk MEWS was tabulated there was an average of 365.33

minutes (6.09 hours) prior to the activation of the RRT team (see Table 13); and when a high risk MEWS was tabulated, there was an average of 238.20 minutes (3.97 hours) prior to the activation of the RRT team. Based on these results, it would be beneficial if the vital sign measurements were more frequent, especially for patients already exhibiting some signs of clinical deterioration. The frequency of vital sign measurement may be a subjective individual nurse intervention in some situations. In other situations this measurement may be determined by protocol and/or by provider order. The frequency of vital sign measurements reflects the critical thinking skills of the nurse. Once clinical deterioration has been identified, an increase in frequency of vital sign measurements should occur until improvement or stability has been achieved. Additionally, once clinical deterioration is identified, interventions to minimize further deterioration and additional reassessments are appropriate until the patient returns to their baseline or no longer exhibits signs of clinical deterioration.

Recommendations for Nursing Practice and Education

The underling goals of this study were to determine if the Modified Early Warning Score risk assessment tool would identify moderate to high risk patients prior to the activation of the Rapid Response Team, and if so, how much time occurred from the onset of clinical deterioration until activation of the Rapid Response Team. By proactively assessing the Modified Early Warning Scores of non-intensive care unit patients, the data suggested that there is potential to decrease the number of

underdetected critically ill hospital patients in this community hospital setting. Additionally, the data showed that there is a delay in activation of the Rapid Response Team and that implementation of the MEWS system would increase RRT awareness of patients with critically abnormal vital signs, so that they can be assessed and clinical deterioration treated prior to a catastrophic event occurring.

The data from this study indicated a need for more frequent observation and documentation of vital signs by nursing staff as the overall average length of time between vital signs collection was 291.60 minutes (4.86 hours) when clinical deterioration was evident. There were MEWS scores in the low, moderate, and high risk categories that resulted in RRT activations; however, if there had been an increase in frequency of vital sign measurements, clinical deterioration may have been detected earlier. One possibility to consider is that vital sign measurements were taken but not documented; however, staff is trained to document these pertinent patient data. To increase the frequency of vital sign measurements and documentation, especially when clinical deterioration is present, would be to confirm knowledge and understanding, and educate the staff on the importance of recognition, assessment, intervention, and reassessment and the potential consequences if actions are not taken. Elevating the level of critical thinking for nurses and providing "just in time" education, as well as a focused education of early warning signs identification, may improve the frequency of vital sign measurements and documentation. Documentation of an increased frequency of vital signs would be especially important if and when the organization implements the use of an automated electronic medical record (EMR) including the MEWS system.

Recommendations for Further Study

Further research investigation is recommended based on the results of this study. The speed of electronic notification combined with the critical thinking skills of nurses would most likely lead to a decrease in the overall rate of preventable patient deterioration. Early recognition of physiologic abnormalities coupled with rapid intervention of suitably educated staff may result in an improvement in functional outcome or mortality rate (Tarassenko et al., 2006). Automated monitoring of patient data may provide earlier recognition of a patient's impending deterioration and minimize additional work for the nursing staff (Kho et al., 2007). An electronic MEWS capturing data from "real time" EMR data to notify RRTs would both decrease the time to recognition of deteriorating patients, and increase the accuracy of the RRT to recognize patients in danger of clinical deterioration. No detection system is perfect. Although a combination of the two systems, automated surveillance with nurse's critical thinking skills utilized for potentially at-risk patients, may be an ideal balance that improves on either system alone (Kho et al., 2007). To study this, an implementation of an automated EMR MEWS system and training for RRT staff would be necessary; this could be piloted on one specific unit to minimize cost and training for staff. After a trial period, the data would indicate if "real time" EMR data monitored and analyzed by the RRT would decrease the time to recognition of clinical deterioration.

The MEWS utilizes only five clinical parameters and would almost certainly be improved by the addition of more detailed patient data such as high risk diagnoses, oxygen saturation, urinary output, and specific laboratory results such as white blood cell

counts, hemoglobin, platelets, creatinine, protime, and cardiac enzymes. To study this concept, a literature review could be completed to see if expanded MEWS systems are already in existence and exhibiting success. Once a review of the literature has been completed, a modified MEWS could be chosen or created and then tested through an automated EMR MEWS system. As described above, this study could be piloted on one specific unit to minimize cost and training for staff. After a trial period, the data would indicate if additional parameters monitored and analyzed by the RRT would decrease the time to recognition of deteriorating patients, and increase the accuracy of the RRT to recognize patients in danger of clinical deterioration.

Although staff nurses play a critical role in recognizing the need to activate the RRT, little is known about the actions and perceptions of staff nurses in relation to activation of the RRT. To study this concept, a literature review could be completed to determine the existence of known perceptions and actions of staff nurses in relation to RRT activations. Once a review of the literature has been completed, a survey could be chosen from the review of literature or created and then performed with a subset of staff nurses. Once the data are gathered, they could be analyzed and the information obtained could be shared with all nursing staff in an effort to improve collaboration between staff nurses and the RRT. An outcome to measure success would be a decrease in patients with an RRT activation for no to low risk MEWS and/or an increase in the total number of appropriate RRT activations.

Summary

This study has added to the body of knowledge about RRT activations. There are many nursing actions including, but not limited to, assessing, monitoring, detecting, reporting, intervening, and reassessing that are necessary to prevent or minimize clinical deterioration in patients. The activation of the RRT hinges upon the recognition of clinical deterioration through the use of frequent vital sign measurements combined with nursing judgment. As the data from the literature review and this study demonstrated, the frequency of vital sign measurements has been inadequate, resulting in a delayed response to counteract clinical deterioration. The use of the MEWS system would potentially alleviate activation of the RRT based solely on nursing judgment. The use of a MEWS system would provide low, moderate, and high risk assessment scores of objective data from the patient's medical record. Used in conjunction with nursing judgment, the MEWS could facilitate activation of the RRT and could potentially decrease the detection time of clinical deterioration, ultimately resulting in improved patient outcomes.

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APPENDIX

APPENDIX A

IRB APPROVAL LETTERS

MINNESOTA STATE UNIVERSITY
MANKATO

Sue Ellen Bell, Ph.D.
360 Wissink Hall
College of Nursing
Minnesota State University, Mankato
Mankato, MN 56001

Nikki Stoffel-Lowis

November 24, 2010

Dear Sue Ellen and Nikki:

Re: IRB Proposal, Log **#5791** entitled *"Rapid Response Team Utilization of Modified Early Warning Scores to Improve Patient Outcomes Archival"*

Your IRB Proposal has been approved as of November 24, 2010. On behalf of the Institutional Review Board I wish you success with your study. Remember that you must seek approval for any changes in your study, its design, funding source, consent process, or any part of the study that may affect participants in the study. Should any of the participants in your study suffer a research-related injury or other harmful outcome, you are required to report them to the IRB as soon as possible.

The approval of your study is for one calendar year from the approval date. When you complete your data collection, or should you discontinue your study, you must notify the IRB. Please include your log number with any correspondence with the IRB.

This approval is considered final when the full IRB approves the monthly decisions and active log. The IRB reserves the right to review each study as part of its continuing review process. Continuing reviews are usually scheduled. However, under some conditions the IRB may choose not to announce a continuing review.

Sincerely,

Patricia Hargrove

Patricia M. Hargrove, Ph.D.
IRB Coordinator
CC: File

COLLEGE OF GRADUATE STUDIES AND RESEARCH
115 ALUMNI FOUNDATION CENTER · MANKATO, MN 56001
PHONE 507-389-2321 (V) · 800-627-3529 OR 711 (MRS/TTY) · FAX 507-389-5974

Immanuel St. Joseph's
Mayo Health System

December 1, 2010

Nikki Stoffel-Lowis, R.N.
204 Cole Court
Mankato, MN. 56001

RE: MSU Study: "Rapid Response Team Utilization of Modified Early Warning Scores to Improve Patient Outcomes".

Dear Ms. Stoffel-Lowis:

The Institutional Review Board of Immanuel St. Joseph's—Mayo Health System reviewed the Investigator Checklist; Study Proposal; Authorization for Immanuel-St. Joseph's – Mayo Health System to Use Medical Information for Medical Research; Risk Assessment Tool; Modified Early Warning Score; Conflict of Interest Disclosures; and proof of Protecting Human Subjects Training for the above referenced study proposal its meeting on December 1, 2010.

Noting that all requirements of Criteria for IRB Approval of Research have been met, approval is given for you to conduct this retrospective medical record review proposal at ISJ-MHS. As protected health information is not being requested from subjects, HIPAA authorization is not required in accordance with 45 CFR 160.103. Approval is granted as follows:

- to conduct the above mentioned study at ISJ-MHS for one year, from December 1, 2010 through November 30, 2011, unless the IRB determines that it is appropriate to halt or suspend the study earlier.
- to review only medical records of patients who agreed to participate at the time of their admission to ISJ-MHS.
- to protect the privacy of the subjects and to maintain confidentiality of the data.
- for this research proposal to be used by yourself and Dr. Sue Ellen Bell, approved investigators, only and you must seek IRB approval to continue past the year granted.

A written review will be due prior to November 30, 2011 that, according to FDA regulations and IRB policy, should include the following:

1) The number of subjects in the study
2) A summary description of the experience (benefits and adverse reactions)
3) Number of persons withdrawing from the study and the reasons for withdrawal
4) Summarize research activity and interim findings since initial approval
5) A current risk-benefit assessment based on the results to date
6) Any new information or unanticipated risks found during the research
7) Any re-consenting that has been required by the IRB due to modifications of the research or identification of new risks
8) Investigator intent to continue the study or intent to close the study

LETTER RE: MSU Study: Rapid Response Team Proposal
Page Two

It is your responsibility to report the end of the study to the Board. Also, any change in the consents or research protocol would need to be reported. Any adverse events that occur during the study at ISJ-MHS should be reported to the Board as soon as possible, but no later than within five working days.

The deadline for submission to the IRB agenda is usually the 3rd Friday of each month. Thank you for your cooperation in complying with these reporting requirements.

Sincerely,

Fawad M. Qureshi, M.D. – Chair
Institutional Review Board

FMQ/kmb

cc: Sue Ellen Bell, PhD, APRN, BC

Enclosure: Authorization for ISJ-MHS to Use Medical Information – approved 12/1/10

APPENDIX B

CONSENT FORM

AUTHORIZATION FOR IMMANUEL ST. JOSEPH'S—MAYO HEALTH SYSTEM TO USE MEDICAL INFORMATION FOR MEDICAL RESEARCH

Immanuel St. Joseph's
Mayo Health System

1025 Marsh Street, P.O. Box 8673, Mankato, MN 56002-8673
Phone: 507-625-4031 Fax: 507-345-2926

As of January 1, 1997, Minnesota law requires every medical center in the state, including Mayo, to receive written permission from each patient before using information from the medical record in medical research.

Under the new law, you decide if Immanuel St. Joseph's—Mayo Health System** can review the medical record for this purpose. If you allow the use of this information for research, Immanuel St. Joseph's—Mayo Health System** will protect your privacy and confidentiality. Only group data are published in studies, not individual identities.

You also have the right to say no. This decision is an individual one, and in each case your wishes will be honored. Your decision will not affect the care you receive at Immanuel St. Joseph's—Mayo Health System** in any way.

The future of quality medical care depends upon research using medical records. Consider the benefits to humanity, your loved ones and yourself provided by medical advances. By signing this form, you will be contributing to medical progress now, and for generations to come.

I ☐ authorize ☐ do not authorize Immanuel St. Joseph's—Mayo Health System** to review medical records about me for medical research. No information which will identify me as a patient or participant in any study will be published.

Please sign here and return: _____ _____
(Patient or Authorized Representative) *(Date)*

_____
(Relationship to Patient (if not patient)

**Includes Waseca Medical Center, Springfield Medical Center, St. James Medical Center.

6/2009
0321MR

APPENDIX C

MODIFIED EARLY WARNING SCORE (MEWS) TOOL FOR DATA COLLECTION

Modified Early Warning Score (MEWS) Tool for Data Collection

Assigned #	Subject #1	Subject #2	Subject #3	Subject #4	Subject #5	Etc.
Date (ex. 01/01/2009)						
Time of RRT call (ex. 0816)						
Unit						
Age						
Gender						
-male						
-female						
Primary Diagnosis						
Reason for RRT call						
-respiratory						
-cardiac						
-neurologic						
-metabolic						
-other (what?)						
Outcome:						
-remain on unit						
-transfer to another facility						
-transfer to higher level of care						
-transfer to ICU						
-death						
-long term outcome death						
MEWS (Initial data - time of RRT call)						
-date						
-time						
-SBP data						
-SBP score						
-HR data						
-HR score						
-RR data						
-RR score						
-Temperature data						
-Temperature score						
-AVPU data						
-AVPU score						
MEWS score						
Pre1 MEWS (Additional data until low score)						
-date						
-time						
-SBP data						
-SBP score						

-HR data						
-HR score						
-RR data						
-RR score						
-Temperature data						
-Temperature score						
-AVPU data						
-AVPU score						
MEWS score						
Pre2 MEWS (Additional data until low score)						
-date						
-time						
-SBP data						
-SBP score						
-HR data						
-HR score						
-RR data						
-RR score						
-Temperature data						
-Temperature score						
-AVPU data						
-AVPU score						
MEWS score						
Pre3 MEWS (Additional data until low score)						
-date						
-time						
-SBP data						
-SBP score						
-HR data						
-HR score						
-RR data						
-RR score						
-Temperature data						
-Temperature score						
-AVPU data						
-AVPU score						
MEWS score						
Pre4 MEWS (Additional data until low score)						
-date						
-time						
-SBP data						
-SBP score						
-HR data						
-HR score						

-RR data						
-RR score						
-Temperature data						
-Temperature score						
-AVPU data						
-AVPU score						
MEWS score						