ENHANCING EFFECTIVENESS OF RAPID RESPONSE TEAM ACTIVATIONS

A DOCTORAL PROJECT
Submitted in Partial Fulfillment of the Requirements
For the degree of
DOCTOR OF NURSING PRACTICE

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May 2015
ABSTRACT

A number of hospitals across the United States have adopted the use of rapid response teams (RRTs) to immediately assist patients experiencing clinical decompensation outside intensive care units and prevent failure-to-rescue events such as cardiorespiratory arrest and death. While conceptualization of the RRT is consistent in many studies, there is a lack of consensus regarding RRT activation criteria for clinical instability. The aim of this study was to evaluate the effectiveness of the Modified Early Warning Score (MEWS) tool, a multiple trigger system developed in a medical center, to identify factors that would alert the staff nurse to seek RRT assistance. With the goal to evaluate the MEWS impact on RRT activations and enhance the effectiveness of activation calls, this retrospective study involved data collection over a 3-month period on RRT events (n = 81). Each RRT event was reviewed and assigned a score using the MEWS tool. Based on MEWS score alone, only 8 activations would have occurred. However, 59 activations would have occurred by execution of clinical judgment. Results also demonstrated the average MEWS was only marginally effective in identifying patients having clinical deterioration (p = .05). Patient demographic variables were analyzed to determine their association with clinical deterioration. No association was found between age (p = .20) or presence of comorbidities (OR 0.94, p = .65) and clinical deterioration. It is recommended that revisions to the MEWS may improve its ability to identify patients at risk for clinical deterioration; its adoption has been postponed in the project setting.
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ACKNOWLEDGMENTS

My profound gratitude to Dr. Margaret Brady, Project Co-Chair, for her generous time, help, guidance, and commitment to the success of this doctoral project. I am eternally grateful to my husband, Francis Mummery, for his endless and unconditional love, support, help, and encouragement over the years and throughout this project. I could not have done it without you by my side. To my son, Thomas, for his patience and understanding and for his daily dose of love and humor that keeps me going. Finally, to my mom, Becky, for her love, for teaching me the value of education, and for always believing in me.
BACKGROUND

Rapid response teams (RRTs), also known as medical response teams, medical emergency teams (METs) in Australia, and critical care outreach system or outreach teams in the United Kingdom, are composed of an interdisciplinary group of health professionals. These teams promptly assist patients experiencing acute clinical instability and offer support to staff to prevent further deterioration and possibly cardiorespiratory arrest (CRA; Beebe, Bawel-Brinkley, & O’Leary-Kelley, 2012; Green & Williams, 2006; Howell et al., 2012). RRTs were originally developed to provide timely assessments and interventions for patients who are hospitalized in clinical areas outside intensive care units (ICUs) and present with signs of clinical deterioration. The team’s goal is to prevent or reduce morbidity and mortality and unplanned ICU admissions (Benin, Borgstrom, Jenq, Roumanis, & Horwitz, 2012; Green & Williams, 2006; Jones, Drennan, Hart, Bellomo, & Web, 2012). Most RRTs are composed of ICU-based staff that usually include a physician with intensive care training, a critical care nurse, and a respiratory therapist. However, the ideal composition of an RRT is unknown (Howell et al., 2012).

Before the use of RRTs, the health care staff had to find staff members and resources to assist in the care of unstable patients and/or to help during cardiac arrests. In addition, the staff may have also had to activate the emergency code system (Leach & Mayo, 2013). Concerns about the safety and well-being of patients in acute care settings led to national patient safety initiatives to decrease unfavorable events, specifically, avoidable deaths among hospitalized patients. One of these initiatives led to the creation of RRTs (Leach & Mayo, 2013). In 2004, as part of the 100,000 Lives Campaign, the Institute for Healthcare Improvement recommended the use of RRTs in hospitals to
facilitate early detection and management of acute clinical deterioration, improve patient care, avoid cardiopulmonary arrests, and decrease mortality as a result of early intervention (Beebe et al., 2012; Scatena Gonçales et al., 2012). A later campaign called the 5 Million Lives started in December 2006 with a new set of goals (Scatena Gonçales et al., 2012). Specifically, the target goal for this campaign was to protect patients from 5 million incidents of medical harm over a 2-year period (Institute for Healthcare Improvement, 2014).

Studies have suggested that RRTs can be used as an effective intervention to reduce failure-to-rescue events (Hammer, Jones, & Brown, 2012). Failure to rescue refers to the inability to save the life of a patient who develops a complication such as hemorrhage, sepsis, pneumonia, or shock while hospitalized (Schmid, Hoffman, Happ, Wolf, & De Vita, 2007; Thomas, Force, Rasmussen, Dodd, & Whildin, 2007). The failure-to-rescue criteria measure the caregiver’s performance and skills to identify and react autonomously to those complications (Thomas et al., 2007). The Agency for Healthcare Quality identified failure-to-rescue events as one of 16 patient safety indicators to be used to evaluate and improve patient safety in hospitals across the United States (Schmid et al., 2007). It was estimated that RRT interventions might contribute to saving 66,000 lives of the 100,000 Lives Saved campaign by avoiding failure to rescue at the first signs of patient deterioration (Taenzer, Pyke, & McGrath, 2011).

Serious adverse events outside the ICUs are often preceded by instability of vital signs. To assist nurses in recognizing patients at risk for clinical adverse effects and knowing when to activate RRTs, different instruments or systems have been utilized. In the attempt to describe clinical instability, different monitoring systems have emerged
(Churpek, Yuen, & Edelson, 2013). These systems rely on measurements of existing vital signs. They are derived from a single parameter system based on identifying an abnormality in at least one or more of the vital signs categories or through multiple trigger systems that rely on the calculation of a score based on various abnormal parameters. One such multiple trigger system is the Early Warning Score (EWS) or the Modified Early Warning Score (MEWS; Ludikhuize, Smorenburg, de Rooij, & de Jonge, 2012). However, these track and trigger systems based on physiological parameters have been flawed by the lack of agreement on what constitutes a deteriorating patient or clinical deterioration (the presenting condition, a new clinical problem, or a medical complication) and which outcomes should be measured (ICU admission or transfer, CRA, or mortality; Churpek et al., 2013; Jones, Mitchell, Hillman, & Story, 2013).

**Needs Assessment**

The Institute of Medicine in its 1999 report *To Err is Human* estimated that approximately 48,000 to 98,000 hospitalized patients in the United States died every year as a consequence of medical mistakes including preventable cardiopulmonary arrest (Al-Qahtani et al., 2013). The introduction of RRTs has transformed the health care provider response from a critical situation approach to a coordinated and systematic approach (Beebe et al., 2012). While the RRT is not able to prevent all in-hospital CRAs, one main objective is to prevent further clinical deterioration in hospitalized patients outside the ICU. The intervention strategy focuses on the premise that delays in treatment could be avoided because signs of clinical instability, including changes in mental status and abnormal vital signs, are usually exhibited hours before a patient experiences a cardiopulmonary arrest or other undesirable clinical incidents (Marshall et al., 2011).
The RRT has four components: afferent, efferent, quality improvement, and administrative. The afferent component addresses the role of health care providers who are able to detect an incident based on their clinical assessment and activate the RRT. The efferent component or crisis component refers to the RRT itself and the medical staff involved in the care of the patient experiencing clinical instability. The quality improvement component monitors the activation and outcomes of the RRT in order to improve patient care. Lastly, the administrative component consists of a committee involved in implementing the process and reporting back to hospital administration (Al-Qahtani et al., 2013).

Members of the RRT must work not only quickly but in an organized manner and communicate clearly and effectively (Beebe et al., 2012). While the presence and actions of the RRT are important in the attempt to stabilize the patient, the RRT’s interventions can be defeated if there is a lack of role definition for team members and staff, deficient communication, and/or the absence of undefined clinical warning signs/symptoms criteria (Beebe et al., 2012). These elements can create chaos, disorganization, and delays in care.

To reduce failure-to-rescue situations that result in negative outcomes, this Doctor of Nursing Practice (DNP) project was developed to focus on the quality improvement components of RRT activations in a tertiary medical center. Thus, this project investigated a multiple trigger system (MEWS) developed in a medical center to identify factors that would alert the staff nurse to seek RRT assistance with the goal of improving patient outcomes.
In 2014, a MEWS algorithm tool was introduced by a team of nurse educators to be used by staff nurses as part of a data collection study in one of the surgical wards of the project setting (Appendix B). Data were collected during a 1-month timeframe. The nurse educator protocol required that every patient admitted to that particular ward received a score each time his or her vital signs were taken to estimate the patient’s risk for clinical deterioration based on MEWS criteria. Scores were classified into three categories: normal, indicating no action was needed; somewhat worrisome, indicating the need for close monitoring or early assessment by the physician; and RRT high alert, signaling that activation was needed. The MEWS data were collected daily for 28 days. The recording of vital signs data using the MEWS tool was for data collection purposes only by the nurse educators only. During this month, no RRT activations were based on the scores; nurses followed the hospital policy related to RRT activations. These recorded data were not used in this study. This project’s author believed it was critical to assess what the impact MEWS would have had on RRT activations if the MEWS instrument had actually been used over a longer period of time.

No prior screening tool for initiating a rapid response alert had been used in this facility. Therefore, this project evaluated the tool’s reliability and validity as to whether it would be an effective screening instrument. The long-term goal for this facility is to have a dependable tool that would identify key parameters alerting the staff nurse to the need for close patient monitoring or to activate the RRT. Thus, it was hoped that the MEWS would be a trustworthy tool to help staff nurses improve their patient care, increase communication among nurses and providers, deliver high quality care in a timely fashion, improve the RRT activations by avoiding or reducing the number of
inappropriate RRT calls, and reduce the number of cardiopulmonary arrests in the surgical and medical units outside the ICU setting.

**Problem Statement**

At the time of the project’s implementation, the medical center involved in this project had a hospital policy in place that defined the specific physiological parameters for the activation of the RRT. The protocol included criteria for changes in vital signs that would necessitate RRT activation (i.e., a deviation in one or more vital signs or mental status or a clinical judgment by the staff nurse that the patient’s clinical status was rapidly deteriorating).

Despite the existence of a policy, staff nurses were not consistently following the physiological parameters outlined in the RRT policy that had been validated as criteria values by review of previous hospital RRT events. Prior to this study, the RRT call was often initiated because the patient was upset or agitated or, at the other extreme, because the patient was on the verge of cardiovascular collapse. In the first scenario, the patient does not meet any criteria for the RRT activation and this type of situation is considered a false alarm. Because the RRT members were pulled from their other duties in the ICU setting, ministering to intensive care patients, without appropriate justification as established in hospital policy regarding initiation of the RRT, this false alarm also constitutes a waste of resources. In the second case, even though the activation of the RRT is appropriate, the caregiver may have failed to recognize earlier signs of physiological deterioration, leading to late activation and delay in treatment, which sometimes can lead to a cardiopulmonary arrest or *code blue* activation.
RRTs are to be activated when the patient meets predefined benchmarks that are usually based on changes in normal vital signs as well as changes in mental status. A sudden alteration in the patient’s general status that is worrisome to the provider is another appropriate reason to activate the RRT (Jones et al., 2012; Scatena Gonçales et al., 2012). Patients are best served if nurses and caregivers have clear criteria that facilitate early recognition of clinical deterioration. Likewise, a resource tool that providers can use to assist in critical thinking as to the need for an early response activation should hopefully facilitate avoidance of failure-to-rescue events. Stolldorf (2008) found that successful instruments have clearly established calling criteria that also contain subjective measures. In addition, the ability to use judgment appears to be key to the success of any instrument that it is used.

The Rapid Recognition and Response to Changes in a Patient Condition policy of the hospital participating in this study, better known as the RRT policy (Appendix A), was created with the goal of nurses seeking assistance from a team of physicians, nurses, and respiratory therapists when a patient outside the ICU experienced clinical decompensation. The policy became effective in September 2009, was revised in April 2010, and underwent subsequent revision in November 2010. The policy in effect at the time of this project contained specific physiological parameters that indicated clinical instability and necessitated an immediate emergency response to be initiated by the staff nurse to alert the RRT. Despite the existence of this policy, a frequent issue identified in the surgical units when the RRT was activated had been the lack of consistency in following the established physiological parameter guidelines and the frequency of unwarranted activations.
This author believed that an in-depth analysis would provide important information about the validity and reliability of the MEWS tool and whether any revision to the existing RRT policy was required. Therefore, a plan was established to retrospectively examine and analyze the RRT activations for a 3-month period (January, February, and March of 2014). This project author reviewed patients’ charts to collect pertinent patient data, including demographic and other health information, and to assign a MEWS based on vital signs recorded in the patients’ charts prior to RRT activation or noted in the RRT report. The investigator then sought to compare the MEWS associated with an RRT activation as assigned by the project investigator or the RRT and the actual hospital protocol policy criteria for an RRT activation. Thus, this project sought to investigate the validity of the MEWS in detecting signs of early clinical deterioration.

**Purpose Statement**

There is ample research evidence documenting that activation of the RRT can save lives if initiated based on protocol. However, activation of this system was not always based on RRT policy in the medical center serving as the site of this project. The MEWS tool, an instrument developed to assist nurses in their patient assessment to identify patients at risk for clinical deterioration, was considered for use at the site of this project as an additional assessment resource for nurses. Thus, there was a need to determine whether the MEWS proposed for use in this setting was valid and reliable in determining the need for early intervention and whether the current RRT policy at this medical center provided sufficient guidance for nurses caring for patients in medical and surgical units. To this end, a detailed analysis and evaluation project was developed to hopefully provide the needed answers.
The purpose of this project was twofold: to assess the impact of the MEWS instrument on the number of RRT activations and to determine whether the MEWS was a valid and reliable instrument to guide nurses in identifying patient clinical conditions that require activation of the RRT.
THEORETICAL FRAMEWORK

The plan-do-study-act (PDSA) model and the model for improvement provided the theoretical framework for this DNP project. These two models have their origins in the scientific method as described by Moen and Norman (n.d.). The PDSA cycle is a four-step model for implementing a change and a continuous circle for improvement. The PDSA cycle, initially known as plan-do-check-act (PDCA), was introduced by Dr. W. Edwards Deming in 1950. The cycle has evolved and has been modified throughout the years and was reintroduced as PDSA in 1986. The model was again modified and reintroduced in 1994 by Dr. Deming who described it as a flow diagram for learning and improvement of a product or a process. He called it the Shewhart cycle (Deming, 1993, as cited in Moen & Norman, n.d.).

The Deming model for improvement was developed in 1994 by Associates in Process Improvement to extend the PDSA model and incorporate strategies to develop, check, and implement improvements (Langley, Nolan, & Nolan, 1994, as cited in Moen & Norman, n.d.). This model is a straightforward and powerful tool that provides the basis for improvement. It addresses three questions: (a) What are we trying to achieve? (b) How do we know if we are improving? and (c) What changes can we make to improve? (Gillam, 2013).

Furthermore, when trying to implement a change, all people involved in the process of change must have direction to work towards the same objective. Therefore, a structured problem-solving approach is essential when trying to successfully implement a change (Walley & Gowland, 2004).
Figure 1 shows the framework that is based on the PDSA (Moen & Norman, n.d.) that will be used for this project. For this project, the PDSA model was utilized in the evaluation of the MEWS algorithm. The goal of this project was to improve staff adherence to the RRT activation protocol by using the MEWS algorithm. This implementation was intended to lead to the prompt activation of the RRT and immediate management of patients who fall under the algorithm.

The planning phase of the PDSA cycle was used to establish the suitability of the proposed change or improvement activity (Walley & Gowland, 2004). Once identification of the problem occurred, a literature review was conducted and evidence-based practices were identified that helped support interventions to tackle the problem. It was also important to identify who would benefit from the change in practice. Nurses, physicians, administrators, and patients were the stakeholders for this project. Therefore, the goals and expected outcomes were communicated to all those involved.

The do phase was intended to carry out the plan (Walley & Gowland, 2004). The current RRT policy and vital signs criteria for RRT activation were reviewed. Following evidence-based practice guidelines, pertinent modifications were made to the RRT policy that had been in place.

The study phase evaluated what was learned (Walley & Gowland, 2004). Once the emergency warning signs algorithm was created, it was utilized in one of the medical center’s surgical wards as a pilot study for an established period.

Act was the final phase of the cycle. It was here where, depending on the results of the study, the decision was made to implement, withdraw, or modify the proposed change (Walley & Gowland, 2004). The information obtained from the implementation
Model for Improvement

What are we trying to accomplish?

How we will know if we have improved?

What changes can we make to improve?

PDSA Model

Plan
- Literature review
- EBP
- Needs assessment
- Stakeholders

Act
- Evaluation of MEWS algorithm
- Implementation in other units

Do
- Review of current practice
- Harbor emergency warning score (MEWS) algorithm

Study
- Pilot study
- Data analysis

Figure 1. The model for improvement and PDSA cycle.
of the modified emergency warning signs algorithm pilot study would then be used to
determine whether the MEWS needed to be implemented in other units within the project
setting or if changes should be made to the algorithm. Thus, this project was designed to
incorporate all aspects of the PDSA model.
REVIEW OF LITERATURE

Overview

The literature review focused on three major topics: (a) failure to rescue, (b) RRTs, and (c) emergency warning signs. PubMed, CINAHL, and EBSCO host databases were searched for clinical trials; literature reviews; and descriptive, prospective, retrospective, longitudinal, and cross-sectional studies investigating the effectiveness of RRTs and the use of the modified emergency warning signs. Article selection was limited to studies published between 2000 and 2014 and in English and Spanish using the following key terms to guide the database searches: rapid response team, rapid response team effectiveness, rapid response team failure, rapid response team mortality, rapid response team outcomes, rapid response activation, rapid response systems, emergency warning signs, modified early emergency signs, MEWS, MEWS validation, failure to rescue, and clinical deterioration.

Articles were selected based upon the relevance of their content to the topic of this paper and consistency with the population of interest. Original research articles less than 14 years old were used as primary sources for the content of this paper. Review studies and clinical guidelines were also included to support the discussion.

Failure to Rescue

Failure to rescue is one of many hospital quality indicators related to the general excellence of care provided. Failure to rescue does not mean wrong doing even though the concept is frequently discussed within the framework of hospital mortality and avoidable adverse events. Failure to rescue refers to the lack of recognition of a patient’s deteriorating status and not taking appropriate action to overturn those changes (Schmid
et al., 2007). In recent times, the study of situations involving failure to rescue was approached by focusing mainly on improving the response to an identified patient crisis, but this strategy failed to focus on patient outcomes. Although the literature supports that adverse events are preceded by a time period of clinical deterioration, inadequate attention has been given to strategies to improve detection of the patient crisis. Consequently, the lack of early detection of physiologic deterioration plays an important role in the failure-to-rescue problem (Schmid et al., 2007; Taenzer et al., 2011).

Kendall-Gallagher, Aiken, Sloane, and Cimiotti (2011) conducted a retrospective study to explore whether the number of staff nurses with baccalaureate education and nursing specialty certification influenced failure-to-rescue rates and mortality. Their research was conducted in 652 U.S. adult acute care hospitals located in four states: Pennsylvania, New Jersey, Florida, and California. The final sample included 28,017 staff nurses and 1,283,241 patients ages 21 and older who were admitted to hospitals in these four states during a 24-month period. Nurses were classified by certification and education status. The hospitals were coded in relation to the overall percentage of nurses, the percentage of nurses having a Bachelor of Science in Nursing (BSN) or higher degree, and the percentage of nurses having a BSN or associate degree who were certified. Logistic regression models were used to estimate the effects of the identified nursing attributes on death and failure to rescue before and after controlling for other hospital and patient characteristics. The effects were the same for failure to rescue and death. Their results demonstrated that decreased hospital mortality and failure to rescue in the different hospitals were associated with an increased number of nurses with BSN and higher degrees and with nurses holding a BSN who were also certified. More
specifically, the findings showed a 6% decrease in the odds of patients dying for every
10% increase in the percentage of BSN nurses in the hospital and a 2% decrease in the
odds of patients dying for every 10% increase in the percentage of BSN nurses with
specialty certifications.

Schmid et al. (2007) conducted a literature review on failure to rescue. They
analyzed articles exploring the influence of hospital features and registered nurse (RN)
staffing on failure-to-rescue events and RRT effectiveness. The researchers focused their
attention on three major categories of research: (a) the implementation and use of failure
to rescue as a quality outcome measure, (b) an evaluation of the impact of RRT in
reducing unanticipated transfers to the ICU and unexpected cardiac arrest in the hospital
setting and, (c) an assessment of the relationship between nurse staffing and failure to
rescue. In their review, Schmid et al. examined several studies conducted by Silber and
colleagues. Their findings showed a negative correlation for failure to rescue with the
ratio of RNs ($p = .01$). A higher number of RN staffing was associated with a lower risk
for failure to rescue. In addition, the ratio between nurses and hospital beds also
explained the rates of adverse events, mortality, and failure to rescue. Furthermore, the
researchers expanded their thinking of failure to rescue as a way of assessing the quality
of care provided by a hospital because it significantly impacted mortality rates. Their
review also explored a study by Aiken and colleagues who found a relationship between
RNs’ educational background and hospital mortality and a relationship between failure to
rescue and the ratio of RNs providing direct patient care. A decrease in failure-to-rescue
events was related to a higher number of RNs having a bachelor’s degree or higher.
Similar results were also supported by the study mentioned previously by Kendall-Gallagher et al. (2011).

A prospective and retrospective descriptive study was conducted by Hammer et al. (2012) to determine the annual hospital and regional rates of failure to rescue in acute care hospitals in a large urban area in North Texas. The researchers used the Agency for Healthcare Research and Quality definition of failure to rescue as death among surgical patients with treatable serious complications. Although the study yielded a downward trend in the annual and regional failure-to-rescue rates in a 5-year period, statistical significance was not reached. However, hospital characteristics seemed to play a role in the results, but it was not clear what specific hospital characteristics contributed to the downward trend of failure-to-rescue events.

**RRT**

Several studies have shown that clinical signs of deterioration are present before adverse events and cardiac arrest (Green & Williams, 2006; Scatena Gonçales et al., 2012). Because studies revealed that hospital personnel have been unable to respond early enough and effectively to these events, the dire outcomes of failure-to-rescue events led to the implementation of measures to improve observational skills and the early detection and response to rescue situations (Taenzer et al., 2011). One approach that emerged was the creation of a team that could be quickly called when patients meet predefined criteria or when health care providers express concern for their patients’ clinical status (Schmid et al., 2007; Taenzer et al., 2011). The success of CRA treatment depends on immediate resuscitation procedures performed by trained and qualified medical personnel with appropriate resources (Scatena Gonçales et al., 2012). RRTs are
now used as an efficient intervention strategy to further decrease failure-to-rescue events (Hammer et al., 2012).

A hospital’s RRT is usually made up of a multidisciplinary group of medical, nursing, and respiratory therapy personnel who promptly respond to assess, triage, and treat hospitalized patients outside the ICUs who are presenting with clinical signs of physiological deterioration (Chan, Jain, Nallmothu, Berg, & Sasson, 2010; Simmes, Schoonhoven, Mintjes, Fikkers, & van der Hoeven, 2013). The RRT is considered a powerful strategy used to promote patient safety. More than taking care of the patient, the RRT’s job is mainly to act as an immediate second opinion in patient situations that can be potentially serious (Scatena Gonçales et al., 2012). The intention of an RRT is to improve the safety of hospitalized patients by preventing CRAs and avoiding unexpected deaths outside the ICU by having a team of experts who can be called to the patient’s bedside 24 hours a day, 7 days a week. The RRT is expected to promote teamwork between critical care nurses and ward nurses though assessment, communication, immediate intervention, education, and support (Scatena Gonçales et al., 2012; Thomas et al., 2007).

The 100,000 Lives Campaign by the Institute for Healthcare Improvement encouraged American hospitals to implement RRTs (Chan et al., 2010). Consequently, approximately 3,100 U.S. hospitals joined the campaign and 60% put into practice the use of RRTs as part of their quality improvement programs (Chan et al., 2010; Hammer et al., 2012). The Institute for Healthcare Improvement proposed six lifesaving strategies to improve patient outcomes; one of them was the use of RRTs (Beebe et al., 2012; Scatena Gonçales et al., 2012; Thomas et al., 2007). Since the implementation of these
interventions in 2004, the Institute for Healthcare Improvement reported in June of 2006 that they exceeded their goal with a remarkable 122,300 deaths prevented (Thomas et al., 2007).

Implementation of the RRT in hospital settings has occurred worldwide and research studies have evaluated its effectiveness. Scatena Gonçales et al. (2012) conducted a retrospective analysis using data from patients’ charts to evaluate the impact of the implementation of an RRT in a Brazilian hospital. This team was to respond to events called *code yellow* and data were collected to compare the rate of CRAs and hospital mortality before and after its implementation. A code yellow was triggered by nursing via telephone when a patient showed deterioration in cardiac, respiratory, or neurological monitoring parameters or when the caregiver had serious concerns about a patient’s general condition. The study analyzed data collected 19 months before implementation of the RRT and 19 months afterwards. Preintervention results showed 3.54 CRA events per 1,000 discharges and 16.27 deaths per 1,000 discharges. The number of CRAs decreased to 1.69 per 1,000 discharges (*p* < .001), representing a 52% decrease, and the in-hospital mortality numbers decreased to 14.34 patients per 1,000 discharges (*p* = .029) after implementation of the RRT. The decline in CRA events was observed in all units in the study hospital, indicating an association between the RRT response and the reduced CRAs events.

Another retrospective analysis of RRT effectiveness was done by Karpman et al. (2013). Their goal was to analyze the impact of the RRT on the patient’s clinical outcome after being transferred from ward and nonward settings (emergency department, operating room, and other hospitals) to two ICUs. The study lasted a total of 6 years and
was divided into two periods of time: pre-RRT and RRT period. A total of 20,745 patients were admitted to the ICUs during the study time. During the pre-RRT period, 10,700 patients were admitted to the ICU, with 2,466 (23%) admitted directly from the ward in comparison with 2,424 (24.1%) out of 10,045 patients admitted during the RRT study period. The admission rate during the pre-RRT period was 58.4 per 1,000 hospital admissions compared to 68.8 during the RRT period ($p < .001$). Of the 2,424 patients transferred from the ward to the ICU, 844 had RRT calls, with the most common reasons for these ICU admissions in both periods identified as respiratory and cardiovascular instability. Although the ICU length of stay was shorter during the RRT period, the daily ICU admission numbers were higher and the mortality risk increased. The reason for the high mortality was thought to be related to the fact that RRT activation was only done in the minority of the patients transferred from the floor. However, the CRAs declined during the RRT study timeframe in comparison to the pre-RRT period.

Leach and Mayo (2013) conducted a descriptive qualitative study with the aim to explore the effectiveness of the RRT in a teaching hospital. Using grounded theory and a convenience sample, they conducted semistructured interviews to describe the perceptions and interventions of RRT calls as they happened in the usual hospital ward setting. A total of nine RRT events were observed in a 30-day period. Two groups of hospital personnel were interviewed—RRT members and hospital leaders associated with the implementation and training of the RRT. The research question asked was, “How does a rapid response team function effectively?” (Leach & Mayo, 2013, p. 200). The researchers identified five categories accounting for the effectiveness of an RRT: organizational structure, team structure, expertise, communication, and teamwork. The
results revealed that some of the distinctive challenges encountered in RRT activations included communication issues among team members during a crisis response, which is critical in managing a patient, and the lack of consistency of RRT membership, which prevents members from forming relationships within the team and from developing team skills.

A systematic review study done by McGaughey et al. (2007) showed inconclusive results regarding the effectiveness of outreach teams. Outreach teams are the United Kingdom’s version of RRTs in the United States. The objectives of this study were to determine the impact of critical care outreach teams on hospital mortality rates and their effect on ICU admission patterns, length of stay, and adverse effects. This review looked at two randomized control trials: one that compared 12 hospitals with outreach teams to 11 without a team and a second study that compared 16 hospital wards with and without an outreach team. The results of the first study showed no significant difference in the number of unexpected deaths or the incidence of unplanned ICU admissions in comparison with the control group. However, an increased incidence of unexpected cardiac arrest was seen in the control group compared with the intervention group. The second study showed that outreach teams reduced hospital mortality but also led to an increase in length of stay in the outreach group compared with the control group.

**Emergency Warning Signs**

RRTs evolved to address the fact that numerous patients who suffered serious adverse events exhibited preceding clinical deterioration shown in the form of identifiable physiological instability (Jaderling, Bell, Martling, Ekbom, & Konrad, 2013). The Joint Commission in its 2008 National Patient Safety Goals recommended a
methodology to allow health care personnel to openly request additional support from
other health care providers when the condition of a patient becomes visibly worse
(Karpman et al., 2013).

Multiple studies have demonstrated that up to 17% of hospitalized patients suffer
complications and serious adverse events while cared for in hospitals (Jones, Bellomo, &
De Vita, 2009). Furthermore, 77% of patients with complications and serious events
exhibit evidence of respiratory instability up to 8 hours prior to cardiac arrest (Gerdik et
al., 2010). The research clearly demonstrates that delays in activation of RRTs have a
great impact on patient outcomes and suggests the importance of early recognition and
timely therapy (Gerdik et al., 2010).

Abnormal vital signs are used by RRTs to identify patients outside the ICU who
are clinically deteriorating and may be at risk of suffering a cardiopulmonary arrest. The
skill to recognize abnormal physiological parameters and a clinically unstable patient is
the principal element of RRT activation (Green & Williams, 2006; Ludikhuize et al.,
2012). The importance of recognizing abnormal vital signs emerged from research
studies showing that clinical decompensation occurs within 6 to 8 hours preceding a
cardiac arrest (Green & Williams, 2006; Kyriacos, Jelsma, James, & Jordan, 2014;
McGaughey et al., 2007). Approximately 80% of patients exhibit signs of deterioration
that can be identified within 24 hours preceding severe adverse events such as CRA
(Ludikhuize et al., 2012). Observational studies have demonstrated that many critically
ill patients who are admitted to critical care units or those who have experienced CRA
display obvious and detectable signs of deterioration in the hours before these incidents
and commonly exhibited abnormal vital signs (Jones et al., 2009; Ludikhuize et al., 2012; Marshall et al., 2011).

The three important components to appropriate recognition and treatment of a deteriorating patient are (a) accurate and opportune documentation of vital signs and the skill to interpret them, (b) prompt action when trends of deterioration are first noted, and (c) availability of an RRT (Hammond et al., 2013). However, studies have shown current clinical practice with respect to vital sign measurement in general ward patients is typically inconsistent (Ludikhuize et al., 2012). For instance, in one Australia study, documentation of vital signs was reported to be poor, with respiratory rate being the least documented sign (Hammond et al., 2013). A study done in the Netherlands by Ludikhuize et al. (2012) revealed that completeness of general vital signs monitoring after major surgery in the first 3 postoperative days was only 17%. Their data also revealed a significant lack of measurements and recording of vital signs in patients in the 48 hours prior to severe life-threatening adverse effects. Blood pressure and heart rate were recorded most often, while respiratory rate was recorded in only 23% of the cases reviewed, and urine output and level of consciousness were rarely recorded (Ludikhuize et al., 2012). In addition, the study by Kyriacos et al. (2014) also recognized the lack of consistency in the evaluation and monitoring of physiological parameters. The results and implications of these studies are concerning because abnormal respiratory rates have been consistently associated with acute clinical deterioration (Hammond et al., 2013).

**Summary**

Prevention of failure-to-rescue scenarios can be approached through the use of RRTs. Numerous factors have been related to failure to rescue, including hospital and
staff characteristics. Therefore, providing staff with the appropriate resources can help address these events. The use of various scoring systems is a way to assist health care providers in identifying situations in which additional assistance is required in the treatment of deteriorating patients. These tools can also help increase the appropriateness of RRT activation for patients whose clinical condition has deteriorated and lead to more ideal treatments and identification of the need for increased levels of nursing and medical care for these patients.
PROJECT GOALS AND OBJECTIVES

The purpose of this project was to determine whether the MEWS was a valid and reliable instrument to guide nurses caring for medical and surgical patients in identifying patient conditions that require activation of the RRT. In addition, this author set out to assess whether the current RRT policy and/or the use of the MEWS tool at the project setting needed to be revised based on the findings of this project. Thus, the overall goal of this project was to improve patient care through the appropriate use of the RRT and to decrease nonindicated RRT activations. To achieve this goal, the author assessed the trustworthiness of the MEWS tool as an instrument to assist nurses and sought to determine whether modification in the tool was needed based on the data collected over an extended period of time. Data were collected on all RRT activations in the hospital and identified by ward setting among other factors. This collection was done via a record review of cases classified as potential failure to rescue and analyzed as to whether MEWS criteria were overlooked.

The long-term desired outcome of this project was to improve patient care outcomes related to early identification of the clinical deterioration in patients by using the MEWS and based on the following premises. This tool highlights awareness for charge and staff nurses as to situations where additional nursing and medical management may be needed in the care of patients whose clinical condition is deteriorating. The MEWS tool allows nurses to identify patients needing continual close monitoring or to request RRT assistance. In addition, the use of this tool should promote better adherence to the RRT protocol for nursing staff taking care of a patient.
If the patient is evaluated by the RN using the MEWS tool and the score does not warrant an RRT activation but indicates a downward trend in the patient’s condition, the policy states that the RN will notify the main medical provider and discuss his or her concerns about changes in the patient’s clinical condition that are worrisome. In these cases, physicians have an opportunity to assess their patient and evaluate possible reasons for changes in the patient’s vital signs and/or mental status and can intervene as needed. This provides the physician with a warning of the patient’s status, which allows for pertinent changes in the frequency of assessment or additional measures or therapy to be implemented if needed. These actions may possibly avoid further instability, RRT activation, and unnecessary ICU admissions. Furthermore, patients will benefit from early assessment and close monitoring by RNs and from faster medical interventions that can prevent complications such as cardiopulmonary arrests. The MEWS tool also notes that a nurse should activate an RRT by clinical judgment, that is, if in his or her opinion there is need for an immediate evaluation by his or her team of experts.

There are many benefits from reductions in mortality and morbidity accomplished by early identification of those patients at risk for clinical deterioration. This warning system can reduce unnecessary ICU admissions and decrease hospital length of stay, leading to savings of financial resources, which is always a consideration of hospital administrators. RRT activation should be initiated if the MEWS warrants activation or if there is still serious concern by the nurse about changes in the patient’s clinical condition. The RRT will come regardless if the MEWS does not warrant its activation. The team will assess the patient even if there are no interventions required. However, situations in which a nurse inadvertently misses early signs of deterioration must be avoided in
hospital settings as this inaction can result in a CRA event or death (i.e., failure to rescue).
METHODS

Design

This study employed a retrospective design involving collecting and analyzing secondary medical record data. RRT data were collected for analysis during 3 consecutive months. This author looked at RRT activations based on the existing hospital policy. The project investigator assigned a MEWS based on the data present in the patient’s record that was linked to the reason for the activation to determine whether the MEWS would coincide with the MEWS identified as requiring an RRT activation. In addition to vital signs or the MEWS, other signs of clinical instability were considered as inclusion criteria for RRT activation. Data were collected via an in-depth review of all the RRT patient records for those in the medical and surgical units outside the ICUs during a 3-month period. The project investigator reviewed the RRT reports and the patients’ charts and collected all data evaluated for this project.

Setting

The setting of this study is a 570-bed county hospital that serves as a level one trauma center in the southwestern region of the United States. The hospital provides health care services mostly to underserved populations. All the adult medical and surgical units not considered ICUs were included in the study. The labor and delivery unit was also excluded because this unit has its own RRT.

Sample

Because RRT activation is an unpredictable event, a convenience sample of hospitalized patients was used. All adult RRT activation cases that occurred in the medical and surgical units in the hospital were included for the 3-month period selected.
Adult was defined as any patient age 18 years and older. Patients in CRA and patients in the clinics and in obstetrics and gynecology (OB/GYN) and labor and delivery floors were excluded.

**Ethical Considerations**

To assure that patients’ confidentiality was protected, Institutional Review Board (IRB) approval was sought at the medical facility where the study was conducted and from California State University, Long Beach. The study was approved by the California State University, Long Beach, IRB and the IRB from the medical facility where the data were collected. The approval letters are shown in Appendices C, D, and E.

**Research Questions**

Research questions that the project investigator attempted to answer included the following:

1. What impact would the use of the MEWS tool have on an RRT activation?
2. Would the MEWS accurately reflect a patient with clinical deterioration?
3. What impact did age and comorbidities have as potential covariates in RRT activations and clinical decompensation?

**Operational Definitions**

*CRA/cardiac arrest/code blue:* CRA is the abrupt failure of the heart to effectively contract and pump blood, leading to cessation of blood circulation (Kasper et al., 2005). When this event occurs, a code blue alert is activated in health care settings.

*EWS/MEWS:* EWS/MEWS are bedside scoring systems that monitor vital signs and calculate a total score to assist in recognizing a patient whose condition is deteriorating (Kyriacos et al, 2014).
Failure to rescue: Failure to rescue is a death after a complication, reflecting a suboptimal quality of care (Hammer et al., 2012).

Physiological deterioration/decompensation: Physiological deterioration/decompensation refers to sudden changes and abnormalities of physiological variables known as vital signs (Kyriacos et al., 2014).

RRT: A rapid response team (RRT) is a multidisciplinary team of medical, nursing, and respiratory therapy personnel who promptly respond to a patient’s bedside to assess, triage, and treat patients outside the ICUs presenting with clinical signs of physiological deterioration (Chan et al., 2010; Simmes et al., 2013).

RRT, Appropriate Activation: An RRT activation is considered appropriate when a patient has been identified as clinically unstable based on abnormal physiological parameters as outlined in the RRT hospital policy or the clinical judgment of the clinician justifies it and the patient received the required immediate attention by nurse activation of the RRT to the patient’s bedside.

RRT, Successful Activation: An RRT activation is considered successful when the identified patient received some form of therapy that improved the patient’s clinical condition or when the patient was transferred to a higher level of care, preventing further deterioration.

Variables of Interest

This study investigated whether the MEWS tool was a dependable, consistent tool that could be used in the identification of patients at risk for clinical deterioration and whether it had construct validity with the RRT policy in place that defined parameters to activate RRT. Other variables that were considered as potential covariates were the
patient’s preexisting medical conditions, diagnosis on admissions, and age. The independent variable of the study was the use of the MEWS tool and the dependent variable was the number of RRT activations.

Additional variables of interest included the need for therapy (intravenous fluids, medications) and/or the need for a higher level of patient care. All RRT activations in the hospital wards that were included in the study were recorded for 3 consecutive months. The author reviewed the RRT activation reports and the patient medical records related to each activation. She then rated the events as a medically appropriate RRT activation based on the following criteria: instability of vital signs (an alert MEWS), sudden change in clinical condition, clinical judgment of the staff RN caring for the patient, and the need for therapy and/or higher level of care. All other activations that did not meet these criteria were judged an inappropriate use of this response team.

The main extraneous variables studied in this project were preexisting medical conditions and type of surgical interventions, if any. Extraneous variables associated with the caregiver were workload, late assessments of the patient, and inconsistency with vital signs recording. These were variables that the project investigator could not control and, therefore, were not included in the analysis.

**Instruments**

**RRT Hospital Policy**

The RRT activation policy used in this medical center is based on a specified range of vital signs, including heart rate, blood pressure, respiratory rate, and oxygen saturation, in addition to other physiological parameters, such as urinary output and level of consciousness. The provider can activate the RRT if one or more of the physiological
parameters is out of range, if there is a worsening in the patient’s condition, or at the discretion of the provider.

MEWS

The MEWS tool used in this facility was created based on the MEWS, a modified version of the EWS developed in 1997. The MEWS is a bedside tool that facilitates early recognition of a patient’s clinical deterioration (McGaughey et al., 2007). A high degree of interest in the use of the MEWS has been exhibited through its adoptions in numerous medical facilities and as the topic of numerous studies. However, the validity of the MEWS tool is still controversial and research has demonstrated that its success depends on the resources of the facility where it is implemented (McGaughey et al., 2007; Wheeler et al., 2013).

The MEWS tool uses a scoring system that assigns a number to values for each of the following physiological parameters: respiratory rate, oxygen saturation, use of supplemental oxygen, temperature, systolic blood pressure, heart rate, and level of consciousness. Each parameter has scores from 0 to 3. A score of 0 is given to a normal parameter, and the number increases according to the degree of abnormality in the specified physiological parameter. The maximum score in each of the parameters is 3 when the deviation from normal is most severe. A total score, across all parameters, from 0 to 4 indicates to the RN to continue monitoring the patient at a minimum of every 4 hours and decide if increased frequency of nursing monitoring or if escalation of clinical care is necessary. Any single parameter with a score of 3 or a total score from 5 to 6 requires the RN to increase monitoring to a minimum of every 2 hours, assess for severe sepsis or septic shock, and notify the patient’s primary provider. With a score of 7 or
more, the RN is to automatically activate the RRT. The RN does not need to report repeated scores for unchanged conditions before an urgent assessment; nevertheless, if there is an increase in score, the RN should follow the appropriate MEWS actions based on the obtained score. It is important to mention that the MEWS was not created as a substitute for knowledgeable clinical judgment. Any concern regarding the patient’s condition overrides the MEWS if the provider believes escalation of care is necessary.

**Procedures**

The project investigator collected information through an extensive chart review of all RRT activations for patients 18 years and older at the medical facility from January 1, 2014, to March 31, 2014. The patient’s data were entered into an Excel data collection software file designed for this study that was developed by the researcher. Causes for the RRT activation were explored in each case, with the exclusion of any identifying information that could directly link the file to a patient (i.e., no social security number, medical record, address, birthdate, data of RRT code, etc.). Each RRT activation report was reviewed to collect the following data: type of RRT (surgical or medical), patient’s age, gender, admitting diagnosis, comorbidities, reason for RRT activation, location of the patient where the RRT was activated, interventions, and if the patient was transferred to a higher level of care (see Appendix F for data collection tool).

The total study period of data collection was 90 days. Data were obtained utilizing the RRT activation reports submitted by the charge nurses of the medical and surgical units to nursing administration and from the daily surgical morning reports kept by the trauma surgery department for the 3 months of this study.
The RRT activation report is a documentation of events involving all the medical and surgical patients who had an RRT event. This record contained demographic information such as the patient’s age and gender. Also, location where the RRT was activated, type of RRT (medical or surgical), and reason for RRT activation were included in the report. Other information available in some of the reports included: patient’s diagnosis, comorbidities, vital signs, interventions, and need for higher level of care.

The surgical morning report contained a list of patients admitted, evaluated, or consulted by the trauma surgical team during a 24-hour call period. The report included those patients who required surgical RRT evaluation. The information provided in the morning report included: patient’s age, gender, diagnosis, reason for surgical consult/RRT activation, brief description of the patient’s clinical condition, and plan or interventions provided.

At the time the study was conducted, the medical facility used hard copy charts. However, some nursing charting, such as vital signs recording, and some provider charting, such as operative notes, discharge summaries, and death summaries, were available in electronic medical record form. Consequently, vital signs records, past medical history (comorbidities), and admitting diagnosis were obtained from the electronic medical records when these were not available in the RRT reports or the surgery morning reports.

Data were collected on all RRT activations for the 3 months of interest. All RRT activations were based on the RRT policy criteria. The study researcher assigned a MEWS to each of the RRT events based on the vital signs or clinical criteria used for the
RRT activation, and an analysis was conducted to see how many RRT events would have occurred if the MEWS tool had been used. This allowed the researcher to evaluate what impact the MEWS would have on RRT activations.

Other criteria the project’s author reviewed were the number of patients transferred to a higher level of care—ICU, step-down units (SDU), and telemetry floors—and the number of patients who received therapeutic interventions. These data were evaluated to determine the effectiveness of the MEWS tool and to evaluate whether its use accomplished what it was designed to do.

An RRT event was considered appropriate when it met one or more clinical parameters included in the RRT policy or when the clinical judgment of the RNclinician justified the activation even in the absence of clinical parameters. Under the MEWS tool that was being tested in the hospital setting, an RRT activation would be appropriate with a score of 7 or higher or if clinical judgment warranted an RRT activation even with a score less than 7. An RRT activation was considered inappropriate if the activation was not warranted by any of the physiological parameters shown in the RRT policy or any other signs of clinical deterioration indicated in the RRT reports. Similarly, an RRT activation was considered inappropriate under the MEWS criteria if the score was less than 7 and there was nothing to suggest an activation based on appropriate clinical judgment.
Data Analysis

An independent statistical consultant with no association to this study assisted with the data analysis reported for this project. For continuous values, descriptive statistics were presented as frequencies and percentages. For age, the mean and standard deviation were reported. The primary research question was to determine if the use of a score system tool (MEWS) had any impact on the activation of the RRT. A logistic regression was conducted with the RRT protocol as the response variable and the met MEWS for activation as the predictor variable. The assumption here was that a met MEWS for activation will predict when an appropriate RRT activation is called. To include more instances where an RRT activation was appropriate, a logistic regression was conducted with the addition of the judgment call response variable.

The second question was to determine whether the MEWSs would accurately reflect a patient with clinical deterioration. Interventions provided to the patient and transferred to a higher level of care were used as the main indicators reflecting whether the patients had clinical deterioration or not. Patients who were transferred to a higher level of care were identified as group 1 and patients who were not transferred were labeled as group 2. A t test was performed to test if these two groups were significantly different from each other. A p value of .05 was considered to be significant.

A third research topic was to determine the impact of age and comorbidities as potential covariates for clinical deterioration. Similar to the approach for the second question, the patients were also divided into two groups. A t test was conducted to test if the age of these two groups were significantly different from each other. The patient’s age was grouped into categories of 10-year differences (i.e., 20 to 29, 30 to 39, and so
on). For comorbidities, Fisher’s exact test was used to test the null hypothesis that the probability of patients who have comorbidities in group 1 was the same as patients in group 2. A $p$ value of .05 was considered to be significant.

**Assumptions**

In the completion of this project, several assumptions were made. First, there was accurate recording of all RRT activations during the 3-month period of this project. Second, patients’ demographic data and patients’ preexisting medical conditions were accurately recorded. Third, all interventions provided to the patient during the RRT event were accurately documented. Lastly, the sample of research participants in this study was representative of patients cared for in medical and surgical units and the results of the study, therefore, have a reasonable degree of generalizability to a similar population.

**Summary**

Data were collected for RRT activations over a 3-month period in the medical and surgical units (outside the ICUs) at a level one trauma center providing care to underserved populations. The medical center of this study used a single parameter RRT policy. An evaluation of a scoring system tool was performed to determine its usefulness in decreasing RRT activations by detecting early necessary interventions to prevent further clinical deterioration. Operational definitions included the primary terms relevant to this study and the collection process was explained. Only adults age 18 and over were included in this study as well as only those in the clinical and surgical wards, with OBGYN and labor and delivery excluded.
RESULTS

The final sample consisted of 81 RRT activations ($N = 81$) during a 3-month period (Table 1). Most of the RRT activations were medical, accounting for 77.78% of all cases, and the remaining 22.22% were surgical. The sample’s age ranged from age 21 to 96 years ($\mu = 56.4$; Figure 2). Over half of the subjects (51.85%) were male and 48.15% were female (Table 2). Comorbidities were found in 81.46% of the subjects.

Table 1

<table>
<thead>
<tr>
<th>Type of RRT</th>
<th>Medical</th>
<th>Surgical</th>
<th>Total for Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>$n$</td>
<td>$n$</td>
<td>$n$ (%)</td>
</tr>
<tr>
<td>January</td>
<td>26</td>
<td>8</td>
<td>34 (41.98)</td>
</tr>
<tr>
<td>February</td>
<td>18</td>
<td>7</td>
<td>25 (30.86)</td>
</tr>
<tr>
<td>March</td>
<td>18</td>
<td>3</td>
<td>22 (27.16)</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
<td>18</td>
<td>81 (100.00)</td>
</tr>
</tbody>
</table>

Figure 2. Age distribution of study subjects.
Table 2

Demographic Characteristics of Study Subjects

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>42 (51.85)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>39 (48.15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>56.44</td>
<td>17.89</td>
<td></td>
</tr>
<tr>
<td>Comorbidities</td>
<td>66 (81.48)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All RRT activations received a score based on the MEWS. The average score was 3.56 (Figure 3). From the data, there were only eight instances where the score was met for RRT activation (MEWS greater or equal to 7). Also, there were 66 cases when the RRT activation was appropriate and 59 cases when a judgment call was made to activate the RRT by the RN. Whenever a MEWS was met for an RRT activation, the RRT criteria were met and the activation was recorded as the RN did not need to make an independent judgment call.

![MEWSs Distribution](image)

*Figure 3.* MEWS distribution.
MEWS and Clinical Judgment Call

The logistic regression conducted with the RRT protocol as the response variable and the met MEWS for activation as the predictor variable concluded that the met MEWS is not significant in predicting an appropriate RRT activation \((p = .991)\). This was expected since only eight out of 81 cases had a MEWS that met the criteria to activate an RRT. To include more instances where an RRT activation was appropriate, a logistic regression was conducted with the addition of the judgment call response variable. This test concluded that the judgment call was significant in determining whether the RRT protocol was met \((p < .0001)\). This result was not surprising as the parameter for the met MEWS was not significant \((p = .993)\). Again, this was expected since judgment calls were used more often to determine an RRT activation than the MEWS tool.

From the RRT data we know that out of 81 patients, eight of them had a MEWS higher than 7. So, the percentage of activations which met the MEWS is 9.88% \((8/81)\). That is,

\[
\frac{\text{the number of activations which met the MEWS score}}{\text{the total number of activations}} = 9.88\%
\]

However, there were more patients \((72.84\%)\) where a judgment call from the RN overruled the MEWS tool in deciding to activate an RRT. If we take the clinical judgment call into account, the number of activations caused by the MEWS is 67 (eight met the MEWS and 59 were judgment calls). Accordingly, the percentage of RRT activations caused by the MEWS is 82.71% \((67/81)\). That is,

\[
\frac{\text{the number of activations caused by MEWS (two criteria)}}{\text{the total number of activations}} = 82.71\%
\]
By using the bootstrap method, the 95% confidence interval of the percentage of RRT activations caused by the MEWS is 74.07% (90.12% with clinical judgment). The bootstrap estimate of standard error is 0.042 (quite small). So, this estimate from the bootstrap method is a good estimate of the population standard error in this case.

For the MEWS tool to have a more significant impact in deciding RRT activation, the MEWS criteria need to be lowered. Just by lowering the MEWS criteria for RRT activation to include a score of 6, the logistic regression shows that the met MEWS for activation parameter becomes significant in determining an appropriate RRT activation at the .05 significance level ($p = .00375$); now 30.86% of the MEWSs call for an RRT activation.

**Clinical Deterioration Difference Between Groups**

Transfer to a higher level of care was used as the main indicator for clinical deterioration (Figure 4). A $t$ test was performed to see if the patients who were transferred to a higher level of care were significantly different than those who were not transferred. Patients transferred were labeled as group 1 and those patients who were not transferred as group 2. The average MEWS was 3.91 in group 1 and 2.93 in group 2. The $p$ value of this $t$ test was .049, which is less than .05, and we marginally reject the null hypothesis that the average scores of these two groups were not significantly different (Table 3).

**Age and Clinical Deterioration Differences Between Groups**

Similar to the second question, the 81 patients were separated into two groups to determine if age and comorbidities were potential covariates to clinical deterioration. Group 1 represented patients transferred to a higher level of care and group 2 were
Figure 4. Number and distribution of patients transferred to a higher level of care.

Table 3

Clinical Deterioration Difference Between Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Transferred to a Higher Level of Care</th>
<th>Group 1</th>
<th>Group 2</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1 Yes (n = 53)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEWS (mean)</td>
<td>3.91</td>
<td></td>
<td></td>
<td>.0495a</td>
</tr>
<tr>
<td>Covariates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (mean)</td>
<td>57.69</td>
<td>54.11</td>
<td>.1945a</td>
<td></td>
</tr>
<tr>
<td>Comorbidities (n)</td>
<td></td>
<td></td>
<td></td>
<td>.653b</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>43</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>23</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Note. MEWS = Modified Emergency Warning Score.

a  *t* test.

b Fisher’s Exact test.

patients not transferred to a higher level of care. The average age of group 1 (n = 53) was 57.69 and the average age of group 2 (n = 28) was 54.11. A *t* test was performed to test if the ages of these two groups were significantly different from each other. The *p* value is .1945, which is greater than .05. So, we cannot reject the null hypothesis that the ages of these two groups are significantly different.
Comorbidities and Clinical Deterioration Differences Between Groups

The most common comorbidities among the subjects in the study are shown in Figure 5. Fisher’s exact test was used to investigate the null hypothesis that the probability of patients who had comorbidities in group 1 was the same for patients in group 2. Group 1 had 43 patients who had comorbidities and 10 patients who did not have comorbidities. In group 2, there were 23 patients who had comorbidities and five patients who did not have comorbidities. The \( p \) value is .653, which is greater than .05. So, the null hypothesis that the probability of patients that have comorbidities in group 1 is the same as patients in group 2 cannot be rejected. There was no difference between the groups as to comorbidities.

Figure 5. Most common comorbidities of study subjects.
DISCUSSION AND RECOMMENDATIONS

This retrospective study was conducted in a large level one trauma center. The study analyzed all the RRT activations \( (n = 81) \) in a period of 3 months. The purpose of the study was to determine whether the score system tool (MEWS) was a valid and reliable instrument to guide nurses caring for patients in identifying a patient whose clinical conditions required activation of the RRT. This project investigator sought to determine if the use of the MEWS would have an impact on the number of RRT events.

After stepwise statistical analysis, the findings of this project indicated that only 67 (82.71%) of the RRT events would have occurred if the MEWS tool had been in use. The standard 95% confidence interval for this percentage is 74.07% (90.12% with clinical judgment). However, it is important to note that of these 67 projected activations, only eight (11.9%) would have occurred based purely on the score. The remaining 59 (88.1%) of the activations would have resulted from clinical judgment being exercised by the treating RN. Therefore, the score-only approach appears highly restrictive and would have little impact in RRT activation because of the greater number of overruling judgment calls made by the RNs. The results are consistent with the findings of the literature that indicate that, in well-established systems, up to half of the RRT activations may be the results of clinical judgment reflecting the concern or worry of the treating RN. This emphasizes that clinical intuition needs to be considered when designing response systems for clinical deterioration (Jones et al., 2013).

For the MEWS tool to have a more significant impact in deciding RRT activation, the MEWS criteria need to be lowered. Just by lowering the MEWS criteria for RRT activation to be at 6, the logistic regression shows that the met score for the activation
parameter becomes significant in determining an appropriate RRT activation at the 5% significance level ($p = .00375$); now 30.86% of the MEWSs call for an RRT activation.

The main purpose of the MEWS tool is to identify early clinical deterioration in the critically ill patient by tracking signs of deterioration and trigger a rapid response either by the primary care team or by activation of the RRT. Using the MEWS alone does not fully accomplish catching those cases where an RRT activation should occur. However, the data suggest that based purely on score, the MEWS seems to accurately reflect a patient with clinical deterioration. This was indicated by the number of patients requiring a higher level of care. Furthermore, the data showed that the average MEWS of patients who were transferred to a higher level of care is significantly greater, albeit marginally, than its comparison group where the patients were not transferred. There is a need for improvement in both capturing those patients who need an RRT and having activated an appropriate RRT for those patients who should be transferred to a higher level of care.

In evaluating the association between age and comorbidities as covariates for clinical deterioration, surprisingly, no difference was found between the groups that were transferred to a higher level of care and those that were not. Through the extensive review of the literature involved for this project, the project investigator found that instability of vital signs was the main predictor of clinical deterioration, but she was unable to find a relation between age or comorbidities and clinical deterioration. However, the study by Jones et al. (2013) suggests that age, gender, and comorbidities, among other variables, should be taken into consideration since these factors affect the patient’s baseline physiological reserve.
The results of this study indicate several severe problems with the MEWS. One is that based purely on the score, only a small fraction (about 9.8%) of the RRTs that did occur would have occurred. A reduction in the number of RRTs could be seen as a positive outcome if those low scores would have indeed eliminated unnecessary RRT activations. The problem noted in this project is that an approach based only on the MEWS would have triggered only 13.6% of the RRT incidents that were deemed as appropriate by this researcher. In short, the instrument as currently constructed is flawed in its ability to appropriately activate an RRT.

There are three possible explanations for the fact that the score-only approach is deficient in appropriately activating an RRT. The first is that the values assigned for specific conditions are too low, thereby making it very difficult for a patient to obtain the requisite score (7 or higher). The second is that the overall score required for activation is simply too high. As was noted previously, if the score for automatic RRT initiation were lowered to 6 instead of 7, then the number of instances captured with the tool based purely on score would have increased to 30.9% of the actual number that did occur. The third possibility is that there is a combination of the two explanations in play. It is believed by this project investigator that this is the likeliest case. The increased number of cases caught by the tool if the score were lowered to 6 suggests that a revision to the threshold score is required. However, this researcher is of the opinion that the instrument applies some scores that just do not make sense. For example, there is some inconsistency in the scoring system. More severe situations are assigned a higher score, but there is a lack of uniformity in the ways the scores are given. In the case of respiratory rate, there are scores of 0, 1, and 3 for the low rate, while scores for the high
rate are 0, 1, 2, and 3. Similarly, scores in the systolic blood pressure are 0 and 3 for the high parameter and 0, 1, 2, and 3 for the low one. It was also noted that a score of 0 was given to some abnormal parameters, while a score of 1 or 2 was given to a parameter within a normal physiological range. Therefore, it is believed that a review of the cut-offs for various scores is needed.

In contrast to the above, the RRT policy that was actually in place was a single scoring system. It was determined by this researcher that approximately 81.5% (66 out of 81 activations) of the RRT activations that occurred over the 3-month period were appropriate, defined as those instances where the patients required a higher level of care.

The following recommendations conclude this report:

1. The MEWS instrument should not be utilized based on scoring alone as currently constructed.
2. Closer examination of the values assigned to patients with various vital sign parameters is required.
3. Consideration of adjusting the minimum score required to mandate an RRT activation should occur.
4. Vital signs must be taken consistently and in a timely manner.
5. More complete vital sign recording is necessary for complete patient documentation.

Limitations

Since RRT activation is an unpredictable event, a convenience sample was used by selecting all of the RRT events. Two of the limitations of this study were the small sample size ($n = 81$) and the short review period since the project only included 3
months’ worth of data. Many of the studies reported in the literature had larger sample sizes and longer study periods.

In addition, this retrospective study relied on preexisting data from RRT reports and the daily trauma reports. Often, the time of RRT activation, vital signs, or reason for RRT activation were not present in the reports. To mitigate these omissions, the researcher went to the electronic vital sign records to fill in the gaps. While vital signs were ultimately found for all patients, there were considerable inconsistencies detected. In some case, meticulous records were kept appropriately. In others, vital signs were recorded in an untimely manner. The fact that some of the data were found on paper records while others were obtained electronically suggests another difficulty in analyzing these events. This agrees with the findings of several studies showing that accurate and diligent recording of vital signs is crucial for recognition and management of a deteriorating patient, but current clinical practice with respect to vital sign measurement in general ward patients is typically inconsistent (Hammond et al., 2013; Ludikhuize et al., 2012).

**Practice Change Implications**

At the time of the study, the hospital was evaluating whether or not to adopt the MEWS as a screening tool. A transition to an electronic medical record system was completed in November 2014, and a MEWS software program was incorporated into the electronic health record. However, at the time of this project, the electronic MEWS tool had not yet been launched for use in the hospital units. Currently, the RRT hospital policy is still under review with the decision-making process ongoing as to which MEWS criteria and scores to use to activate an RRT response.
The goal of this MEWS tool study was to provide data to use in the decision-making process related to the development of an RRT policy that provides clear direction and is effective in screening for early clinical deterioration in a patient’s status. Having a more explicit policy will potentially help nurses identify patients at higher risk for clinical deterioration, guiding nurses as to when to ask for earlier assessment and assistance from providers. The results of this study will be shared with the hospital administration to use in their decision. This project will provide the administration with data to show the impact of the MEWS by comparing the number of RRT activations by the RRT policy criteria with those that would have occurred under the MEWS obtained for the same RRT events.

**Summary**

American hospitals have implemented RRTs as part of their quality improvement programs. The RRTs have been shown to reduce failure-to-rescue events; however, the lack of consensus on the calling criteria is still a challenge. Having a clear, reliable monitoring instrument that can measure risk of clinical instability by using both subjective and objective criteria may provide a more individualized strategy of assessment for patients with clinical deterioration. Although the single parameter RRT policy used in this medical facility may not be perfect, RRT policy guidelines identifying vital signs parameters were able to capture the majority of the patients in need for immediate evaluation and treatment, while the MEWSs failed to do so. The findings of this study suggest that the MEWS criteria need to be reviewed before considering its adoption.
REFERENCES


Gillam, S. (2013). Frameworks for improvement: Clinical audit, the plan-do-study-act cycle and significant event audit. Quality in Primary Care, 21, 123-130.


APPENDIX A

RAPID RESPONSE TEAM HOSPITAL POLICY

SUBJECT: RAPID RECOGNITION AND RESPONSE TO POLICY NO. 351

CHANGES IN PATIENT CONDITION

PURPOSE:
The Rapid Response Team (RRT) program is designed to improve staff's ability to recognize and respond quickly and appropriately to a deteriorating patient.

POLICY:
Patient care staff will be trained to recognize signs of clinical deterioration. Any staff member who recognizes these signs will initiate a rapid response notifying a specially trained team. The team will be responsible for responding immediately to the patient’s bedside, performing initial assessment and intervention, and notifying the patient’s existing care team (if they are not already part of the team or aware of the response).

The bedside nurse may choose not to activate the rapid response team if a resident (PGY 2 or above) from the primary team is already present and managing the patient, although activation is still an option if additional resources are needed. The RRT will only respond for admitted patients in the ward and Progressive Care Unit (PCU)/Step Down Unit (SDU) areas, or any patient in the 5 West Infusion Clinic or 5 West Dialysis Center.

BACKGROUND:
Patients who are initially stable can deteriorate clinically in a short period of time. The ultimate form of clinical deterioration is a respiratory or cardiac arrest. The hospital has created Code Blue and Code White teams to provide immediate response in these cases. Information from researchers and healthcare improvement agencies shows that many patients who have a Code Blue/Code White response actually begin to show signs of deterioration many hours before the Code Blue/Code White is called. Rapid Response Teams are now widely used to provide immediate assessment and stabilization, long before a Code Blue/Code White occurs.

DEFINITIONS:
- Signs of Clinical Deterioration
  1. Acute change in heart rate.
  2. Acute change in systolic blood pressure.
  3. Acute change in respiratory rate or effort.
  4. Acute change in oxygen saturation.
  5. Acute change in mental status.
  6. Acute change in urinary output to less than 50 mL in 4 hours (adults only).
  7. Severe, uncontrolled bleeding.
  8. Any staff member is worried that the patient is deteriorating even in the absence of any of the above criteria.
**SUBJECT: RAPID RECOGNITION AND RESPONSE TO POLICY NO. 351**

**CHANGES IN PATIENT CONDITION**

Age-specific vital signs parameters are summarized in the table below and the RRT should be activated for **acute** changes:

<table>
<thead>
<tr>
<th>Age</th>
<th>Heart Rate</th>
<th>Respiratory Rate</th>
<th>Systolic Blood Pressure</th>
<th>Oxygen Saturati on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>Less than 40</td>
<td>Less than 8</td>
<td>Less than 90</td>
<td>Less than 90%*</td>
</tr>
<tr>
<td></td>
<td>More than 130</td>
<td>More than 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-teen/Adolescent (over 10 years)</td>
<td>Less than 50</td>
<td>Less than 90</td>
<td>Less than 90</td>
<td>Less than 90%*</td>
</tr>
<tr>
<td></td>
<td>More than 100</td>
<td>More than 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Age (6-10 years)</td>
<td>Less than 60</td>
<td>Less than 90</td>
<td>Less than 90</td>
<td>Less than 90%*</td>
</tr>
<tr>
<td></td>
<td>More than 120</td>
<td>More than 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toddler/Preschooler (1-5 years)</td>
<td>Less than 60</td>
<td>Less than 90</td>
<td>Less than 90</td>
<td>Less than 94%†</td>
</tr>
<tr>
<td></td>
<td>More than 180</td>
<td>More than 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infant (30 days-1 year)</td>
<td>Less than 70</td>
<td>Less than 90</td>
<td>Less than 90</td>
<td>Less than 90%*</td>
</tr>
<tr>
<td></td>
<td>More than 180</td>
<td>More than 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neonate (0-30 days)</td>
<td>Less than 80</td>
<td>Less than 90</td>
<td>Less than 90</td>
<td>Less than 90%*</td>
</tr>
<tr>
<td></td>
<td>More than 200</td>
<td>More than 60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Despite oxygen.
† Despite supplemental oxygen therapy or the patient requires a non-rebreather mask.

- **Rapid Response Team:** There are four different rapid response teams covering the different clinical services in the hospital:

<table>
<thead>
<tr>
<th>Rapid Response Team Covering</th>
<th>Clinical Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical RRT</td>
<td>Medicine, Family Medicine, Hospitalist, Neurology, Psychiatry</td>
</tr>
<tr>
<td>Pediatric RRT</td>
<td>Pediatrics</td>
</tr>
<tr>
<td>OB/GYN RRT</td>
<td>Obstetrics, Gynecology</td>
</tr>
</tbody>
</table>
APPENDIX B
MEWS TOOL

XXX Medical Center
Department of Nursing

Nursing Documentation for the Modified Early Warning Score (MEWS)
Write MEWS score in appropriate column when taking V/S Q4H. If any physiological parameter has a score $\geq 3$ please notify the RN. RN activates RRT if the MEWS score is $\geq 7$. Follow the legend on the back of this form for appropriate interventions.

<table>
<thead>
<tr>
<th>MEWSKEY</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>DATE:</th>
<th>UNIT:</th>
<th>BED:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSIOLOGICAL PARAMETERS</td>
<td>HEWS SCORE</td>
<td>0200</td>
<td>0600</td>
<td>1000</td>
<td>1400</td>
<td>1800</td>
<td>2200</td>
</tr>
<tr>
<td>RESPIRATORY RATE</td>
<td>$\geq 25$</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>21-24</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-20</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\leq 8$</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OXYGEN SATURATION</td>
<td>$\leq 91$</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>92-93</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>94-95</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 96$</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUPPLEMENTAL OXYGEN</td>
<td>YES</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEMPERATURE</td>
<td>$\leq 35.0$ C</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.1-36.0 C</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>36.1-38.0 C</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>38.1-39 C</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 39.1$ C</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYSTOLIC BLOOD PRESSURE</td>
<td>$\leq 90$</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>91-100</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>101-110</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>111-219</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 220$</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEART RATE</td>
<td>$\leq 40$</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>51-90</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>91-110</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>111-130</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 131$</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEVEL OF CONSCIOUSNESS</td>
<td>Alert</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V, P, U</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL SCORE**

Legends: $V =$ Responds to: Verbal stimuli; $P =$ Painful stimuli; $U =$ Unresponsive

- Green – 0-4
- Yellow = 5-6 or 3 in any single parameter
- Red = 7 or more
### Clinical Response/Actions Taken Based on MEWS

<table>
<thead>
<tr>
<th>HEWS Score</th>
<th>Actions</th>
</tr>
</thead>
</table>
| 0-4                 | • Continue to monitor at a minimum of every 4 hours  
                      • Registered nurse must assess the patient and decide if increased frequency of monitoring and/or escalation of clinical care is required |
| 5-6 or 3 in any single parameter | • Increase frequency of monitoring to a minimum of q2 hours  
                      • Registered nurse to inform the provider and patient flow coordinator  
                      • Urgent assessment by a provider  
                      • Consider transfer to higher level as appropriate  
                      • Assess for Severe sepsis/Septic Shock and if present use the Severe Sepsis order form (Form#P248 from affinity) for fluids, antibiotics, and labs. |
| 7 or more           | • Registered nurse to activate the Rapid Response Team                                                                                  |

### Key Concepts
- MEWS should not be used in children (<16 years old) or women who are pregnant.
- The chronically disturbed physiological conditions of some patients can influence the sensitivity of the MEWS, which should be recognized when interpreting HEWS in these patients (e.g., COPD, A-fib, Hypertensive urgency etc.)
• MEWS is not a substitute for competent clinical judgment. Concerns about a patient’s condition always override the MEWS if the health care provider considers it necessary to escalate care. Repeat scores for unchanged conditions do not need to be reported to provider for an urgent assessment. However, if an increase in score is obtained, proceed as indicated above.
APPENDIX C

CSULB IRB LETTER OF APPROVAL

CALIFORNIA STATE UNIVERSITY, LONG BEACH
OFFICE OF RESEARCH & SPONSORED PROGRAMS

DATE: January 22, 2015

TO: Jacqueline Mummery
FROM: California State University, Long Beach (IRB)

PROJECT TITLE: [663914-3] Enhancing the Effectiveness of the Rapid Response Team Activation: A Pilot Study
REFERENCE #: 15-111s
SUBMISSION TYPE: Revision

ACTION: APPROVED
APPROVAL DATE: January 20, 2015
EXPIRATION DATE: January 19, 2016
REVIEW TYPE: Administrative

This is to advise you that the Institutional Review Board for the Protection of Human Subjects (IRB) of California State University, Long Beach, has reviewed your protocol application.

Your application is approved. The requested modifications have been received, reviewed, and accepted.

Approval is for a period of one year and conditional upon your willingness to carry out your continuing responsibilities under University policy. If you would like to continue this research after this one year period, please submit a renewal application and an annual report to the Office of Research & Sponsored Programs two months prior to your expiration date of January 19, 2016.

1. You are required to inform the Director or Senior Associate Director, Office of Research & Sponsored Programs, in writing (email is acceptable) or through IRBNet within twenty-four hours of any adverse event in the conduct of research involving human subjects. The report shall include the nature of the adverse event, the names of the persons affected, the extent of the injury or breach of security, if any, and any other information material to the situation.

2. You may not change any aspect of your research procedure involving human subjects without written permission from the Director, Office of Research & Sponsored Programs or the Chair of the IRB. Please use the Protocol Modification Form on IRBNet to request any changes.

3. Maintain your research records as detailed in the protocol.

- 1 -
**APPENDIX D**

**MEDICAL CENTER IRB LETTER OF APPROVAL**

---

**APPROVAL OF RESEARCH**

On 01/07/2015 the John F. Wolf, M.D. Human Subjects Committee reviewed the following protocol:

<table>
<thead>
<tr>
<th>Type of Review/Submission:</th>
<th>Exempt/Initial Review, Reference #603250</th>
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<tbody>
<tr>
<td>Project Title:</td>
<td>Enhancing the Effectiveness of the Rapid Response Team</td>
</tr>
<tr>
<td></td>
<td>Activation: A Pilot Study</td>
</tr>
<tr>
<td>Investigator:</td>
<td>David Plurad, M.D.</td>
</tr>
<tr>
<td>LA BioMed Project No.:</td>
<td>30520-01</td>
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<tr>
<td>Funding Agency:</td>
<td>LA BioMed</td>
</tr>
<tr>
<td>Documents reviewed:</td>
<td>HRP-211: Submission Packet for Initial Review by IRE (Version 1.1)</td>
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<td>Institutional Research Project Application – Mammery Signature Page (Version 2.0)</td>
</tr>
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<td>Jacqueline Mammery CV (Version 1.0)</td>
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</table>

The John F. Wolf, M.D. Human Subjects Committee determined that the protocol was Exempt under Exempt Category #4 on 01/07/2015.

**Important Note:** Approval by the IRB does not, in and of itself, constitute approval for the implementation of this research. Other LA BioMed clearance and approvals or other external agency or collaborating institutional approvals may be required before study activities and initiated. Research undertaken in conjunction with outside entities, such as drug or device companies, are typically contractual in nature and require an agreement between the institute and the entity.

In conducting this research you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

---

HRP Form-596
Rev. n/A/2001
Signature applied by Gina Fierro on 01/09/2015 09:45:32 AM PST

Gina Fierro
Compliance Office

cc: Jacqueline Mummery, MSN, NP
Office of Research Administration
APPENDIX E

HIPPA WAIVER APPROVAL

HIPAA WAIVER APPROVAL
EXEMPT PROJECTS

On 01/07/2013 the John F. Wolf, M.D. Human Subjects Committee reviewed the following protocol:

<table>
<thead>
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<tr>
<td>Project Title:</td>
<td>Enhancing the Effectiveness of the Rapid Response Team Activation: A Pilot Study</td>
</tr>
<tr>
<td>Investigator:</td>
<td>David Plural, M.D.</td>
</tr>
<tr>
<td>LA BioMed Project No.:</td>
<td>305420-01</td>
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<tr>
<td>Funding Agency:</td>
<td>LA BioMed</td>
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<tr>
<td>Documents reviewed:</td>
<td>HEP-211: Submission Packet for Initial Review by IRB (Version 1.1)</td>
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<td>HEP-211: Application (Version 1.1)</td>
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<td>Submission Response Form/Modifications Required to Secure Approval (Version 1.0)</td>
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<tr>
<td></td>
<td>RRT data collection sheet (Version 1.0)</td>
</tr>
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<td>Investigator Protocol (Version 1.1)</td>
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<td>David Plural CV (Version 1.0)</td>
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<td>Institutional Research Project Application – Mummery Signature Page (Version 2.0)</td>
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<td>LA BioMed research project application (Version 1.0)</td>
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<td>Jacqueline Mummery CV (Version 1.0)</td>
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</table>

Your request for a waiver of the requirement for individual authorization for use and disclosure of protected health information in the above project was reviewed by a member of the John F. Wolf, M.D. Human Subjects Committee (which serves as the LA BioMed Privacy Board) and approved after consideration of the following points:

1. Since the investigators will be abstracting medical data without personal identifiers from a database to which they have routine access for clinical purposes, this project meets the criteria for a waiver of the requirement to seek prospective authorization for the use of protected health information.

If you have any questions, please call me at the above extension.

Sincerely,

Rev. December 7, 2011
Signature applied by Gina Fierro on 01/09/2015 09:30:07 AM PST

Gina Fierro
Compliance Office

cc: Jacqueline Mammoery, MSN, NP
## APPENDIX F

### RRT COLLECTION DATA SHEET

<table>
<thead>
<tr>
<th>RRT Activations</th>
<th>Mont</th>
<th>Type of RRT</th>
<th>Age</th>
<th>Gender</th>
<th>Diagnosis</th>
<th>Comorbidities</th>
<th>Reason for RRT activation</th>
<th>Location</th>
<th>Transfer Protocol</th>
<th>MEWS</th>
<th>Judgment Call</th>
<th>Intervention</th>
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<tr>
<td></td>
<td></td>
<td>Medical</td>
<td>64</td>
<td>Male</td>
<td>In A Year</td>
<td>Male/ Male</td>
<td>Ward/ PCU/ PCU/ SDU/</td>
<td>Ward/ PCU/ PCU/ PCU/ SDU/</td>
<td>ICU</td>
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<tr>
<td></td>
<td></td>
<td>Surgical</td>
<td></td>
<td>Male</td>
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