

FACTORS INFLUENCING THE USE OF THE MODIFIED EARLY WARNING
SCORE (MEWS) TO IDENTIFY PATIENT DETERIORATION

by

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ABSTRACT

Background: Approximately 80% of patients admitted to the ICU or requiring cardiopulmonary resuscitation display signs of deterioration up to 24 hours prior. Lack of timely recognition, response, and intervention for deteriorating patients increases patient mortality and poor outcomes. Rapid response teams (RRT) can be activated to avoid these outcomes, however only in 1 in 3 RRT activations occur in a timely fashion. Early warning score (EWS) systems such as modified early warning score (MEWS) have been proven to properly identify such patients and escalate care, but no such program is in place at Desert Regional Medical Center (DRMC).

Purpose: The purpose of this project was to identify the factors influencing the adoption of the modified early warning score (MEWS) for detecting early patient deterioration and initiating proper escalation of patient care in progressive care unit (PCU) nurses.

Methods: This was a quantitative descriptive project. Participants were day-shift PCU nurses at DRMC working on a unit treating a multitude of ill patients but primarily specializing in stroke patients. Nurses were given a pre-education questionnaire followed by education on the MEWS and its utility and were then asked to complete a post-education survey. Both pre- and post-education questionnaires/surveys were self-report measures with the post-education survey based on a Likert-type scale.

Results: Analysis of questionnaire responses showed that 90% of nurses did not feel properly prepared for RRT situations and felt a lack of confidence. Lack of confidence in participating in a RRT situation was associated with feelings of insufficient training affecting confidence in clinical ability, concerns of rudeness from other doctors or nurses, chaos making them feel uncomfortable, and feelings of overwhelm or lack of time to manage the situation. After

receiving education on the MEWS, 100% of nurses reported that implementation of this type of early warning tool would be beneficial for the hospital and was easy to follow. In addition, over 80% of nurses felt better prepared to identify patient deterioration, more confident to care for deteriorating patients, and more certain on when to activate RRT. Lastly, 86.7% of nurses reported that an early detection tool such as the MEWS had the potential to make their jobs easier.

Conclusion: The MEWS is an evidence-based clinical prevention tool that can help nurses identify patient deterioration earlier, with more accuracy, and potentially increase their confidence in initiating or participating in a RRT situation if necessary. Research shows that implementation of early warning tools such as the MEWS is associated with improved patient outcomes, decreased mortality rates, and have been most successful when perceived to be necessary by hospital staff. Considering that DRMC nurses reported the need for an early warning system, the MEWS may be effectively implemented on this unit, and has the potential to not only improve patient outcomes but also improve nursing confidence in RRT participation. Results of this study can be used to guide future implementation of the MEWS into DRMC's protocols and can inform the literature regarding nursing staff perceptions about early warning systems and participation in RRTs.

INTRODUCTION

It is estimated that approximately 80% of patients admitted to the intensive care unit (ICU) or who suffer from cardiopulmonary arrest display clinical signs of deterioration up to 24 hours preceding the event (Lim et al., 2015; Ludikhuizen, Smorenburg, Rooji, & Jonge, 2012). This suggests that earlier detection of patient deterioration may lead to more rapid intervention, and potentially prevent these medical emergencies from occurring. Not only may delayed intervention lead to higher mortality rates, but also to increases in ICU admissions, longer inpatient hospital stays, and therefore significant costs to both patients and the health care system (Bonafide, Localio, Song et al., 2014; Skinner, Coffey, Jones, Heslin, & Moy, 2016). Patients' clinical stability is regularly monitored by nursing and other medical staff through vital signs and modern use of telemetry. However, in an effort to improve and hasten medical intervention for patients whose vital signs indicate deterioration, hospitals have implemented Rapid Response Teams (RRTs), which are multidisciplinary groups of medical professionals who promptly respond to specified patients in need (Xu, Dobson, Thabane, & Fox-Robichaud, 2018). RRTs are a great tool for early medical intervention, yet multiple barriers prevent them from being used as effectively as necessary (Ludikhuizen et al., 2012). The resulting lack of timely recognition, response, and intervention to deteriorating patients increases patient mortality and poor outcomes (Mathukia et al., 2015). Considering the potential for RRTs to prevent medical emergencies early in the deterioration process, barriers to their initiation require further examination, and tools are needed to mitigate these barriers (Saucedo Braaten, 2015). The goal of the current project is to examine the utility of an early warning tool in helping nurses more rapidly identify signs of patient deterioration and feel more confident in initiating a RRT. Additionally, this project aims

to identify best practices in implementing an early warning system within a specific PCU hospital unit.

Background Knowledge

Rapid Response Teams (RRT)

Originally developed to reduce ICU admissions and prevent unnecessary patient mortality, rapid response teams (RRTs) were created to promptly respond to, manage, and treat deteriorating patients (Xu, Dobson, Thabane, & Fox-Robichaud, 2018). Rapid response teams (RRTs); equivocally known as medical emergency teams (MET), or critical care outreach teams (CCOT), were created with a sole purpose: Identify and respond to patients at the very first sign of clinical deterioration (Berwick et al., 2006; Jones et al., 2011; Rozen & Butt, 2016). RRTs are considered to be an international standard of care and endorsed by the American Medical Association (AMA), Centers for Medicare and Medicaid Services (CMMS), the American Nurses Association (ANA), and The Joint Commission (TJC) (Gosfield & Reinertsen, 2005; Hammer, Jones, & Brown, 2012; Sandrick, 2007). RRTs rely on two critical components; an afferent component, and an efferent component. The afferent component corresponds to the “stimulus” or “trigger” of which relies on quantifiable data, often in the form of vital signs or subjective data, such as heart rate, blood pressure, respiration rate, level of consciousness, and/or other physiological measures (Rozen & Butt, 2016). The efferent component of RRTs consists of the emergency response team that attends the patient using preventative and other necessary medical interventions, or increases in level of care (Hanson, Randolph, Erickson, Mayer, Bruckel, Harris, & Willis, 2008). RRTs have been shown to decrease rates of cardiac arrest and unexpected mortality (Jung, Daurat, De Jong, Chanques, Mahul, Monnin, Molinari, & Jaber,

2016), improve end-of-life care (Jones, Moran, Winters, & Welch, 2013), decrease the occurrence of adverse events after surgery (Bellomo, Goldsmith, Uchino, Buckmaster, Hart, Opdam, Silvester, Doolan, & Gutteridge, 2004), increase nursing staff confidence (Jones et al., 2013), and even reduce workload (Bagshaw, Mondor, Scouten, Montgomery, Slater-MacLean, Jones, Bellomo, & Gibney, 2010). As demonstrated by the research, RRTs have the potential to save more lives and potentially decrease length of hospital stays and associated costs (Maharaj, Raffaele, & Wendon, 2015). However, in order for RRTs to be effective, they must be initiated in a timely manner and utilized properly (Kolic, McCartney, Perkins, & Taylor, 2015; Ludikhuizen et al., 2014). Unfortunately, hesitation in initiating RRTs has decreased their effectiveness (Jones et al., 2009; Sandroni & Cavallaro, 2011).

Barriers to Effective RRT Implementation

Clinicians are failing to properly activate RRTs, with only 1 in 3 doing so in a timely fashion (Xu et al., 2018). A considerable amount of research focuses on factors that hinder or delay the use of RRTs, often citing a lack of confidence among nursing staff (Davies et al., 2014; Saucedo Braaten, 2015; Williams et al., 2011). Confidence in activating a RRT has been associated with fears of criticism, lack of clearly defined activation protocols, and lack of education, training, and support (Davies, Devita, Ayinla, & Perez, 2014). For instance, research shows that nursing staff are often hesitant to initiate a RRT due to potential physician pushback, previous criticism for initiating an “unnecessary” RRT, or simply questioning their own clinical judgment (Davies et al., 2014; Saucedo Braaten, 2015; Williams et al., 2011). The quality of care immediately preceding serious adverse events (SAEs) has been shown to be impacted by medical professionals’ critical thinking ability and knowledge, clinical resources, and sense of urgency,

all which are often lacking (Massey, Chaboyer, & Anderson (2016). In response to the difficulties that have emerged with initiation of RRTs, early warning tools have been developed to help hasten medical decision-making and trigger RRTs more efficiently and effectively (Subbe et al., 2001).

Early Warning Systems

The use of early warning systems (EWS) such as modified early warning score (MEWS) have been extensively evaluated in various acute care settings and have proven beneficial in detecting patient deterioration early (Alam et al., 2014; Subbe et al., 2001). Utilizing a track and trigger (TT) approach, the MEWS categorizes physiological parameters such as temperature, blood pressure, heart rate, respiratory rate, and level of consciousness to provide a score, with higher scores prompting a trigger to notify necessary emergency teams such as RRTs and attending physicians (Irish Department of Health, 2013). By implementing the MEWS, it is possible that bedside nurses will begin to recognize clinical deterioration earlier, have more confidence in activating a RRT, thereby prompting them to intervene sooner (Nishijima, Oyadomari, Maedomari, Toma, Igei, Kobata, Koyama et al., 2016). Notably, implementation of the MEWS is directly in line with the clinical practice guidelines recommended by the National Institute for Health and Care Excellence (NICE), which state that “prompt recognition of symptoms” using a “validated assessment tool” be the first step to effective treatment (NICE guidance [NG50], 2007). In order to reduce patient mortality and improve quality of healthcare delivery, prevention, and early detection, validated measures are key (van Galen, Dijkstra, Ludikhuizen, Kramer, & Nanayakkara, 2016). The use of MEWS can be a solution for success.

Implementation of early warning systems and the modified early warning score.

Similar to the introduction of any new protocol, implementation of an early warning system such as the MEWS requires careful assessment of the standard operating procedures of the hospital, as well as identification of potential barriers, and their solutions. Research focused on implementation of organizational policies and procedures has found that a common barrier to introducing new policies, is simply resistance to change (Buchanan, Claydon, & Doyle, 1999; Lawler & Worley, 2006; Thames & Webster, 2009). Additionally, concerns about cost, the quality of the new policy, and required time commitment play a role in its implementation as well (Atkinson, 1999). The MEWS is in fact a low-cost tool and requires minimal changes to the hospital's standard operating procedures. Time will be needed to train employees on its use yet considering that nurses already monitor and record patients' vital signs, the MEWS simply poses a new method of recording the same physiological measures. Implementation of the MEWS may be enhanced by introducing the literature showing its effectiveness and potential benefits to employees, thereby mitigating concerns about its quality. Previous research on implementation of the MEWS has shown that good adherence in hospital settings is possible and that a clear and concise protocol must be in place (van Galen et al., 2016). While changes will be required to implement the MEWS in any setting, its cost-effectiveness, supporting research, simplicity, and similarity to most hospitals' current standard procedures should make it an easy tool to adopt. Additionally, lessons can be learned from other health care entities that have already incorporated EWSs. For example, Kaiser Permanente, a leader in evidence-based innovation will soon be implementing an advance alert monitoring (AAM) EWS at each of their Northern California facilities after showing significant success with their pilot study. Hospitals

participating have shown statistically significant decreases in all-patient length of stay, as well as a decrease in hospital and 30-day mortality of those patients who triggered alerts (Dummett et al., 2018). Kaiser Permanente has credited the success of this undertaking with a company-wide commitment to a change in culture and encourages other healthcare facilities to change their mindset regarding proactive patient care. Such successes with EWS implementation further support its utility in other health care facilities. Desert Regional Medical Center, a hospital in Palm Springs, California has been identified to be in need of a EWS such as the MEWS to increase initiation and use of RRTs. In order to identify best practices in the implementation of the MEWS at this facility, the current study will add to the literature by examining factors associated with initiation/lack of initiation of RRTs and the role that MEWS implementation may play.

Local Problem

Desert Regional Medical Center (DRMC) a 385-bed hospital located in Palm Springs, CA, where screening for early signs of patient deterioration is not yet a standard of practice, is leaving patients vulnerable for adverse events. While DRMC has recently begun efforts to improve clinical monitoring through implementation of sepsis screening measures and further education and training on code blue situations, these efforts only aim to improve treatment response once medical emergencies have already occurred. This neglect for preventative measures indefinitely places patients at risk for AE at this facility. DRMC is a hospital with over 70,000 ER visits a year, a 19% admission rate, and has two 15-bed PCU units. The population of acutely ill patients admitted to this facility is diverse and substantial, and efforts aimed at primary prevention, rather than post-emergency management are needed. Despite the

overwhelming evidence in support of EWS, as described above, many individual and systems-level factors exist that serve as a barrier to implementation. Further information about these barriers, especially those specific to DRMC, is needed to help mitigate them, and then implement these much-needed early warning systems.

Intended Improvement

As mentioned above, hospitals that have elected to employ EWSs have had tremendous success. Implementation of a EWS such as the MEWS has the potential to increase initiation of RRTs, thereby decrease rates of mortality, length of hospital stays, resulting costs, and ultimately improve nursing knowledge and confidence. Such a tool could transform the quality of medical care at DRMC, and further information that may help implement the MEWS is needed. The purpose of this project is to identify the factors influencing the future adoption of the modified early warning score (MEWS) for detecting early patient deterioration and initiating proper escalation of patient care in progressive care unit (PCU) nurses at Desert Regional Medical Center in Palm Springs, CA. The aim of this study is to ascertain the negative and positive perceptions of PCU nurses after being educated on the MEWS tool by first identifying current system factors affecting RRT activation. Understanding these factors in conjunction with education on the MEWS tool could help extract crucial information that could be used to influence future implementation of the MEWS at this facility. Stakeholders for this project include the clinical leader, PCU management, and PCU bedside nurses. Rather than the current focus DRMC is placing on the bedside nurse's role during code blue situations, patient-focused emphasis should be placed on possible prevention of such codes by empowering and educating their nurses on early detection of patient deterioration to influence RRT activation.

Project Question

This DNP project is intended to answer the following PICOT question: In progressive care unit (PCU) nurses, what are the factors influencing the potential use of the Modified Early Warning Score (MEWS) for assessing early patient deterioration?

Theoretical Framework

The Ottawa Model of Research Use (OMRU) was developed by Jo Logan and Ian Graham in 1998 to understand the various contextual factors involved in successful and unsuccessful knowledge translation (KT) in clinical practice (Hogan & Logan, 2014). Influenced by a social constructivist perspective, the model was created with simplicity in mind to facilitate and provide quality research translation into practice. This was achieved by incorporating various theories such as diffusion of innovation, social and behavioral theories, and research utilization frameworks (Graham et al., 2006). Classified as a planned action model, OMRU incorporates a broad interdisciplinary network of elements that directly influence the process of applying research to practice (Rycroft-Malone & Bucknall, 2011). Via both descriptive and prescriptive methods, its purpose attempts to provide stakeholders with direction and perspective on how to implement evidence-based research into clinical practice. This model can be relied upon for guidance when ascertaining PCU nurse perceptions of new KT such as MEWS. Organizations would ultimately use this framework to engineer change within groups to enhance successful adoption.

Concepts

Before implementation, three important assumptions are to be considered and achieved: (1) Patient/client health outcomes are the priority and basis for research use, (2) research

evidence should be ethically obtained and research projects appropriately tested, and (3) external and societal factors will influence all components of the process and exclusively be considered through its course (Rycroft-Malone & Bucknall, 2011). Fulfillment of these assumptions is then followed by six elements (evidence-based innovation, potential adopters, practice setting/environment, implementation of interventions, adoption of innovation, and outcomes) which are grounded under three categories: assess, monitor, and evaluate (Graham et al., 2006).

Evidence-Based Innovation

The first element, innovation, consists of introducing a new idea or concept to stakeholders which is validated by evidenced-based research (in this instance, MEWS) (Rycroft-Malone & Bucknall, 2011). Subsequently, potential adopters are important for innovation to be viable and therefore perceptions of attributes in the innovation need to be evaluated, which include relative advantage, the complexity and compatibility involved, trialability, and observability (Olsson, Skovdahl, & Engström, 2016).

Potential Adopters

The potential adopters of such innovation will include PCU nurses but ultimately practitioners, policy makers, and hospital informaticists (Rycroft-Malone & Bucknall, 2011). By investigating awareness levels of chosen innovation and subsequent misconceptions, essential feedback can be gathered for the planning of the implementation process (Logan & Graham, 2010). Practice environment, or the setting in which change will take place (DRMC), involves all structural factors: rules, policies, regulations, workload, and current practice culture. It is necessary to consider and evaluate all components to identify barriers and gaps to innovation and adoption, which is the crux of this project (Logan & Graham, 2010).

Outcomes

The remaining three elements are a consequence of understanding the fundamentals of this model. Implementation interventions encompass barrier management strategies, both passive and active implementation techniques, and follow-up activities aimed: to eliminate barriers to adoption, assist adopters to sustain adoption, and ensure that adopters have skill sets to implement effectively (Rycroft-Malone & Bucknall, 2011). Adoption, on the other hand, involves the initial uptake or utilization of an innovation by potential adopters and its continuous usability in practice; instrumentalism during this section is especially important to promote changes in behavior necessary to achieve confident client outcomes (Rycroft-Malone & Bucknall, 2011). Lastly, outcomes are used to analyze the implementation of innovation with specificity to the initial innovation recommendation while using the most stringent study design (Rycroft-Malone & Bucknall, 2011).

For purposes of this project, the focus will be placed on the assessment of nurse responses to MEWS itself. The Implementation portion of this theory will occur at a later time and utilize the latter stages of the Ottawa Model. The factors identified in this study can be addressed by stakeholders using shared governance. Future buy-in can be achieved when management is presented with quantitative statistics showing the need for MEWS. The plethora of literature available on MEWS will aid in replication of implementation, and feedback will be elicited throughout the process in accordance with the OMRU.

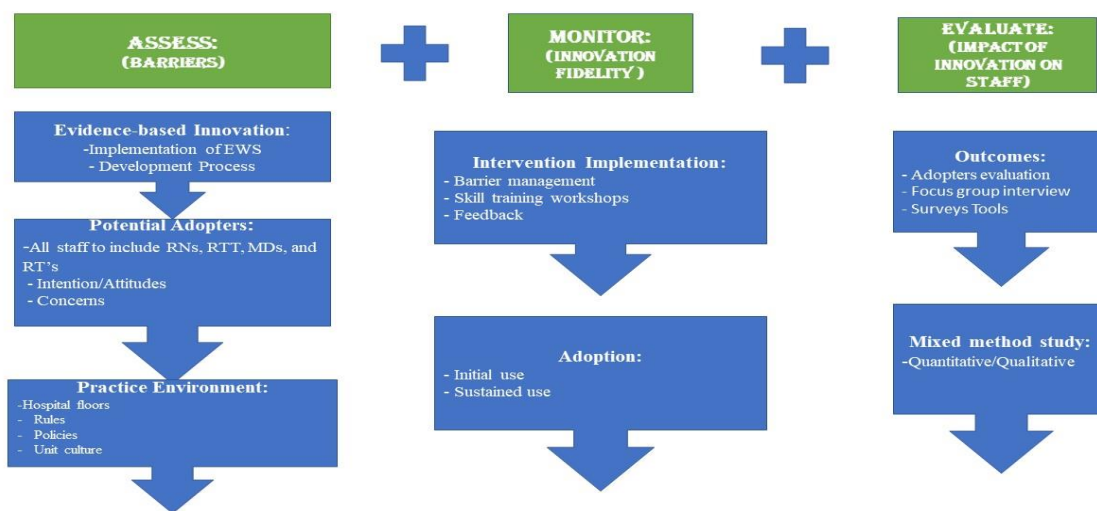


FIGURE 1. Projected use of the OMRU to implement MEWS.

Synthesis of Evidence

Failure to recognize patients at risk for clinical deterioration happens all too frequently in hospital settings. Such failures not only place patients in danger but also expose a huge flaw in our healthcare system that requires reparation. Physiological parameters such as VS have been well understood to aid in the recognition of patient deterioration, yet healthcare workers are still failing to interpret such findings into urgency and the need for intervention (Mathukia et al., 2015). These findings eventually lead to an increase in unplanned ICU admissions, increase in hospital length of stay, and ultimately an increase in healthcare costs and patient mortality (Mathukia et al., 2015; Mitchell et al., 2010; Zografakis-Sfakianakis et al., 2018). For this reason, methods to help clinicians stratify at-risk patients early are mandatory and can be achieved through early recognition and prevention. Track and trigger systems (TTSs) such as MEWS can be used to quantify patients at risk by translating physiological parameters such as VS, and mental status in a scoring system that ultimately guides clinicians on how to intervene

(Zografakis-Sfakianakis et al., 2018). Implementation of a EWS also requires extensive education and buy-in from hospital staff utilizing such a tool. For this reason, understanding factors involved in the implementation of EWS is mandated to substantiate its proposed use and need.

Literature Review

To further our understanding for the need of a EWS and to determine present nursing perceptions and attitudes on its use and effectiveness, an extensive literature review was performed using PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and EBSCOhost. Specific key words used included “early warning system,” “modified early warning score,” “Track and Trigger,” “rapid response team,” “perceptions,” and “attitudes” to refine relevant articles. Inclusion criteria for articles included articles published within 10 years, adult (>18 years old) human subjects, English-language, peer-reviewed, randomized control trials, observational studies, and full text. Utilizing these preferences, 48 articles were found. Articles without an attributed evidence level of IV or greater, not related to early warning systems, or pertaining to nursing perceptions, attitudes, or clinical outcomes of using such systems were excluded. Final refinement yielded 13 relevant articles applicable to the project’s purpose (Appendix A).

Benefits of EWS Implementation

Patient and nursing outcomes with EWS implementation demonstrated positive trends in various themes throughout the literature. Common themes included the usefulness of EWS’s (MEWS, NEWS, EWS) in improving RRT utilization, improving inter-provider communication, enhancing clinical assessment and identification of patient deterioration, ability to enhance

clinical monitoring, and lastly reducing ICU transfers (Borgert et al., 2014; Gagne, 2018; Kyriacos et al., 2015; Mitchell et al., 2010; Petersen et al., 2017).

In a prospective time-series study by Gagne et al. (2018), authors attempted to determine the impact of a EWS communication bundle on the number of medical-surgical transfers to ICU, RRT calls, and patient morbidity in patients transferred to ICU. Measurements recorded before and after the implementation of the EWS demonstrated an increase in RRT calls (6.47 to 8.29 per 1000 patient days) and a reduction of ICU admission associated with these RRT calls, especially in patients with EWS >4, suggesting that earlier intervention to deterioration occurred. This indicated that the use of a EWS communication system was successful in not only prompting nurses to call RRT's but ultimately reducing the number of ICU transfers through early intervention (Gange et al., 2018). In a similar study, Mitchell et al., (2010) attempted to determine the effectiveness of the MEWS with an education program (COMPASS) in reducing the rate of predefined adverse outcomes. When compared to the control group (standard monitoring) utilization of the MEWS was associated with significant reductions in unplanned ICU admissions (21/1157 vs 5/985) and hospital deaths (11/1157 vs 2/985) with an increase in RRT's attending to patients with clinical instability.

The MEWS also demonstrated an ability to correlate the severity of scores with patient outcomes. Zografakis-Sfakianakis et al., (2018) was able to demonstrate this in his observational study that analyzed 153 patients admitted to the ICU after sustaining a serious adverse event (SAE). Patients included in the study had to sustain an adverse event within 24 hours of admission to the unit of which both VS and MEWS scores were calculated every four hours prior to the event. Most common SAE reported included acute respiratory failure (ARF) (39.9%) and

septic patients (20.3%). Results utilizing the MEWS every four hours revealed a progressive increase in scores after four hours on the floor with a score of '7' or greater being reported four hours before ICU admission. This significance demonstrated a strong association between scores greater than '7' and ICU mortality and ICU length of stay. The higher the score, the more likely to be transferred to the ICU (Zografakis-Sfakianakis et al., 2018).

Determining nursing perceptions on the implementation of a new tool is crucial to determine factors that can influence future adoption. McDonnell et al. (2012) elaborated on this by implementing a model for the detection and management of deteriorating patients and evaluating its impact on nursing knowledge and confidence. Using a structured survey and qualitative interviews after EWS utilization, results demonstrated not only an increase in nursing knowledge but also confidence to recognize and manage deteriorating patients. Similar results were seen in a study by Lydon et al. (2015) who not only attempted to examine nurse but also physician perceptions on the use of a similar tool (NEWS). This study however, attempted to add further knowledge by also examining underlying variables that may impact the intention to comply with using the NEWS. Following semi-structured interviews and a questionnaire revealed positive trends by nurses. Willingness of nurses to continue using the tool were reflected by thoughts on its ease of use to communicate information, effectiveness in helping detect patient deterioration and escalating care, legal protection with compliance, and assurance that critical patients were at least noticed (Lydon et al., 2015).

Adequate training and education on MEWS in conjunction with a supportive RRT has many positive effects on nursing staff. Stafseth et al. (2016) attempted to explore this concept by exploring nursing experiences after the implementation of a MEWS tool and a Mobile Intensive

Care Nurse (MICN) available 24-hours for nursing support. Prior to implementation, training and a proper educational program was also used to ensure understanding. Following appropriate training and implementation of the MEWS/MICN intervention, focus group interviews were used to explore nursing perceptions. Three themes were identified: 1) experiences of MEWS detecting early patient deterioration, 2) improved collaboration and communication between nurses and 3) MEWS scores were described as creating a “new” precise language when communicating with physicians. Authors determined the MEWS scoring system in conjunction with support from an MICN (with education), was associated with not only improving identification and care for deteriorating patients but also improving interprofessional collaboration between nurses and physicians (Stafseth et al., 2016).

Iddrisu et al. (2018) attempted to explore nursing roles in recognizing and responding to patient deterioration in post-surgical patients. Authors revealed that using a track-and trigger (TT) observation chart allowed nurses to demonstrate higher-levels of role awareness in recognizing and managing patient deterioration. More surprisingly, the TT observation chart allowed nurses to identify patient deterioration prior to meeting RRT criteria (Iddrisu et al., 2018). This further emphasizes that EWS are beneficial at early detection of deterioration even before necessitating intervention.

Limitations of EWS Implementation

Many system-wide and personal barriers to RRT activation and adoption of a EWS exist, including inadequate staffing, heavy workload, impracticality of tool, interdisciplinary tension, and sociocultural conflicts (Lydon et al., 2015; Shearer et al., 2012; Smith et al., 2015; Stafseth et al., 2016).

In a study by Shearer et al. (2012) authors attempted to explore the underlying causes of failure in activating RRT's. Utilizing a mixed-method approach with a survey and structured interviews, nurses and physicians involved in the care of patients with unplanned ICU admissions or death, over an 8-week period were investigated. The results of the study indicated that 42% of clinically unstable patients did not receive escalation of care, despite most nurses (69.2%) recognizing the need for RRT activation and being concerned (75.8%) (Shearer et al., 2012). Sociocultural factors responsible for failure to activate RRT revealed various themes: 1) feeling situation was under control in current unit 2) feeling that staff should be able to manage deteriorating patients by themselves and 3) concerns regarding negative reactions and criticism from colleagues for alerting the RRT (Shearer et al., 2012). This study revealed that although organizations are committed to RRT's, the problem here is not lack of staff cognition in deteriorating patients but rather an issue of local culture rules within the clinical environment.

Lydon et al. (2015) also investigated lack of protocol adherence when attempting to determine nursing perceptions on the use of s NEWS tool. Nursing barriers in adherence of the tool were related to understaffing, increased workload, and interdisciplinary tension between physicians. Physician's complaints revealed the tool lacked specificity, often requiring doctors to adjust parameters, ultimately leading to lack of compliance due to increased workload and inaccuracy (Lydon et al., 2015).

Petersen et al. (2017) also revealed various barriers to EWS implementation. Although the study revealed that early warning score tool non-compliance was low, nurses found themselves being over-cautious and often over-monitoring leading to increased workload, ultimately affecting their time management (Petersen et al., 2017). Other barriers also included

understaffing, but also the impracticality of the tool to reveal true patient deterioration given the high number of patients with elevated scores. This frequent reporting of high early warning scores to physicians, was responsible for creating ineffective communication and tension amongst physicians and RRT members (Petersen et al., 2017).

Other factors affecting the use of EWS involved equipment issues, delegation issues, and volatile patient interactions. Smith and Aitken (2015) further elaborated on this when attempting to evaluate nursing barriers in the use of a single parameter TT system. The results of the study demonstrated a major variability in repeat observations following a patient trigger. Reasons were identified as nursing barriers and included lack of available and or faulty equipment (unable to monitor VS), conflicting priorities (delegation issues between staff), and patients interrupting VS observations (confused, refused, etc.) (Smith & Aitken, 2015).

Patient outcomes after EWS implementation improved dramatically in most studies examined, with increases in RRT activation, vital sign recording, and decreases in ICU transfers and unexpected hospital deaths (Borgert et al., 2014; Gagne, 2018; Kyriacos et al., 2015; Mitchell et al., 2010). Bedside nurses benefited significantly from EWS implementation, displaying increased role awareness, confidence, interprofessional collaboration, and understanding of patient deterioration (Iddrisu et al., 2018; McDonnell et al., 2012; Shearer et al., 2012; Stafseth et al., 2016). However, various barriers were also identified in its use.

Heavily burdened, under-staffed, and poorly equipped nurses will undoubtedly continue to struggle with compliant adoption of innovative tools such as MEWS (Ludikhuize et al., 2014). With some studies reporting an increase in tension amongst bedside nurses, RRT, and physicians after implementation, much more work must be done to incorporate professional and positive

interactions amongst healthcare providers, perhaps through the use of debriefings (Lydon et al., 2015). Furthermore, it behooves organizations and leaders to fully consider the efficacy of EWS tools as not only beneficial to patients but also towards medical providers adopting them. Crucial components in this process must allow administrators and change agents to not only demonstrate the efficacy of such tools in reducing adverse events and improving patient outcomes, but also ensuring staff understanding of their use through proper training, education, support, and acknowledgment of provider feedback, to enhance compliance. Although analyses of the literature exposed various benefits and limitations towards the use and adoption of EWS's in the acute care setting, further investigation is warranted on how organizations should mitigate these limitations, in particular socio-cultural and organizational barriers. Further understanding these issues, followed by determining evidence-based strategies and solutions to such barriers could potentially improve EWS tool adoption and thus improve utilization of RRT's. This is an area of future study.

METHODS

Ethical Considerations

Consideration of ethics in attempt to gather nursing perceptions on a clinical tool must include three fundamental components: 1) ensuring informed consent, 2) autonomy, and 3) confidentiality. Informed consent with a disclosure statement provided participants the chance to understand all aspects of the project including its purpose, study procedures utilized, potential risks and benefits in participation, timeframe of the study, and extent of confidentiality all while emphasizing voluntary participation (Musmade et al., 2013). Autonomy demands recognition and respect of participants making their own decisions without coercion in participating in the

study (Owonikoko, 2013). Lastly, confidentiality ensured anonymity and protected the identification of participants partaking in the study (Owonikoko, 2013).

Participants recruited for the study were first provided with a disclosure statement, which included: (1) a brief explanation of both the aim and purpose of the study, (2) an outline of procedures and duration, (3) and explanation of any risks involved. Participants were further ensured that participation would be maintained anonymous and responses would remain confidential throughout and after the data collection and analysis process. Maintaining anonymity was achieved by removing potential personal identifiers and using a numbering system for both the questionnaires and surveys all while providing for a secure location once data was collected. Completed questionnaires and surveys were secured and stored in a locked cabinet located in a private room on the PCU unit of which only the primary investigator had access. Once all questionnaire and surveys were completed, they were subsequently taken home and transferred to a secure Microsoft excel file and interpreted with the help of the University of Arizona's Office of Nursing Research (ONR). Access to data was limited to the primary investigator and the University of Arizona's Office of Nursing Research department.

Institutional Review Board (IRB)

The application for determination of human research was submitted to both Desert Regional Medical Center and the University of Arizona's institutional review boards. A formal institutional review board application was first submitted to Desert Regional Medical Center and subsequently approved on August 2, 2019 (Appendix H). A mutual agreement between Desert Regional Medical Center and the University of Arizona's Institutional review boards (Appendix I) determined this project as non-research related and exempt from IRB oversight. Required

documents and compliance training programs including conflict of interest (COI), HIPPA, financial disclosures and CITI modules were completed prior to IRB submission.

Design

This quality improvement (QI) project used a quantitative descriptive approach to determine contributing factors to progressive care unit (PCU) nurses adopting the modified early warning score (MEWS) to identify early patient deterioration and initiate appropriate escalation of care. This approach is appropriate for studies where data will only be collected once, rather than the experimental pre- and post-test designs of other types of quantitative studies; it also assists in increasing reliability through replicability (Creswell, 2018). Quantitative descriptive research also allows for measuring frequency of the variables it examines (Gray, Burns, Grove, & Sutherland, 2017).

Setting

This project took place on a PCU of a 385-bed teaching hospital located in Palm Springs, California. The selected unit specializes in stroke patients and is comprised of 15 beds, which is staffed by five registered nurses per shift. This unit was selected because it is a “step-down” unit where ICU patients transition on their road to discharge. Understandably, many rapid response calls occur here, as it is a middle ground between critical condition and stable condition in hospitalized patients. This unit also has a wide trajectory of ill patients requiring bi-hourly monitoring and assessments.

Participants

Morning shift PCU registered nurses were the population of focus in this project and considered crucial components in the early assessment of clinical deterioration. As potential

adopters of screening for patient deterioration, determining factors influencing the use of a screening tool is critical to determine future implementation. Participants in this study included 30 PCU registered nurses from a PCU stroke unit. Inclusion criteria was as follows: a) be core PCU staff, b) not hold an administrative or management position, and c) consent to participation. Nurses were recruited via convenience sampling, and each participant was independently approached and voluntarily consented to participate.

Measures

Modified Early Warning Score (MEWS)

Screening for clinical deterioration in hospital settings is a well-known concept, yet many institutions fail to provide staff with the necessary guidance and tools needed to do so. The MEWS is a 5-item measure of physiological symptoms, including blood pressure, heart rate, respiratory rate, temperature, and AVPU/RASS score (i.e., level of consciousness). The MEWS is rated on a scale from 0-3 for each vital sign. The sum of the five scores equals the total MEWS score. Based on this MEWS score, the escalation of care algorithm (EOCA) is then used to guide nurses on how to intervene and escalate care. Scores between 0-2 require no intervention while scores of three and above prompt nurses to not only notify the charge nurse but also suggest notifying RRT's and increasing clinical monitoring until their arrival (Subbe et al., 2001). This MEWS tool and EOCA was used to educate PCU nurses after the administration of the pre-education questionnaire (Appendix B & C, respectively).

Demographics and Pre- and Post- Education Questionnaire/Survey

Several items were created following the University of Wisconsin's 2010 Survey Fundamentals: A Guide to Designing and Implementing Surveys: a demographic questionnaire,

pre-education questionnaire, and post-education Likert-type survey. Likert scales are widely used in medical research and are an appropriate choice to determine to what degree participants in research agree with a statement (Sullivan & Artino, 2013). To assist in ensuring reliability and validity of this as-yet untested tool, the hospital's clinical educator was asked to review all materials. This helped to establish the project's face validity, measuring what it purports to measure (Polit & Beck, 2012). The constructed three-question demographic questionnaire was developed as means to gather basic demographic characteristics of nursing staff and included questions on sex, age in years, and years of experience as a registered nurse (Appendix D). This was followed by a three-question pre-education questionnaire that gathered data on the nurse's perceptions and experience with rapid response situations (Appendix E). This measure included questions on the number of RRT participations, overall confidence in participating in RRT situations, and lastly, a "select-all" question to clarify the reasons for lacking confidence during RRT situations. After a brief education on the use of the MEWS/EOCA, a six question post-education survey was administered and included questions that specifically evaluated the screening tool with regards to its ease of use, improving nursing confidence in participating in RRT situations, benefit of use for the hospital, and helping nurses better identify and participate in patient deterioration situations (Appendix F).

Data Collection

The primary investigator is employed by Desert Regional Medical Center and has a professional relationship with the RRT amongst many other hospital departments including the selected PCU, thus recruitment was easily achieved. The primary investigator utilized convenience sampling as means to recruit AM-shift nurses; therefore, each PCU nurse was

individually approached during working hours, although only while on their mandated lunch or rest-break periods. Once all potential participants were approached, those that agreed to participate were subsequently taken to a private room and provided with a disclosure statement, explaining the aim and purpose of the study, methods used and duration, and explanation of any risks involved. With verbal agreement, the first phase of the process included a three-question demographic questionnaire which was subsequently followed by a three3-question pre-education questionnaire. Upon completion of these two questionnaires, participants were educated on the MEWS screening tool and EOCA, which included handing out a sheet of paper displaying the MEWS screening tool/EOCA, a brief explanation on its use, and a patient case study/example as means to help participants understand application of the tool and calculate scores. Following this education, participants were provided with a six-question post-education survey. The entire process from completion of demographic questionnaire, pre-education questionnaire, educational in-service, and post-education survey was approximately 10-15 minutes. A total of 30 PCU nurses participated and were included in this project.

Data Analysis

Both questionnaires and post-education survey data was collected on paper and then transferred to a Microsoft office excel spreadsheet. Variables within both questionnaires included basic demographic data, questions on RRT activation/participation experience, confidence in such participation, and reasons for lack of confidence. Variables within the post-education survey contained questions aimed to elicit the effectiveness or ineffectiveness of the MEWS tool after education. Data from the demographic questionnaires, pre-education questionnaires, and post-education surveys were analyzed using SPSS with the assistance of The University of

Arizona College of Nursing Office of Nursing Research. Descriptive statistics were used to examine factors influencing the future adoption of the MEWS tool.

RESULTS

Participant Demographics

Data collection took place on September 18, 2019 and was completed on September 25, 2019. A total of 30 participants met inclusion criteria and participated in the project. Most participants were female ($n = 27$, 90%) with only three (10%) being male. The participants varied in age with 90% ($n = 27$) reporting they were between the ages of 18-50 years old, with only three (10%) being between the ages of 51-70 years old. Most participants ($n = 21$, 70%) had anywhere between 0-10 years of nursing experience, while only 30% ($n = 9$) had 11-20+ years of experience (Table 1).

TABLE 1. *Sample demographics.*

Characteristic	N (%)
<u>Sex</u>	
Male	3 (10)
Female	27 (90)
<u>Age (years)</u>	
18-30	12 (40)
31-40	8 (26.7)
41-50	7 (23.3)
51-60	2 (6.7)
61-70	1 (3.3)
<u>Nursing Experience (years)</u>	
0-2	7 (23.3)
3-5	7 (23.3)
6-10	7 (23.3)
11-20	5 (16.7)
20+	4 (13.3)

Pre-Education Questionnaire

When participants were asked about the number of “rapid response” situations they had participated in during their career, 43.3% ($n = 13$) reported participating in over 11 rapid response situations, 13.3% ($n = 4$) reported 6-10 situations, 36.7% ($n = 11$) reported 3-5 situations, and only one participant (3.3%) reported participating in 1-2 rapid response situations. Therefore, the majority or 93% ($n = 28$) had reported participating in over three rapid response situations (Table 2).

TABLE 2. *Number of RRT situation participations.*

Frequency	N (%)
1-2	1 (3.3)
3-5	11 (36.7)
6-10	4 (13.3)
11+ 13 (43.3)	

When asked about confidence in participating in rapid response situations, the majority of participants ($n = 22$, 73.3%) reported they were somewhat confident, while only 16.7% ($n = 5$) reported not feeling confident. Interestingly, only 10% ($n = 3$) reported feeling very confident in participating in RRT situations (Table 3).

TABLE 3. *Nursing confidence in participating in RRT situations.*

Confidence	N (%)
Not confident	5 (16.7)
Somewhat confident	22 (73.3)
Very confident	3 (10)

Among participants who did not report feeling very confident in participating in RRT situations ($n = 27$, 90%), a final “select all that apply” question was provided to further examine the factors affecting confidence in these situations. Results showed that the least reported factor

associated with a lack of confidence was the RRT nurses or other team members being unpleasant or rude ($n = 3$, 10%). A higher number of nurses (20%, $n = 6$) reported not feeling confident because the doctors were rude, unresponsive, or harsh. Other participants reported that their lack of confidence was due to a sense of chaos on the unit, making them feel uncomfortable ($n = 8$, 26.7%), while another 26.7 % ($n = 8$) reported lacking confidence in their clinical ability. The most prominent factors associated with a lack of confidence in RRT situations were noted as: a) feeling too overwhelmed with their patient assignment and simply not having the time to properly manage ($n = 11$, 36.7%) and b) feeling that their training in RRT situations was insufficient ($n = 11$, 36.7%) (Figure 2).

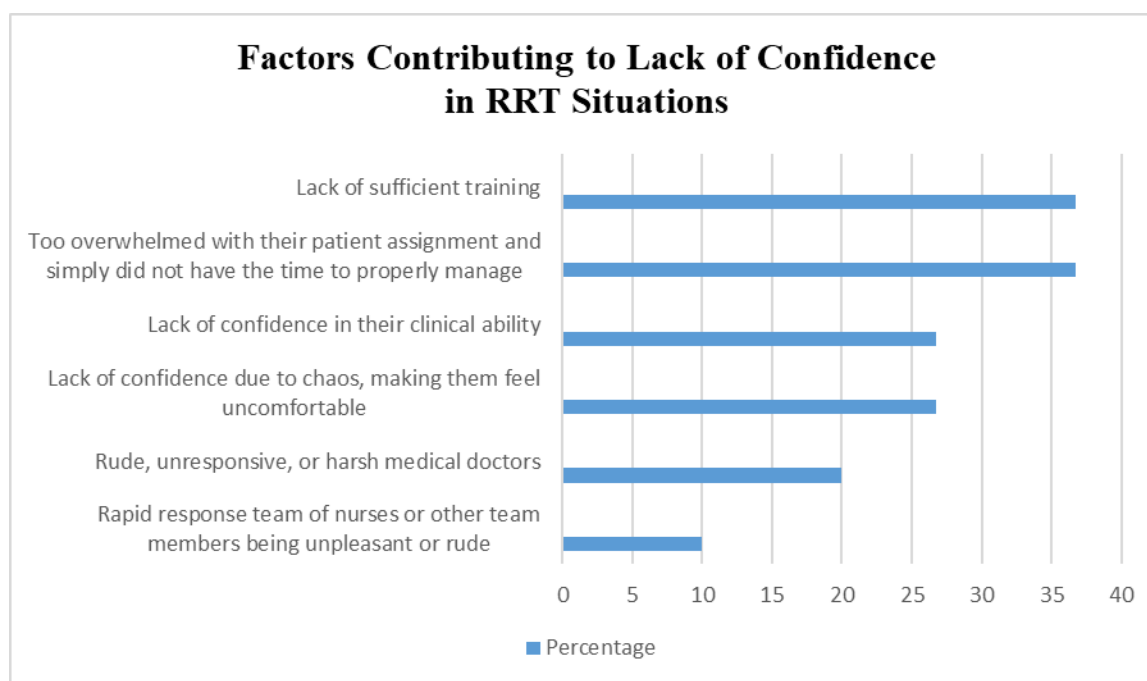


FIGURE 2. Factors contributing to lack of confidence in RRT situations.

Post-Education Survey

After educating the participants on the MEWS tool and EOCA, 86.7% ($n = 26$) of nurses reported they felt better prepared to identify patient deterioration. In addition, 83.3% ($n = 25$) reported they felt more confident to participate in the care of deteriorating patients and 93.3% ($n = 28$) reported they felt more certain on when to activate the RRT. In regard to the MEWS and nurse workload, 86.7% ($n = 26$) of participants reported that using the MEWS tool would make their job easier. Astonishingly, 100% ($n = 30$) of participants believed that the MEWS tool was not only easy to understand and follow, but also believed that the hospital would benefit from its implementation (Figure 3).

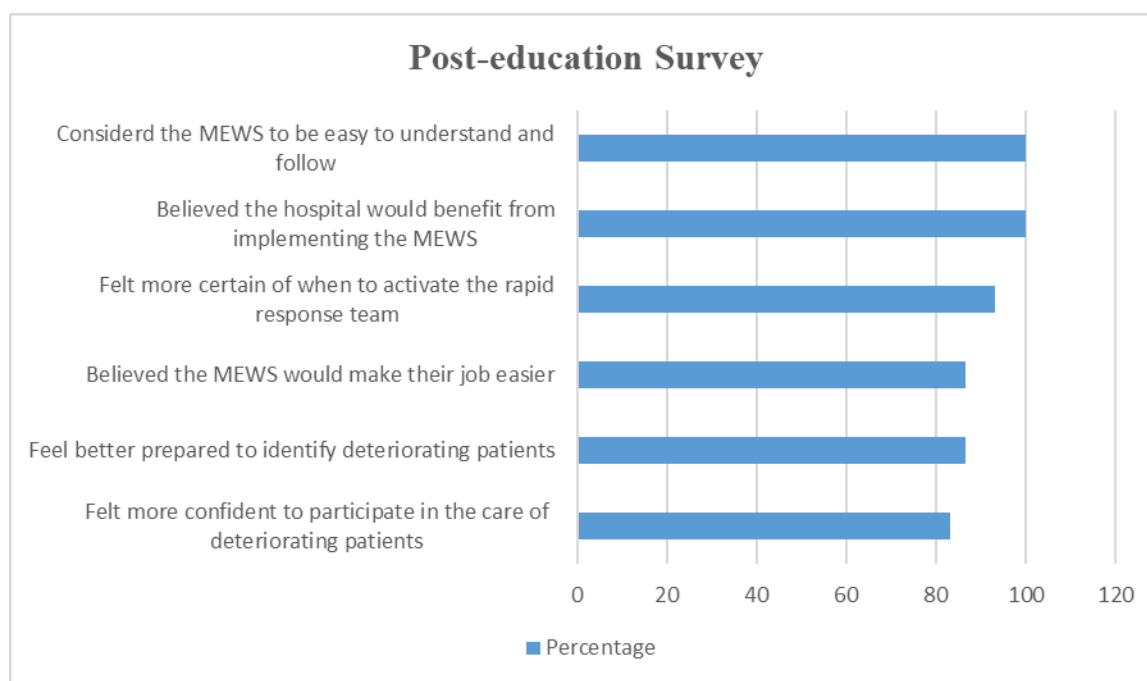


FIGURE 3. Post-education survey responses.

DISCUSSION

The purpose of this project was to examine the factors influencing the future implementation of the MEWS/ECA as measured by PCU nurse responses on pre- and post-

education questionnaire/survey questions. Results revealed various factors that can potentially influence the implementation of the MEWS tool. The pre-education questionnaire reflected that most nurses (93.3%) had experience in RRT situations, having participated in over three RRT situations in their career. However, 73% of these respondents reported only being somewhat confident during their involvement in an RRT situation. This speaks to how nurses even with experience may not feel completely confident in the RRT process. Previous research has focused on levels of confidence in nursing staff, and its relation to initiation of, or participation in RRTs (Clayton, 2019; Stafseth et al., 2016) indicating that a nurse's level of confidence is not an uncommon factor in these situations. Clayton (2019) reports that an imbalance between patient needs and nursing staff competence can lead to a decrease in a nurse's level of confidence and poorer patient outcomes. These findings support the need for earlier detection of patient deterioration via use of an early warning system (e.g., MEWS), which may decrease the likelihood of an imbalance between patient needs and nurse's perceived competence. Improved nursing staff confidence may in turn, increase the likelihood of accurate RRT initiation without hesitation and lead to improved patient outcomes.

Underlying issues affecting confidence in the current project were widespread and were depicted by the final "select all that apply" question. In an institution that does not provide for RRT participation training nor a properly constructed policy or EWS tool, it was not surprising to find that 36.7% of participants reported lack of sufficient training as a contributing factor. It was also not surprising to find that another 26.7% reported a lack of confidence in their clinical ability, with another 26.7% describing situational chaos making them feel uncomfortable. Williams et al. (2011) describes how the composition of RRTs, feedback to nurses after calling

an RRT, and RRT outcomes significantly affect the nurse's level of comfort with the situation. For example, nurses who are chastised for initiating a RRT may be less likely to do so in the future, even in a situation where it is needed. Therefore, tools that can increase the predictability of patient decline may increase a nurse's comfort with and confidence in RRT initiation, thereby improving the healthcare system and decreasing unnecessary treatment costs.

Organizational barriers such as understaffing, insufficient training, and lack of policy guidance can most definitely contribute to nurse unpreparedness and clinical uncertainty, significantly impacting clinical confidence (Davies et al., 2014). Other notable factors affecting nursing confidence were directly attributed to patient assignment strain (36.7%) and both RRT and physician tension (10% and 20%, respectively). Although it is uncertain whether these factors could directly influence the adoption of the MEWS, further investigation into the root causes of these confrontations could be delineated in future studies.

Education on the MEWS Tool and EOCA received mainly positive reviews from participants, substantiating the desire for such a tool at this institution. Post-education survey questions were able to target and expose crucial factors that would directly have an influence on the future adoption of the MEWS tool. When participants were asked whether the tool would help them better identify patient deterioration, 86.7 % responded yes, while only 13.3% responding somewhat. When asked to ascertain its effectiveness in improving confidence to participate in the care of deteriorating patients, 83.3% also said yes with only 6.7% responding somewhat. In determining whether the tool helped them be more certain on when to activate the RRT, 93.3% stated yes, with only 6.7% stating somewhat. Most participants (86.7%) believed the tool would make their job easier, while 100% of participants believed the tool was easy to

understand and follow and that the hospital would benefit from the tool's adoption and implementation. With over 83 % of participants agreeing to all categories in the tool's proposed use, benefit, and need at this institution, future implementation should be considered to help guide nurses in the care of deteriorating patients. An investigation into organizational barriers would be an excellent starting point project prior to the implementation of the tool.

Limitations

The current project had several limitations. First, this project took place at a single hospital and with a very specific population of nurses and patients, and a modest sample size of 30. Therefore, the results may not be generalizable to other hospital units and institutions (Kukul & Ganguli, 2012). Concerns for bias was a considerable factor as the primary investigator holds a current position at the chosen institution and has established personal relationships with the participants of the study. This type of bias, known as acquiescence bias, could interfere with the validity of the responses from the participants (Hinz et al., 2007). Further bias could be identified in the method of recruitment, which was through convenience sampling. This method of sampling was used to only recruit day-shift nurses on the unit and therefore did not allow for participation by night-shift nurses. This sampling bias would ultimately underrepresent night-shift nurses, again affecting the project's generalizability. Finally, the post-education survey that examined reasons for feeling a lack of confidence in RRT situations was a multiple-choice question. As a result, nurses were forced to select one of the pre-determined reasons for not feeling confident. Future research should include a "fill-in-the-blank" response option, which could be qualitatively analyzed and may allow for a better representation of how nurses feel in these situations. Nevertheless, the information gleaned from the current post-education survey

adds to the literature by revealing a general theme of why nurses feel a lack of confidence in RRT situations.

Conclusion

Various factors were identified and considered that would directly influence the adoption of the MEWS tool by PCU nurses. Underlying trends affecting lack of confidence in RRT participation were not merely associated with lack of experience in these situations but rather elicited from a combination of organizational and cultural barriers. An institution that lacks well-defined protocols and insufficient training for nursing staff will ultimately affect nursing competence and confidence.

Research clearly shows that when patient decline is not effectively recognized and attended to, the result is an increase in ICU usage, and longer hospital stays (Mitchell et al., 2010). These repercussions are costly to both the patients and the health care system (Alam et al., 2014). Implementation of an early warning system such as MEWS, which has been associated with improved clinical outcomes and declines in mortality rates (Mathukia, Fan, Vadyak, Biege, & Krishnamurthy, 2015), has the potential to eradicate such costs.

In this project, the MEWS Tool and EOCA received positive reviews from nursing staff praising its ease of use, help in workflow, and increased confidence not only in detecting patient deterioration, but in properly escalating RRT's. Implementation of the MEWS tool could be beneficial not only in improving patient outcomes, but also in guiding providers to properly detect clinical deterioration early and escalate care effectively. This tool would also help guide nurses on preventative measures such as detecting early prevention to properly escalate care and encourage RRT utilization.

APPENDIX A:
EVIDENCE APPRAISAL TABLE

Evidence Appraisal Table

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
Borgert, M., Ludikhuizen, J., Binnekade, J., Subbe, C., Dongelmans, D., & Goossens, A. (2014).	Quasi-experimental study	<p><u>Sample</u> Patients staying at least 1 overnight stay</p> <p>Protocolized unit: Patient VS recordings N=372</p> <p>Control unit: Patient VS recordings N=432</p> <p>Mean age= 56.7 Male=</p> <p><u>Setting</u> 1000-bed University Hospital in Amsterdam, the Netherlands</p>	<p>Protocolized unit: Calculation of MEWS using patient VS 3 times daily</p> <p>Control group: MEWS calculation only when “clinically indicated”</p>	<p><u>Primary</u> Process measures including degree of VS measurement and compliance to monitoring standards</p> <p><u>Secondary</u> Investigate degree of delay in notifying physicians and RRT in patients with MEWS ≥ 7</p>	<p><u>Primary</u> MEWS scores using VS were performed on 70% (2513/3585) of patient in protocolized group vs only 2% (65/3013) of patients in control group. -Compliance with regimen was reported at 68% (819/1205) in protocolized group vs 4% (47/1232) in control group.</p> <p><u>Secondary</u> -90 calls were made to attending physician in protocolized group vs only 9 in control. -RRT activation calls were twice as much in experimental group vs control.</p>	<p><u>Internal Validity</u> History: Presence of policy change from new director could impact nursing compliance.</p> <p><u>External Validity</u> Representativeness: Data represented only medical/surgical patients, not generalizable to all hospital patient acuties. Replication: Single site study</p>
Gagne, C., & Fetzer, S. (2018).	Time-Series Pilot study	<p><u>Sample</u> Inpatient medical-surgical patients with an EWS greater than 4, indicating clinical deterioration N=1000.</p>	Recordings and measurements of modified early warning scores, rapid response team activations, and admission data on medical/surgical	<p><u>Primary</u> Determine impact of Modified early warning score (MEWS) communication bundle on med/surge</p>	<p><u>Primary</u> - RRT calls increased during the study period (6.47 to 8.29 per 1000 in-patient days). - ICU admissions after RRT activation</p>	<p><u>External Validity</u> Representativeness: Acuity of patients influenced by seasonal changes. Replication: single-site study</p>

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
		<p><u>Setting</u> Southern New Hampshire Medical Hospital located in Nashua, New Hampshire.</p>	<p>patients transferred to ICU SPSS and IBM were used to generate descriptive statistics on data also to conduct analysis of variance.</p>	<p>transfers to Intensive care unit (ICU), RRT activations, and morbidity of patients prior to ICU transfer.</p>	<p>decreased significantly (p=0.03). -ICU admissions with EWS >4 also decreased significantly (p=.01) due to early deterioration detection and intervention.</p>	
<p>Iddrisu, S. M., Hutchinson, A. F., Sungkar, Y., & Considine, J. (2018).</p>	<p>Qualitative exploratory study</p>	<p><u>Sample</u> Full-time registered nurses (RN's) working bedside in either medical or orthopedic unit N=14 Orthopedic nurses n=9 Medical/surgical nurses n=5 Female=93%</p> <p><u>Setting</u> 28-bed surgical and 24-bed orthopedic unit at a single site teaching hospital in Australia.</p>	<p>Focus group interviews from September 1 to October 31, 2014,</p>	<p><u>Primary</u> Perceptions of nursing roles in response to clinical deterioration of post-operative patients 3 days after surgery.</p> <p><u>Secondary</u> Nursing perceptions of barriers to implementation of early warning system for deteriorating patients in early post-operative phase.</p>	<p><u>Primary</u> Nurses demonstrated high levels of awareness in their respected roles in detecting and responding to early clinical deterioration. -Focus group themes included “struggling with blood pressure” and “we know patient is sick”. -Nurses were ultimately confident in understanding clinical indicators of deterioration and were aware of options to escalate care. -Using a track and trigger (TT) observation chart enabled nurses to identify deteriorating patients before having</p>	<p><u>Internal Validity</u> Selection bias: Self-selecting sample</p> <p><u>External Validity</u> Representativeness: Mostly female gender and only representing Medical/surgical population of patients.</p> <p>Replication: Single site study</p>

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
					<p>to activate the rapid response team (RRT).</p> <p><u>Secondary</u> Barriers themes: -Poor hospital communication system -Delayed and untimely RRT attendance to deteriorating patients</p>	
<p>Kyriacos, U., Jelsma, J., James, M., & Jordan, S. (2015).</p>	<p>Pragmatic, parallel-group, cluster randomized controlled trail</p>	<p><u>Sample</u></p> <p>Patient chart and notes provided both clinical and demographic data N=1427 Randomized charts n=114.</p> <p>Full-time bedside RN's N=122.</p> <p><u>Setting</u> 867- bed academic hospital in Cape Town, South Africa.</p>	<p>Intervention vs standard care: 3 intervention groups and 3 control groups. MEWS with training was implemented in Intervention group and standard care (no training) was used in control group. Patient charts were reviewed after trial.</p> <p>“Knowledge was assessed in both trial arms by blinded independent marking of written tests before and after training of nurses in intervention wards.”</p>	<p><u>Primary</u> Nurses’ documented responses to abnormal VS’s, determined by either rechecking VS or seeking help (charge nurse, calling MD).</p> <p><u>Secondary</u> -Number of patients recorded via MEWS (intervention) and VS (control) -Number of times VS recorded first 8 hours post-op. -Nursing knowledge test</p>	<p><u>Primary</u> -Use of MEWS was not associated with an improved response to clinical deteriorating patients (50 of 57 received no assistance versus 55 of 57, odds ratio (OR): 0.26, 95% confidence interval (CI): 0.05 to 1.31), despite increased nursing knowledge in the intervention group.</p> <p><u>Secondary</u> -Patients in intervention group had better recording of all seven VS parameters (5 of 57 versus 0 of 57</p>	<p><u>Internal Validity</u> -Maturation: Nurses working double shift or overtime may have been fatigued which may have influenced participation.</p> <p><u>External Validity</u> - Representativeness: Poor compliance in using and completing MEWS (47%) affects validity.</p>

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
				scores pre/post intervention.	patients, risk estimate: 1.10, 95% CI: 1.01 to 1.2) specifically RR (27 of 57 versus 2 of 57, OR: 24.75, 95% CI: 5.5 to 111.3) when compared to control group.	
Ludikhuize, J., Smorenburg, S. M., Rooij, S. E., & Jonge, E. D. (2012).	Retrospective observational study	<p><u>Sample</u> All patients admitted who endured SAE N= 204 Mean Age=66 Male=124 (60%)</p> <p><u>Setting</u> 1000-bed Academic teaching hospital in Amsterdam, the Netherlands</p>	<p>Conducted using retrospective chart review. Demographic data & VS data was obtained 48 hours prior to SAE was collected from medical and nursing charts for analysis.</p> <p>-MEWS tool was used to stratify patient deterioration risk utilizing VS within 48 hours prior to AE.</p>	<p><u>Primary</u> Explore current nursing practice in recording VS at university hospital</p> <p><u>Secondary</u> Effectiveness of MEWS in early recognition of medical/surgical patients who died or suffered SAE</p>	<p><u>Primary/Secondary</u></p> <p>Of the 204 patient VS reviewed, 81% had a MEWS of 3 or more at very least once within 48 hours before AE. -Nurses charted incomplete VS, directly affecting MEWS usefulness and effectiveness. -Despite high MEWS scores (>3), RR, SpO2, and diuresis were only documents 30-66%.</p>	<p><u>Validity</u></p> <p>Low quality study with observational design with retrospectively retrieved data.</p> <p>Representativeness single-site study.</p> <p>Risk for increased false/positives due to cohort design with only patients with SAE.</p>
Lydon, S., Byrne, D., Offiah, G., Gleeson, L., & O'Connor, P. (2015).	Mixed Method	<p><u>Sample:</u> Phase I: Bedside RN's and Physicians N=30.</p> <p>Phase II: Bedside RN's and Physicians N=215.</p>	<p>Phase I (Qualitative): Semi-structured interviews</p> <p>Phase II (Quantitative): Questionnaires</p>	<p><u>Primary</u> Nursing and Physician perceptions of using a national Physiological Track and Trigger System (PTTS).</p>	<p><u>Primary</u> Interview data revealed mostly positive attitudes in the use of PTTS with a few barriers including causing tension between</p>	<p><u>Internal Validity</u> Sampling: Snowball sampling was used to recruit participants.</p> <p><u>External Validity</u> Representativeness:</p>

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
		<u>Setting:</u> 2 teaching hospitals located in Ireland.		<u>Secondary</u> Variables involved that impact compliance with protocol.	nurses and doctors and sociocultural factors between units. <u>Secondary</u> Variable involved in following protocol included PTTS ease of use to relay information, effectiveness to detect clinical deterioration, legal protection in using tool, and influence of tool to escalate care.	Low response rate of questionnaires (24.1%) and mostly females participated in study (10/10).
McDonnell, A., Tod, A., Bray, K., Bainbridge, D., Adsetts, D., & Walters, S. (2012).	Mixed method study	<u>Sample</u> Bedside nursing staff N=238 Female=194 (91%) Mean age: 41 <u>Setting</u> 500-bed General hospital located in England, UK.	-Before/after survey using questionnaire to measure changes in nursing knowledge -Before/after Semi-structured interview to further provide in-depth reasoning on questionnaire results.	<u>Primary</u> Evaluate the impact of a TT system for detection of deteriorating patients on nursing knowledge and confidence	<u>Primary</u> -Use of TT system was associated with increased knowledge and confidence in recognizing and managing deteriorating patients. -Interviews confirmed findings stated above confirming that TT system had improved practice.	<u>Internal Validity</u> -Selection bias: Convenience sampling <u>External Validity</u> - Representativeness: Majority of nurses were female (91%) -Replication: Single site study and study excluded elderly/gerontology units.
Mitchell, I., McKay, H., Leuvan, C. V.,	Prospective, Controlled before and after intervention trial.	<u>Sample</u> Adult patients admitted to four	Recording of VS/Medical review analysis of all patents	<u>Primary</u> Number of unplanned ICU	<u>Primary</u> -Overall reduction in unplanned ICU	<u>Internal Validity</u> Regression toward mean: Lack of

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
Berry, R., McCutcheon, C., Avar, B., Neeman, T., Lamberth, P, (2010).		<p>medical/surgical units N=2142 Pre-intervention: n=1157 Post-intervention: n=985</p> <p><u>Setting</u> 2 teaching hospitals of the Australian National University located in Canberra, Australia.</p>	<p>admitted to 4 medical/surgical units during 4-month period.</p> <p>Pre-intervention: VS and medical review analysis (RRT activation, physician notification).</p> <p>Post-intervention: Vital Signs (VS) and medical review analysis (RRT activation, physician notification).</p>	<p>admissions, RRT activations, and unexpected hospital deaths</p> <p><u>Secondary</u> Frequency of VS documentation and incidence of RRT activation following clinical deterioration</p>	<p>admissions (21/1157 [1.8%] vs. 5/985 [0.5%], $p = 0.006$) and unexpected hospital deaths (11/1157 [1.0%] vs. 2/985 [0.2%], $p = 0.03$) during intervention time-period -RRT activation for patients with clinical instability increased 58/133 [43.6%] vs. 55/79 [69.6%] $p < 0.001$)</p> <p><u>Secondary</u> Average daily frequency of VS documentation increased during intervention time-period ((3.4 [SE 0.22] vs. 4.5 [SE 0.17], $p = 0.001$).</p>	<p>concurrent control group to justify observed improvement outcomes.</p> <p><u>External Validity</u> Representativeness: Pre-intervention/post-intervention groups were uneven with higher proportion of medical patients in intervention group.</p>
Petersen, J. A., Rasmussen, L. S., & Rydahl-Hansen, S. (2017).	Qualitative study	<p><u>Sample</u> Nurses having worked at least 3 months on med/surge unit. N= 18 Female: n=16 (80%) Male: n=2 (20%).</p> <p><u>Setting</u> Bispebjerg-</p>	Focus group interviews from July 20- October 29, 2014.	<p><u>Primary</u></p> <p>Facilitating factors in 1) adherence to monitoring frequency, 2) call for resident doctors to patients with an elevated Early Warning</p>	<p><u>Primary</u></p> <p>“EWS and the corresponding escalation protocol were described in positive terms, specifically their usefulness as an aid in clinical assessment, to</p>	<p><u>Internal Validity</u></p> <p>Selection bias: Charge nurses were the ones recruiting nurses to participate.</p> <p><u>External Validity</u> Representativeness:</p>

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
		Frederiksberg University Hospital located in Copenhagen, Denmark.		Score (EWS) and 3) call for the rapid response team. <u>Secondary</u> Barriers to same factors as above.	facilitate inter- and intra-professional communication, and prioritize workload, were emphasized.” <u>Secondary</u> Barriers themes: -Impractical reporting and communication of EWS to physicians -Lack of adherence to monitoring frequency due to workload -Poor collaboration with rapid response team due to poor and negative attitudes.	only included medical/surgical nurses, predominantly female. Single site study.
Shearer, B., Marshall, S., David Buist, M., Finnigan, M., Kitto, S., Hore, T., Sturgess, T., Wilson, S., Ramsay, W. (2012).	Multi-method study	<u>Sample</u> “Frequency of physiological instability and outcomes within the in-patient hospital population.” Point Prevalence study N (23) Prospective study n= (31)	Three data collection methods were used. 1) Point prospective study. Inpatient chart review (previous 24 hour) who met RRT activation criteria. 2) Prospective study: 8-week review of all cardiac arrests/ICU admissions who met RRT criteria. 3) Qualitative study:	<u>Primary</u> Explore reasons why nurses fail to activate the RRT	<u>Primary</u> Of the 504 inpatient charts reviewed 23 patients met RRT activation criteria. RRT activation was missed on 10 of these patients. - Interview themes of those who missed RRT activation include 1) Feeling situation was under control in current unit 2) Feeling that staff	<u>Internal Validity</u> History: Change of management or director can influence test results

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
		<p>Qualitative study n= (91) <u>Setting</u> Four comprehensive tertiary care hospital sites in Melbourne, Australia</p>	<p>All staff who missed RRT activation were individually interviewed.</p>		<p>should be able to manage deteriorating patients by themselves 3) Concerns regarding negative reactions and criticism from colleagues for alerting the RRT. -A combination of sociocultural issues and interprofessional hierarchies are major factors that hinder RRT activation</p>	
Smith, D. J., & Aitken, L. M. (2015).	Mixed Method	<p><u>Sample</u> -Physiological triggers/Characteristics of triggering patients N=336 Mean age: 74 -Student nurse (SN), Healthcare Assistant (HCA), RN N=105 <u>Setting</u> Tertiary University Hospital located in central London.</p>	<p>Phase I: Chart audit and recording of physiological triggers/characteristics of triggering using pre-existing EWS. Phase II: Questionnaires to SN's, HCA's, and RN's.</p>	<p><u>Primary</u> Investigate frequency of triggers, characteristics of patients with triggers, and average time taken to repeat observations of those triggering. <u>Secondary</u> Nursing staff perceptions of barriers/facilitators relating to patient monitoring.</p>	<p><u>Primary</u> Hypotension was the most frequent trigger abnormality. -High proportion of triggers were from elderly patients. <u>Secondary</u> Nursing staff barriers: -Increased workload -Lack of or faulty equipment. -Conflicting priorities -Volatile interactions with patient (refusing VS).</p>	<p><u>Internal Validity</u> <u>External Validity</u> Transferability- Single site study</p>

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
Stafseth, S. K., Grønbeck, S., Lien, T., Randen, I., & Lerdal, A. (2016).	Exploratory qualitative Study	<p><u>Sample</u> Bedside RN's N=7 Female=6 (85%) Male=1 (15%)</p> <p><u>Setting</u> University hospital located in Norway.</p>	Focus group Interviews “Semi-structured guide and an inductive thematic analysis was used to identify interview themes.”	<p><u>Primary</u> Explore nursing experiences after implementation of the MEWS and a 24 hour on-call Mobile Intensive Care Nurse (MICN).</p>	<p><u>Results</u> Three themes were immediately noted: 1) Experiences with using MEWS were positive. Nurses found MEWS helpful for recognizing clinical deterioration. 2) Increased support/collaboration and knowledge transfer between unit nurses and MICN. 3) Improved new and precise language of describing patient severity to MICN/Physician</p>	<p><u>Validity</u> - Single site study - Very small population compromises generalizability.</p>
Zografakis-Sfakianakis, M., Bree, E. D., Linardakis, M., Messaritaki, A., Askitopoulou, H., Papaioannou, A., & Aggouridakis, P. (2018).	Combined prospective-retrospective observational study	<p><u>Sample</u> Patients with Serious adverse events (SAE) at least 24 hours after admission to hospital unit. and patients with unplanned admissions to ICU N= 153 Male=57% Mean Age=67 Exclusion criteria patients < 16, patients in hospital < 24 hours</p> <p><u>Setting</u></p>	“Parameters retrospectively studied were 5 MEWS values at 4 hourly intervals, up to 20 hours before ICU admission. Parameters prospectively studied were ICU length of stay, ICU mortality, and mortality after ICU discharge.”	<p><u>Primary</u> Investigate the effectiveness of the MEWS in predicting patients at risk for clinical deterioration in patients who suffered SAE during stay in Medical/surgical units.</p>	<p><u>Primary</u> The most common SAE were septic shock (20.3%) and respiratory failure (39.9%). -MEWS scores progressively increased in the 20 hours prior to SAE. - MEWS scores ≥ 7 prior to ICU transfer were highly associated with hospital mortality.</p>	<p><u>Internal Validity</u> Regression toward mean: Incomplete data sets were imputed based on average value between proceeding and known value. Difficult to prove causality in retrospective studies</p>

Author(s)/Year	Study Design	Sample and Setting	Methods	Main Outcome Measures	Results	Challenges to Scientific Rigor
		700-bed tertiary university hospital				<u>External Validity</u> Representativeness: Single site study

APPENDIX B:
MEWS SCORING SYSTEM

MEWS

	3	2	1	0	1	2	3
Systolic BP (mmHg)	<70	71-80	81-100	101-199		>200	
Heart rate (bpm)		<40	41-50	51-100	101-110	111-129	>130
Respiratory rate		<9		9-14	15-20	21-29	>30
Temperature (°C)		<35		35-38.4		>38.5	
AVPU score/ RASS score				Alert +3 to 0	Reacting to Voice -1 to -3	Reacting to Pain -4	Unresponsive -5

APPENDIX C:
ESCALATION OF CARE ALGORITHM

Proposed guided MEWS response for Nursing

		Notify			
MEWS Score	Usual Care	Charge RN	Primary responder	ERT team	Associated care
1	x				
2	x				
3	x	x			Consider increased clinical monitoring
4	x	x	x	<i>Consider</i>	Consider increased clinical monitoring
5	x	x	x	<i>Recommend</i>	Consider increased clinical monitoring
6	x	x	x	<i>Recommend</i>	Consider increased clinical monitoring
≥7	x	x	x	<i>Recommend</i>	Consider increased clinical monitoring

APPENDIX D:
DEMOGRAPHIC QUESTIONNAIRE

This short survey will help me to learn more about my participants. The information you provide will be used for study purposes alone and will be kept confidential. By completing this survey, you are agreeing to allow me to use the information in this project. Thank you for your time.

- What is your sex?
 - Male
 - Female
- What is your age?
 - 18-30
 - 31-40
 - 41-50
 - 51-60
 - 61-70
 - 71+
- How many years have you been a nurse?
 - 0-2
 - 3-5
 - 6-10
 - 11-20
 - 20+

APPENDIX E:
PRE-EDUCATION QUESTIONNAIRE

- Approximately how many “rapid response” situations have you participated in during your career?

None 1-2 3-5 6-10 11+

- How confident did you feel participating in these situations?

- Not Applicable
- Not Confident
- Somewhat Confident
- Very Confident

- If you did not feel very confident, what were the reasons why? Select all that apply.

- The doctors were rude, unresponsive, or harsh.
- The chaos made me feel uncomfortable.
- I was not confident in my clinical ability.
- The rapid response nurse or other team member were unpleasant or rude.
- I was too overwhelmed with my patient assignment/ did not have time to deal with it.
- I have not received sufficient training.

APPENDIX F:
POST-EDUCATION SURVEY

Please take a few moments to reflect on the information on MEWS that you have received, then answer the following questions. All information provided will be used solely for study purposes and will be kept confidential. After receiving information on the MEWS, please answer the following questions:

- I feel better prepared to identify deteriorating patients now.
 - No
 - Somewhat
 - Yes
- I feel more confident to participate in the care of deteriorating patients now.
 - No
 - Somewhat
 - Yes
- I feel more certain of when to activate the rapid response team.
 - No
 - Somewhat
 - Yes
- I consider the MEWS to be easy to understand and follow.
 - No
 - Somewhat
 - Yes
- I believe the MEWS will make my job easier.
 - No
 - Somewhat
 - Yes
- I believe this hospital would benefit from implementing the MEWS.
 - No
 - Somewhat
 - Yes

APPENDIX G:
PARTICIPANT DISCLOSURE FORM

**FACTORS INFLUENCING THE USE OF THE MODIFIED EARLY WARNING SCORE
(MEWS) TO IDENTIFY PATIENT DETERIORATION**

Allen A. Duran

The purpose of this project is to identify the factors influencing the adoption of the modified early warning score (MEWS) for detecting early patient deterioration and initiating proper escalation of patient care in progressive care unit (PCU) nurses at Desert Regional Medical Center.

If you choose to take part in this project, you will be asked to complete a demographic questionnaire, pre-education survey, be educated on the MEWS scoring system and escalation of care algorithm, and lastly complete a post-education survey. It will take approximately 10 minutes to complete this whole process. There are no foreseeable risks associated with participating in this project and you will receive no immediate benefit from your participation. The information you provide will be used for study purposes alone and will be kept confidential. By completing this survey, you are agreeing to allow me to use the information in this project. There will be no personal identifiers in the survey. Thank you for your time.

If you choose to participate in the project, participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw at any time from the project. In addition, you may skip any question that you choose not to answer. By participating, you do not give up any personal legal rights you may have as a participant in this project.

For questions, concerns, or complaints about the project, you may call Allen Duran, BSN, RN at (760) 851-8029 or via email at Allend10289@email.arizona.edu.

APPENDIX H:
DESERT REGIONAL MEDICAL CENTER INSTITUTIONAL REVIEW BOARD
APPROVAL LETTER



August 2, 2019

Allen Alexander Duran
Desert Regional Medical Center
1180 N. Indian Canyon,
Palm Springs, CA 92262

RE: (IRB#2019-917): Factors Influencing The Use Of The Modified Early Warning Score (MEWS) To Identify Patient Deterioration

Jurisdiction: Desert Regional Medical Center, 1180 N. Indian Canyon Drive, Palm Springs, CA 92262

Dear Mr. Duran:

The IRB Chair has determined that the proposed activity is not research as defined by DHHS and FDA regulations.

Specifically, the following documents were submitted:

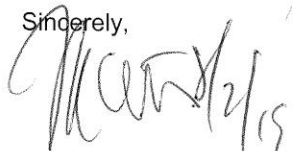
- E mail communications of July 31, 2019
- Quality Initiative Proposal

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, please submit a new request addressing proposed changes.

All publications and communications related to this quality initiative are subject to Tenet Policy AD 2.16 related to the substantiation of all data/claims with reliable scientific evidence

Please call me if you have any questions about the terms of this determination at 508-383-8786 or e-mail me at mary.oster@mwmc.com.

Sincerely,



Mary Oster
IRB Administrator

APPENDIX I:
THE UNIVERSITY OF ARIZONA INSTITUTIONAL REVIEW BOARD APPROVAL
LETTER


 Human Subjects
 Protection Program

 1618 E. Helen St.
 P.O. Box 245137
 Tucson, AZ 85724-5137
 Tel: (520) 626-6721
<http://hgw.arizona.edu/compliance/home>

Date: September 24, 2019

Principal Investigator: Allen Alexander Duran

Protocol Number: 1909986098

Protocol Title: FACTORS INFLUENCING THE USE OF THE MODIFIED
EARLY WARNING SCORE (MEWS) TO IDENTIFY PATIENT
DETERIORATION

Determination: Human Subjects Review not Required

Documents Reviewed Concurrently:

HSPF Forms/Correspondence: *Determination of Human Research-Allen A. Duran Revised.pdf*

Regulatory Determinations/Comments:

- Not Research as defined by 45 CFR 46.102(1): As presented, the activities described above do not meet the definition of research cited in the regulations issued by U.S. Department of Health and Human Services which state that "Research means a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge. Activities that meet this definition constitute research for purposes of this policy, whether or not they are conducted or supported under a program that is considered research for other purposes. For example, some demonstration and service programs may include research activities. For purposes of this part, the following activities are deemed not to be research."

The project listed above does not require oversight by the University of Arizona.

If the nature of the project changes, submit a new determination form to the Human Subjects Protection Program (HSPF) for reassessment. Changes include addition of research with children, specimen collection, participant observation, prospective collection of data when the study was previously retrospective in nature, and broadening the scope or nature of the study activity. Please contact the HSPF to consult on whether the proposed changes need further review.

The University of Arizona maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #00004218).

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