Effects of an Early Warning Score Protocol on Patient Outcomes

By

Danielle M. Molina

A Directed Scholarly Project Submitted to the
Department of Nursing
in the Graduate School of
Bradley University in
partial fulfillment of
the requirements for the
Degree of Doctor of Nursing Practice.

Peoria, Illinois

2020

DNP Project Approval

Bradley University
Department of Nursing

Effect of an Early Warning Score Protocol on Patient Outcomes

By
Danielle M. Molina

has been approved

November 30, 2020

Approved: *Deborah Erickson PhD, RN 11/30/20*
(DNP Project Team Chairperson name, credentials & date)

Approved: *Toni Bishop-McWain DNP, NEA-BC, CCRN 11/30/20*
(DNP Project Team Member name, credentials & date)

Acknowledgements

I would like to thank several people for their help and support in this adventure in pursing my Doctorate of Nursing Practice (DNP) degree. A big thank you to the preceptors for the clinical hours to help me strengthen my leadership skills: Dr. Sandy Schiedenhelm, Dr. Vincent Kucich, and Dr. John Kreckman. Each had valuable skills to teach and allowed me the opportunity of time with them.

To Dr. Toni Bishop-McWain who was my main DNP mentor during my project planning, defense, and implementation. Toni was available to guide and mentor and provided me with valuable feedback.

To Dr. Deborah Erickson, thank you for providing constructive feedback to ensure quality work on my project. Your support as my faculty advisor helped guide me through the process of this program smoothly.

To my mentor in my career and schoolmate, Molly Nicholson. We started this school journey together after talking about it for years. While we are not able to conclude this part together, I feel your spirit as the semester wraps up. Thank you for always encouraging me to go farther.

Lastly, to my family and friends, thank you. To my friends, thank you for continually pushing me to do a little work daily instead of a lot of work in crash sessions. The check in texts to see if I am on schedule with the project. Your kindness helped me push through. To my husband and daughters, thank you for your words of encouragement, support, and most of all understanding of the long hours and days needed to finish this degree. You have been the stable rock on this journey.

Abstract

The use of critical thinking in medical surgical nursing is essential to maintain the health of the patients receiving care. Evidence-based practices have become available providing more tools for RNs to use in conjunction with physical assessments to determine early deterioration. Such evidence-based tools, like Early Warning Score (EWS), have given objective scores to help weigh the severity of abnormal vital signs for an individual patient. This Quality Improvement (QI) project established a protocol to provide interventions to a patient with an elevated EWS at a 3 or higher. Education was developed and rolled out to registered nurses, patient care techs, and providers on the medical surgical units and the intensive care unit.

During this project, the use of different thermometers to measure body temperature became an important data piece to understanding the high occurrences of elevating EWS. With quick action of recalibration and ultimately removal of the specific method of temperature obtainment, the number of elevated scores in response to temperature alone was reduced.

The findings show with a standard protocol for nursing to follow in response to an elevation in the EWS, the number of occurrences elevated scores dropped by 83%, allowing for increased sensitivity to the score and increased interventions to those patients identified.

The QI project confirmed when using the EWS as an objective tool with accurate assessment information, an improvement in patient outcomes can be realized. Further research needs completed to understand the best frequency of vital signs in the medical surgical population.

Keywords: early warning score, EWS, patient deterioration, rapid response team, RRT

Effects of an Early Warning Score Protocol on Patient Outcomes

Effects of an Early Warning Score Protocol on Patient Outcomes

Chapter I: Introduction

The use of critical thinking in medical surgical nursing is essential to maintain the health of the patients receiving care. Evidence-based practices have become available providing more tools for RNs to use in conjunction with physical assessments to determine early deterioration. Such evidence-based tools, like Early Warning Score (EWS), have given objective scores to help weigh the severity of abnormal vital signs for an individual patient. With these tools, an important piece is missing, a standard approach to the elevated EWS to provide appropriate follow up or escalation of patient care.

Background and Significance

Multiple different EWS tools have been validated to detect early deterioration in the patient within the acute care setting (Churpek et al., 2019). Some examples are the National Early Warning Score (NEWs), modified Early Warning Score (MEWS), and the electronic Cardiac Arrest Triage (eCART). The EWS, at the project site, is calculated based on the patient's vital signs readings of temperature, heart rate, respiratory rate, systolic blood pressure, and oxygen saturation. Table 1 demonstrates the different abnormal vital signs with the corresponding EWS number. A score of 3 or above could be achieved by one vital sign parameter or a combination of a few vital sign parameters being outside the normal range. When the score is elevated at a 3 or above,

Table 1

Early Warning Score Parameters

Vital Sign	Parameter	EWS score
Respiratory rate	<=10 or >= 28 24-27 23-20	3 2 1
Oxygen Saturation	<=86 87-89	3 1
Temperature	<=96.8F or >=102.4F 101.5-102.3F 100.4-101.4F	3 2 1
Heart Rate	<=40 or >=129 111-128 41-50	3 2 1
Systolic Blood Pressure	<= 70 or >= 200 71-80 81-100	3 2 1

there is no defined or standard follow up for nursing. Without a defined early intervention to respond to an elevated EWS,

the patient has a potential to continue to deteriorate increasing the risk of mortality (Bunyaphatkun et al., 2017). The only standing procedure is to call a rapid response team (RRT) for an EWS of 5 or greater; however, no monitoring of compliance is in place. Without monitoring compliance to the current procedure and identifying current practice, the impact of RRT on patient outcomes is unknown. The EWS provides an objective number to help identify a patient at risk of deterioration but critical thinking is also a vitally important skill to evaluate the patient's condition and providing high-quality care.

Needs Assessment

A SWOT tool was used to conduct a needs assessment on EWS process. Within the organization, several strengths exist to help with successful implementation of the project. The organization currently has the EWS built within the electronic medical record (EMR). While the EWS tool exists in the EMR, several weaknesses co-exist within this strength. Comprehensive education is not provided to new hires or annually to registered nurses (RNs) on the validity of EWS, functionality in the EMR of EWS, or the tracking and trending of EWS. Patient care technicians (PCT) do not receive specific education on EWS or the importance of a complete set of vital signs.

An advanced report is available abstracting patients with an EWS of 5 or greater in the EMR platform. These reports allow for an in-depth review retrospectively. This report could be used in real time to identify patients with a score of 5 or greater. Ideally, the report would identify patients with an elevated EWS of 3 or above as well.

Weaknesses identified include no standard protocol or practice exists for EWS of 3 or above, no compliance monitoring with current practice of utilizing the RRT for an EWS of 5 or greater, high nurse turnover, and lack of experienced medical surgical nurses. This organization has faced staffing challenges over the last year. In the interim, a large number of travel nurses and new graduate nurses have been hired. This skill mix provides a challenge to ensure standard nursing care practices are being implemented for patients experiencing an elevated EWS of 3 or greater. An educational program needs to be developed with a competency in vital sign obtainment, EWS trending, and appropriate follow up measures. Multiple modalities of education delivery will need to be available.

Opportunities identified consist of the ability to collaborate with other organizations to share best practices and the ability of the existing EMR to trigger interventions when EWS is elevated. The organization is a part of a larger health care system consisting of 13 hospitals across Illinois and one in Michigan. Being a part of a large healthcare system, the ability exists to have access to other health care systems for benchmarking and sharing best practices. Upon successful project completion, demonstrating the need for a standard practice, the opportunity for building the best practice into the EMR could further help with early recognition and action for patients who are deteriorating. By recognizing patient deterioration earlier within the disease or acute illness progression, the patient could benefit with improved outcomes.

An external threat to the objective includes locum physician groups. As the organization has struggled with nurse staffing, the organization has struggled with physician staffing. With locum physicians, some agreements are only for a weekend or contracts exist for multiple months. The shorter-term contracts provide the potential for a lack of knowledge of practice in escalation with an elevated EWS. With the shorter contracts, provider collaboration with the

EWS escalation could be problematic. Providers will be educated with the EWS parameters to understand the language of the scoring system. The provider's role in EWS is important in providing medical interventions when appropriate in response to the elevated EWS. Being able to provide earlier medical treatment in response to an elevating EWS could prevent the further escalation of EWS and patient deterioration interventions (Ludikhuize et al., 2014; Sutherasan et al., 2018; Vincent et al., 2018). Physician involvement and education is important in this initiative to create the best outcomes.

A current assessment of the frequency of elevated EWS scores (3, 4, 5 and higher) is needed. A better understanding of the number of patients with elevated scores is needed to understand the potential increase in workload.

A baseline assessment is needed to understand nurses' feelings and attitudes about calling an RRT. This assessment, called the Rapid Response Staff Knowledge and Satisfaction survey will be important during the education development and implementation steps (Australian Commission on Safety and Quality in Health Care, 2012). Using a 5-point Likert style survey, nurses will be asked to answer questions related to feelings and attitudes with utilizing the RRT and knowledge questions related to current EWS practice.

Problem Statement

Patient deterioration can occur due to disease or acute illness progression. Detecting patient deterioration is vital to decrease the patient's risk of mortality, decrease cardiopulmonary arrests outside of the ICU, potentially decrease the length of stay, and improve overall outcome. The EWS tool is an evidence-based tool (Bunyaphatkun et al., 2017; Downey et al., 2017; Haegdorens et al., 2018; Watkinson et al., 2018). However, the follow up of elevated scores is not defined in a standard nursing practice.

Purpose

The purpose of the project is to create a standardized practice for nurses when caring for patients with an EWS of 3 or greater by providing increase frequency in vital sign obtainment and patient assessment. At the end of this project, successful outcomes will reveal an increase in vital sign frequencies demonstrating compliance to the practice, an increase in RRT calls for an EWS of 5 or greater, and a decrease in cardiopulmonary arrests outside of the intensive care unit (ICU).

PICOT

In nurses caring for adult patients in acute care settings outside of the Intensive Care Unit, how does a standard protocol following an elevated early warning score (I) compare to no standard protocol for elevated early warning scores (C) affect rapid response calls and cardiopulmonary arrests (O) while hospitalized (T)?

Congruence with Organizational Strategic Plan

The Midwestern hospital's strategic plan and goals for fiscal year 2020 include safe patient care delivery with excellence in patient outcomes, improved employee engagement scores, and optimizing financial performance (OSF Healthcare, 2019). The outcomes of this project demonstrate excellence in patient outcomes by potentially decreasing cardiopulmonary arrests outside of the ICU by providing early interventions utilizing the EWS.

Employee engagement is another measure of success in the strategy. By including front line nursing staff in the development and structure of this project, employee engagement, specifically nursing, could be improved. Front line nurses will be asked to participate in the survey to gather knowledge and perceptions related to EWS and RRT. Eliciting this feedback will help nurses feel voices were heard.

Optimizing financial performance is essential in a health care organization to continue to provide care. Providing early interventions to patients experiencing elevated EWS could help decrease length of stay and ICU admissions thus decreasing cost of care to the patient and organization.

Search Strategy

Using Cumulative Index to Nursing and Allied Health (CINAHL), Google Scholar, and Cochrane databases, key words of "nursing observation", "early warning score", "patient deterioration", and "escalation" were used to find articles for review. Articles published within the from 2013 to 2019 and "all adult" population were used as limiters. With these search options and limiters, a total of 272 articles were found. The following inclusion criteria were used for the studies utilized: (a) the intervention discussed focused on implementation or improvement of EWS utilization and patient outcomes, (b) the article discussed nursing perceptions to EWS, RRT, and/or patient deterioration, and (c) articles completing literature reviews, randomized controlled trials, and observational studies not opinions. A total of 21 articles were used for the synthesis of evidence.

Synthesis of Evidence

In reviewing the evidence, three different types of themes became clear: (a) vital sign or EWS accuracy with patient outcomes, (b) EWS bundle interventions effect on patient outcomes, and (c) nurses' attitudes or feelings about calling an RRT. Five studies focused on accuracy or completeness of vital signs and EWS scoring and the relation on patient outcomes. Twelve studies focused on the EWS and follow up nursing interventions and subsequent patient outcomes. Five articles studied nurses' feelings on knowledge or competence on the EWS or vital signs and attitudes or barriers for calling an RRT in response to a deteriorating patient.

Within all the studies, the dependent variables were consistent evaluating what impact the practice changes had on patient mortality, increasing RRT calls, and decreasing cardiopulmonary arrests outside the ICU.

Accuracy of Documentation

Accurate information is essential in providing high-quality patient care. When reviewing vital sign documentation and how EWS is calculated, a few studies reviewed accuracy and ease of workflow for clinicians. Christofidis et al. (2015) researched accuracy, ease of use, and error rates on three different paper flowsheets. A simple approach to documentation helps improve effectiveness of vital sign documentation and decrease errors in calculation. Simplicity and clear expectations on vital sign documentation are imperative to providing high quality care. Within 24 hours prior to the patient experiencing a cardiac arrest, a clear lack of documentation of vital signs was discovered (Stevenson et al., 2016). Accurate documentation of vital signs within those 24 hours prior to an event could have demonstrated the potential point of deterioration.

Providing comprehensive knowledge of patient assessment and vital sign correlation is an important concept to education and re-education with nurses. Vital signs can be a redundant task many take for granted. However, minor changes in the respiratory rate is usually the first indicator the patient's status is changing. The mode of monitoring can impact the tools with the EMR. Because of the importance of respiratory rate, continuous monitoring captures this change more rapidly than through manual assessment (Watkinson et al., 2018).

Going a step further is tying the clinical correlation with the objective assessment of vital signs. Different illnesses can manifest in different ways, but the clinician must be thorough in assessments to create the entire clinical picture. Creating thorough assessment tools to prevent delayed symptom recognition increases the ability of clinicians to intervene earlier in the

patient's admission (Bunyaphatkun et al., 2017). Thorough assessment and standardization of processes help decrease the lack of knowledge and delays in recognition (Mullany et al., 2016). The implementation of EWS and standardization of calling RRTs led to an increase in RRT calls and a decrease in cardiac arrests and hospital mortality (Mullany et al., 2016).

EWS Bundles

Critical thinking and the ability to interpret patients' clinical findings protect patients from further deterioration. Using the EWS to help guide providers in the detection of deterioration is only one step in critical thinking. Follow up investigation to explain the EWS or further observations are needed to holistically care for patients. Providing expectations of EWS calculations and established frequencies of monitoring patients promotes consistency within nursing staff. Creating and implementing a standard approach to patient deterioration increases the ability to provide earlier patient care interventions (Ludikhuize et al., 2014; Sutherasan et al., 2018; Vincent et al., 2018).

With the creation of standard EWS bundles or protocols, patients with elevated EWSs receive more vital sign and assessment observations. With this increase in observations, monitoring patient deterioration improved and patient mortality decreased (Haegdorens et al., 2018). Measuring the response time from first sign of distress to intervention is frequently completed during retrospective chart reviews. Often times, some sign was present but overlooked demonstrating a need for better standards of care for abnormal vital signs (Bonnici et al., 2016).

Gagne and Fetter (2017) researched for similar results in how to increase RRT calls implementing a communication bundle. One point strengthening the study was the added measurements reviewing the EWS of the RRTs. An increase in RRTs was seen in patients with EWS of 4 (4 is the lowest score for an RRT activation). This implementation involved electronic

communication with the determined score. Removing the human element of determining whether an RRT should be activated, allowed for more timely identification of clinical deterioration and provided interventions. In the study, a decrease in ICU transfers was witnessed. Downey et al. (2017) completed a literature review of over 825 papers, concluding EWS helped increase multidisciplinary communication for the patient's condition. Another method of EWS screening involved a crisis nurse monitoring EWSs during hospitalization in real time outside of the ICU (Heal et al., 2016). Positive outcomes, such as earlier RRT activations for elevated EWS patients were demonstrated; however, a dedicated resource to monitor, respond, review, and react are difficult to obtain in smaller hospitals.

Understanding the nurses' beliefs and trustworthiness in an EWS tool is important to evaluate the potential barriers in utilization of the tool. During focus groups, nurses interviewed felt EWS was not the only piece of information used to activate the RRT, but used to help validate the physical assessment of the patient to activate the RRT (Stewart et al., 2014). Pazar and Yava (2013) developed a small study with a nursing guide application of interventions following EWS calculation. The results demonstrated interventions were provided earlier to patients experiencing the onset of complications (Pazar & Yava, 2013). Pazar and Yava's (2013) study helps support the need and clinical significance for a nursing guide or protocol in the medical surgical area.

Patients within the medical surgical area continue to be more acutely ill and the complexity of conditions higher (Scott et al., 2019). Due to this shift in complexity, some nurses worried the EWS would be falsely elevated because of chronic conditions. A consistently high EWS in chronically ill patients is uncommon, which helps validate the usefulness of the tool in today's environment (Scott et al., 2019). In a large systematic review, EWS was cited to be a

good indicator for patient deterioration and improves patient outcomes (Downey et al., 2017). Limitations to EWS include clinician engagement, which is required to ensure the tool is a part of patient assessment and not a standalone tool (Downey et al., 2017). Wood et al. (2019) found nurses used the EWS score as the only assessment for escalation in care needed additional education and follow up connecting the score with the physical findings of the patient.

Nurses' Attitudes and Feelings

Vital signs are the basic measurements to help clinical staff assess the patient's status. Vital signs in conjunction with a multitude of other assessment findings help formulate the entire clinical picture. In health care organizations, continued validation and professional development on vital signs is not routinely done. Completing an observation of nurses' knowledge of the importance of vital signs demonstrated a large gap (Mok et al., 2015). Nurses felt vital signs were a time-consuming task instead a vital piece of the clinical picture. While EWS is an objective tool giving values to abnormal vital signs, the tool itself needs reinforcement as part of a complete assessment (Mok et al., 2015). Incorporating the score during an RRT increases communication and a smooth transition of care during the RRT call. Providing comprehensive education involving the EWS, such as how to interpret the score with the patient's condition and effective communication to provider and/or RRT, increased nurses' competence in using the EWS tool (Jensen et al., 2017; Saab et al., 2017).

Many times, nurses feel worry or concern about the patient prior to vital sign changes. Using this information, Douw et al. (2015) studied what feelings of worry or concern in relation to the patient's condition to create a validated tool called the "dutch-early-nurse-worry-indicator-score" (DENWIS). Douw et al. (2016) used the DENWIS tool to demonstrate nurses scoring a sense of "worry" about the patient prior to the vital signs scoring at an elevated level in EWS.

Situational awareness and subtle changes in the patient's condition increase a nurse's "worry". The DENWIS tool helps validate the nurses' "worry" during the study; however, having "worry" can also be a barrier to calling an RRT. In an organization struggling with teamwork between departments, nurses felt worried to call an RRT too prematurely even when the nurse felt the patient possibly needed some intervention (Alshehri et al., 2015). Building the structure of calling the RRT, in response to EWS, needs to have a clear form of communication established. Education for both medical surgical nurses as well as the RRT would be crucial in providing a supportive environment for all nurses to call a RRT regardless of their experience level.

Conceptual Framework

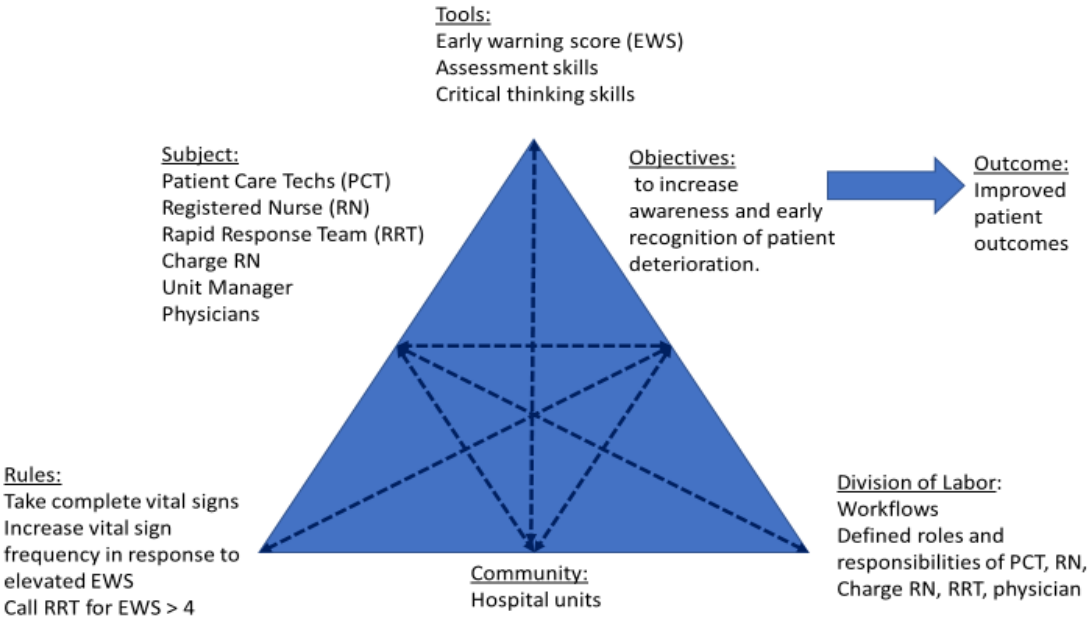
Engeström's Activity Theory provides a conceptual framework by analyzing the activity and the cross sections to multiple different disciplines (Sadeghi et al., 2014). Engeström's theory is depicted as multiple triangles intersecting with multiple different aspects influencing or motivating the activity. There are four principles to the Activity theory. First, explore the activity as a dynamic phenomenon. Second, capture all aspects of the activity to create the activity system. Third, understand how all the activity systems work together to meet the desired outcome. Fourth, identify the problems within the system and find solutions.

Defining the activity systems is shown in Figure 1 (Engeström, 1987). The activity system is the EWS process. The subjects of this activity are the PCTs, RNs, RRT, Charge RNs, and the physicians. These are the individual roles involved in the EWS process. The community is the location of the patients within the hospitals on the selected units. The objective of this activity is to increase awareness and early recognition of patient deterioration. The outcome from achieving this objective is to have improved patient outcomes. The tools in this activity are the EWS within the EMR, assessment skills, and critical thinking skills of nurses. The rules within

the activity are to help motivate the subjects to act in a certain manner to achieve the objective and outcome. The rules in this activity are completeness of vital sign documentation, following a protocol for increased vital sign monitoring for elevated EWS, and calling an RRT for an elevated EWS greater than 4. Understanding roles and responsibilities of the subjects is important to ensure a clear activity system. The division of labor includes clear roles for all subjects involved and workflows for the increase in vital sign monitoring in response to elevated EWS. Engeström's activity theory provides the needed structure for this project with mutiple different variables to improve clarity.

Figure 1

Early Warning Score Activity System



Chapter II: Methodology

Project Design

Implementation of a standard practice in response to the elevation in EWS will be a quality improvement (QI) project based on evidence-based practice. Providing a standard approach to patients with elevated EWS will increase the amount of RRT calls, which will provide a higher level of care at the bedside sooner during patient deterioration.

Setting

A Midwestern hospital was chosen for the practice change site for multiple reasons. First, this hospital is a 174-bed acute care facility with an Emergency Department, an ICU, two medical-surgical units, surgical services, and maternal child services. Within the two medical-surgical units, the average daily census is 50 patients (25 on each unit), which will provide a good sampling of patients. When reviewing the EWS report from the EMR from April 2019 to September 2019, 282 individual patients triggered an EWS of 5 or above (Epic, 2020).

Population/Sample

The two medical surgical units named 4 East (4E) and 4 West (4W) will be the test sites. These units treat acutely ill patients admitted for observation and inpatient care. The two units chosen have similar patient populations in comparison to the literature reviewed. Both units care for non-intensive care medical surgical patients, which was the setting for a majority of the literature.

Patients with an EWS of 3 or above will be included in this project. Patients with treatment plans focusing on comfort measures or hospice will be excluded.

All PCTs and RNs on 4E and 4W will complete mandatory online education provided on the change in practice to manage patients with elevated EWS. Rapid response nurses and ICU

charge nurses will also receive education on the new practice. Skills validation will follow the online learning in the lab.

Tools and Instruments

The Rapid Response Survey Staff Knowledge and Satisfaction survey will be distributed via online tool to the medical surgical nurses for voluntary and anonymous participation (Australian Commission on Safety and Quality in Health Care, 2012). This 5-point Likert survey tool will provide baseline information on the current RRT process and perceived barriers. (See Appendix A). Approval has been received. (See Appendix B.) The survey was created to help organizations identify known barriers for successful RRT calls, current state of managing emergenices, and perceived teamwork during RRTs (Australian Commission on Safety and Quality in Health Care, 2012). Information on this tool's reliability and validity was unable to be retrieved.

The tool used to screen patients at-risk for clinical deterioration is the EWS which is validated and evidenced based (Churpek et al., 2019). The EWS, at the project site, is calculated based on the patient's vital signs readings of temperature, heart rate, respiratory rate, systolic blood pressure, and oxygen saturation. A score of 3 or above could be achieved by one vital sign parameter or a combination of two or more vital sign parameters being outside the normal range. See Table 1 for the vital sign parameters and correlating EWS.

Table 1

Early Warning Score parameters

Vital Sign	Parameter	EWS score
Respiratory rate	<=10 or >= 28 24-27 23-20	3 2 1
Oxygen Saturation	<=86 87-89	3 1
Temperature	<=96.8F or >=102.4F 101.5-102.3F 100.4-101.4F	3 2 1
Heart Rate	<=40 or >=129 111-128 41-50	3 2 1
Systolic Blood Pressure	<= 70 or >= 200 71-80 81-100	3 2 1

To understand the effectiveness of the education for the practice change, all RNs and PCTs on 4E and 4W will complete mandatory online education (See Appendix C for education outline). Education will be different for PCTs and RNs. All charge nurses on 4E, 4W, and ICU will attend education sessions in addition to understand the management of this patient population.

A pre-test will be conducted to gather baseline knowledge on the topics. A post-test will be completed to assess learning after the mandatory online education (See appendix D). A simulated competency for nurses will be completed to demonstrate EWS concept and critical thinking skills and assessments. (See Appendix E).

Project Plan

Education

As identified in the need's assessment, RNs, PCTs, and providers have a knowledge gap regarding expectations for the management of patients with elevated EWS. Education will include the validity of EWS tool, the vital signs parameters and score correlation, importance of an accurate respiratory rate, follow up monitoring, and the functionality of the tool within the EMR. The intended audience to this education is medical surgical nurses, charge nurses, and PCTs.

The RRT is comprised of critical care nurses, respiratory therapists, and house supervisors. The RRT will receive education on EWS vital sign parameters, the tool's validity, proactive ICU charge nurse rounding, and the new practices implemented. This education will include appropriate response to EWS of 5 or greater and review of current RRT standing orders. Providers, including hospitalists, intensivists, and advance practice nurses, will receive education on the goals and interventions of the project.

Interventions

Vital signs frequency is not well researched. Vital signs intervals are difficult to apply to all populations; however, on a medical surgical unit, providing an intervention for an EWS of 3 or 4, vital signs every two hours seems appropriate for the type of intervention to be given. For example, if the EWS score is elevated due to fever and heart rate, giving the fever reducing medication should positively affect both vital signs within two hours. If the issue does not resolve in two hours when the vital signs are taken again and EWS remains elevated, more interventions should be received by the provider upon notification.

Interventions chosen to follow with elevated EWS are the following:

EWS of 3

- complete vital signs every two hours for three times with EWS calculation
- notify the charge RN

EWS of 4

- complete vital signs every two hours for three times with EWS calculation
- charge notification
- physician or provider notification

EWS of 5 or greater

- complete vital signs every two hours for three times with EWS calculation
- charge notification
- physician or provider notification
- rapid response is called

During the project, documentation of complete sets of vital signs will be monitored by the charge RNs and data abstractors to ensure the tool is calculating EWS correctly. A complete

set of vital signs includes temperature, heart rate, respiratory rate, blood pressure, and oxygen saturation. To monitor the compliance with the project, a chart review tool will be created. This tool will keep track of cardiopulmonary arrests outside of the ICU, numbers of RRT called, and each patient's discharge disposition. (See Appendix F). A hospital procedure supporting the EWS standard will be approved. (See Appendix G).

Outcomes

From the nursing education, post education tests will demonstrate an increase in knowledge on EWS scoring, importance of respiratory rate accuracy, and follow up interventions for elevation in EWS prior to implementation of the project on the units. RNs on 4E and 4W will demonstrate competence in the assessment of a patient with elevated EWS within the simulation lab. Continued surveillance of patients with EWS of 3 or above will be audited weekly by DNP student and clinical educators to ensure adherence to the new practice. Rapid response calls will increase based on the EWS of 5 of greater. Cardiopulmonary resuscitation outside of the ICU will reduce following the project's implementation.

Data Collection

Prior to implementation, the data accessible is rapid response calls, cardiopulmonary resuscitation outside of the ICU, and EWS of 5 or greater. Patients with scores of 3 or 4 are not kept within any report in the EMR and will have to be manually abstracted. Due to time constraints, abstracting this data prior to the project was not possible.

The data abstractors will be educated on the process and the elements to abstract. The DNP student will educate the data abstractor on EMR reports, EWS standard practice, and data points from the EMR. Once education is completed, data collection competency will be completed with the abstractors and the DNP student to ensure accuracy and consistency. Once

data abstraction competency is completed, the abstractors will audit daily Monday through Friday. Two clinical educators will assist in the collection of data for patients experiencing elevated EWS. A chart review tool will be utilized on every patient with an EWS of 3 or above. The data will be saved in a password protected shared network drive.

All documentation will be within the EMR for data collection. Review of appropriate flowsheet rows and EWS reports will help in the collection of information. Confidentiality will be maintained as medical record numbers (MRNs) will be hidden in the data collection tool.

Evaluation and Sustainability

Once the implementation phase is concluded, data analysis will start. Vital signs completeness, manual calculation of the EWS, and compliance with notifications and rapid responses for patients with elevated scores will be analyzed. Results of this data review will demonstrate the percentage of compliance to the EWS bundle. Rapid response outcomes for patients with EWS of 5 or greater will show how many patients were treated and remained on the unit, treated and transferred to the ICU, or treated and code status or direction of care changed due to acuteness of illness. During this project, the usefulness of the current EWS tool within the EMR will be monitored. Currently, the EMR calculates the EWS score; however, known limitations exist with the auto-calculation. For sustainability, the EWS tool will need some revisions along with some possible queries for additional documentation to support the needed practice change.

New RNs (travel and permanent), PCTs, ICU RNs, and providers (locum and permanent) hiring into the organization will require the same education upon hire in the classroom setting and during unit orientation. Annual education will be provided to each discipline identified with a competency during a skills day.

Timeline

Once Institutional Review Board (IRB) approval is obtained, the Rapid Response Survey will be distributed via an online tool. EWS education will begin to be deployed. Using the pre-project data of EWS practice gaps identified, the education will include objectives listed previously. The education will be delivered to the medical surgical RNs and PCTs over a two-week period. During the same two-week period, the RRT responders, and critical care charge RNs will receive education. Providers will be delivered information at the same time. Implementation will begin after education. During the implementation phase, data will be collected weekly and reported back to 4E, 4W, ICU, and senior leadership. Nursing practice which is non-compliant with change will be reviewed with staff individually. See complete timeline on Appendix H.

Data Analysis

Using the new EMR report, pre-project data will be collected from January 2020 through March 2020. Baseline data will be gathered on current state with EWS trending, follow up monitoring, RRT calls based solely on EWS of 5 or higher, and number of cardiopulmonary arrests outside of the ICU. For all cardiopulmonary arrests outside of the ICU, EWS will be reviewed to monitor for trends of rising EWS or if a lack of complete vital signs is discovered.

Only data found in the EMR flowsheet rows and nursing notes will be abstracted into the data collection. Education for the RNs and PCTs will indicate where these data elements should be documented for clear understanding.

Descriptive statistics will be analyzed to review RNs' responses to the Rapid Response Staff Knowledge and Satisfaction survey, EWSs, vital sign frequency compliance, number of RRT activations, all-or-none compliance with EWS bundle with elevated EWSs, and number of

cardiopulmonary arrests outside the ICU. Data analysis will be conducted using a t-test to measure if a statistical difference exists between the pre-project data and post-project data. Predicted outcomes should demonstrate an increase in accuracy and completeness of vital sign documentation, an increase in RRT calls on the medical surgical unit when warranted, and a decrease in cardiopulmonary arrests outside the ICU. A statistician has been consulted to guide the data collection for accurate analysis.

Institutional Review Board/Ethical Concerns

Institutional Review Board application will be completed to seek expedited review. This project will have minimal risk to patients. Vital sign frequency will increase based on a patient's EWS. Vital sign frequency is a standard of care during hospitalization. This project was submitted for review and approval received from the organization's Research Committee. An application to the Community's IRB was completed and approval received. See approval form in Appendix I.

Patients' confidentiality will be protected by using MRNs as the identifiers instead of names. No informed consent is needed. Pre and post test results of RNs and PCTs will be have all personal identifiers removed.

Chapter III: Organization Assessment and Cost Effectiveness Analysis

Organizational Assessment

In the 2019 employee opinion survey, the identified units performed better than in previous years. Part of the Press Ganey survey measures the RNs' engagement and readiness to support change which were positive with the latest survey. Even with the improvement in the engagement scores, barriers still exist. Both units have gaps in the permanent charge RN role. To mitigate this barrier, secondary charge RNs will need to be identified to receive the same level of education for charge RNs.

Another barrier is the medical surgical staff feeling comfortable in calling a rapid response. In an organization struggling with teamwork between departments, RNs felt worried to call an RRT too prematurely even when the RN felt the patient possibly needed some intervention (Alshehrier et al, 2015). Understanding this barrier, providing a simulated RRT event with the RRT and medical surgical RNs could help establish a stronger rapport between the two units. Additionally providing a script for the RRT responder and the medical surgical RN could provide a smoother transition during the RRT which would build confidence in calling more RRTs.

Interprofessional collaboration will be essential to facilitate a successful project. All care providers in the team will gain knowledge of EWS and the importance of the tool with detecting deterioration.

Cost Factors

This project will not directly generate revenue. The project has the potential to improve length of stay by providing earlier interventions to patients with elevated EWS; however, this is not the focus of the project. Education development and delivery will incur the largest amount of

expense from salaries. The goal of the initial education is 1 hour for PCT, 1.5 hours for RN, and an additional hour for charge RN. The RRT responders are included in this expense budget. In order to avoid these costs to be above and beyond worked hours, multiple education sessions will be held during RNs' shifts. A statistician has been contacted for consultation on the data set up and analysis without response yet.

The Rapid Response Survey will be conducted through online tools to decrease expense. Pre and post-tests and attendance to the mandatory education will be completed through the organization's online learning system. A complete expense budget can be found in Appendix J.

Chapter VI: Results

Analysis of Implementation Process

The overall goal for this project was to improve patient outcomes when EWS is elevated demonstrating potential deterioration. Even amidst the COVID-19 global pandemic, the project was able to start on the originally planned date. The online survey to measure staff's knowledge on rapid response was launched (Appendix A). Nineteen of the 79 (24%) RNs invited to participate completed the survey. The results from this survey identified RNs seemed to feel confident in the RRT response.

Because of the COVID-19 pandemic, in-person education could not be completed due to public health mandates. The education was modified to be online through the organization's learning module system. Nursing managers helped by reminding staff to get the assignment completed. Simulations were not allowed to be completed after the online learning due to social distancing and organizational policies. With the loss of the simulations aiding in application of the new protocol, the DNP student completed rounding with RNs, PCTs, providers and nursing managers in order to help hardwire education.

Weekly feedback was provided to nursing leadership on compliance to the EWS interventions identified. This feedback consisted of the patient MRN, diagnosis, and vital signs causing the elevation in EWS. In rounding with RNs and PCTs, additional resources were requested. Badge cards with the EWS parameters and interventions were created and dispersed. The impact of these badge cards is unknown. Weekly data was also shared through the organization's nursing practice council, charge RN meeting, and house supervisor staff meeting. Open communication sharing barriers and successes was imperative.

Several weeks into the monitoring of the EWS vital signs a patterned issue of one specific vital sign emerged. Temperatures being taken by the temporal artery thermometer frequently give a temperature at 96.8^{o}F or below. This temperature creates an EWS of 3. Biomedical engineering was engaged to investigate if recalibrating the thermometers would correct this issue. For approximately a week after biomedical engineering recalibrated the thermometers, the temperatures issue appears to resolve; however, quickly the pattern re-emerged. Preliminary data was presented to the organization's nursing practice council. The council recommended the removal of this method of temperature obtainment as the method is not founded in best practice. Nursing leadership supported the recommendation and the temporal artery thermometer was removed from inpatient units. With this method removed from practice, the number of elevated EWS due to temperature decreased.

Several requests to Information Technology (IT) department were submitted throughout the data collection process. Multiple times, the vital signs documented did not support the EWS displayed. Through these requests, an error in the calculation was discovered. When the RN or PCT edit the vital signs due to a key stroke error, if the EWS has calculated, the correction in the score will not be captured. Further investigation into the calculation of the scoring revealed the EMR would complete a two-hour look back of vital signs documented. The calculation takes the worst vital signs completed in the two-hour look back to create the EWS. This calculation creates issues with trending the EWS if the vital signs are improving. Even with improving vital signs, the EWS will continue to be elevated as the EMR calculates using the worst of the vital signs within two hours.

Continuing to work with the IT department, the reports were able to be enhanced for easier use. The EWS report now excludes patients located within the ICU. This revision in the

report will be able to give better comparative data for pre-project implementation of patients with scores above 3 on the medical surgical units without manual abstraction.

Lesson Learned 1

Clear communication of expectations for all responsible parties within the project is essential to success. During the project implementation, communication to the charge RNs on expectations was shared; however, as the census increased during the season, charge RNs had to take patient assignments causing this responsibility to not be completed. The organization's structure at the time of implementation did not have a House Supervisor during day time hours.

Creating and implementing a standard approach to patient deterioration increases the ability to provide earlier patient care interventions (Ludikhuize et al., 2014; Sutherasan et al., 2018; Vincent et al., 2018). With the gap in House Supervisor at the beginning of the project, clearer expectations and a standard of work for the charge RNs would have improved role clarity.

Lesson Learned 2

Being agile and overcoming barriers throughout this project was necessary to continue to create positive changes. During this project, small issues arose, but having the ability to analyze quickly, communicate effectively, and gather needed information made the project continue to progress. Moving the issues forward with accurate information to the correct audience increases the ability for quick changes. This lesson was learned with the education being adapted and the temperature assessment method being changed.

Lesson Learned 3

Ongoing continual education and individual feedback are needed to produce a sustainable change. A single educational delivery method could have limited the ability for the RNs and

PCTs to learn in a way best suited for the individual learner. Additional tip sheets, online interactive learning modules, and in person review or mock situations could have created a better learning environment.

Lesson Learned 4

RRT is a nursing driven practice to assist the primary RN with more resources to provide interventions to the patient. Interprofessional collaboration is essential to provide clarity in roles. The project plan was shared with the group of providers; however, individual follow up to the providers could have allowed for more participation. As data review continued, EWS of 5 or greater without a RRT called were sent to nursing peer review. The nursing practice council suggested proactive ICU RN rounding to promote use of the RRT and a debriefing tool after RRT calls to promote better teamwork and learning.

Analysis of Project Outcome Data

Quantitative Data Analysis of Project Education

The online education was created with pre-test and post-test requirement. The order of questions was changed from pre-test to post-test to challenge learners to recall learned knowledge. A completion rate of 74% (67/90) completed the education on time. Scores on the pre-test ranged from 0% to 50% with an average score of 25%. Scores on the post-test ranged from 31% to 100% with an average percentage of 75%. See Appendix D for the test.

The original project plan included an in-person competency of the EWS process. Unfortunately, with the COVID-19 global pandemic and public health direction of social distancing, the in-person competency was not allowed to be completed.

Quantitative Data Analysis of Rapid Response Satisfaction Survey

The *Rapid Response Survey Staff Knowledge and Satisfaction* survey was administered via online tool to the medical surgical RNs for voluntary and anonymous participation (Australian Commission on Safety and Quality in Health Care, 2012). This 5-point Likert survey tool provided baseline information on the current RRT process and perceived barriers. (See Appendix A). The survey was created to help the organization identify known barriers for successful RRT calls, current state of managing emergenices, and perceived teamwork during RRTs (Australian Commission on Safety and Quality in Health Care, 2012). See Table 2 for specific question responses. Seventy-nine RNs were asked to participate, nineteen responded. The RNs participating in the survey feel confident in the activation of the current RRT as evidenced by responses to questions 2, 3, and 4.

Eighty-four percent of participants revealed they would call the covering provider before activating the RRT (question 6). This action and feeling remained constant throughout the project. One barrier identified was RNs were not calling the RRT and only calling the provider covering. Seventy-seven percent of the RNs would call the RRT if the provider could not be reached (question 7). Time spent trying to get the provider was not measured but a possible concern in delay in treatment. Unfortunately, 26% of participants are reluctant to activate the RRT for fear of being criticized (question 8). Fifty-five percent of the participants rated "worry" would drive an activation of the RRT if the patient's vital signs were stable (question 11). In an organization struggling with teamwork between departments, RNs felt worried to call an RRT too prematurely even when the RN felt the patient possibly needed some intervention (Alshehri et al., 2015). The fear of criticism and not acting on the RNs' worry could also be continuing to contribute to the lack of RRT calls.

Table 2

Results of Rapid Response System Staff Knowledge and Satisfaction Survey

	Questions:	Strongly Disagree/ Disagree (1-2)	Neutral (3)	Agree/ Strongly Agree (4-5)
1	Patients in the hospital have complex medical problems	0/19 (0%)	1/19 (5%)	18/19 (95%)
2	Patients receive effective emergency assistance from the rapid response team	1/19 (5%)	0/19 (0%)	18/19 (95%)
3	I feel confident activating the rapid response system.	0/19 (0%)	0/19 (0%)	19/19 (100%)
4	The rapid response system allows me to seek help for my patients when I am worried about them.	0/19 (0%)	0/19 (0%)	19/19 (100%)
5	The rapid response system is not helpful in managing sick patients on the med/surg unit.	13/19 (68%)	2/19 (11%)	3/19 (16%)
6	When one of my patients is sick I call the covering doctor before calling the rapid response team	1/19 (5%)	2/19 (11%)	16/19 (84%)
7	If I cannot contact the covering doctor about my sick patients, I activate the rapid response system	2/18 (11%)	2/18 (11%)	14/18 (77%)
8	I am reluctant to activate the rapid response system for my patients because I will be criticized if they are not that sick	12/19 (64%)	1/19 (5%)	5/19 (26%)
9	Rapid response system calls are required because the management of the patient by the doctors has been inadequate.	17/19 (89%)	0/19 (0%)	2/19 (11%)
10	Rapid response system calls are required because the management of the patient by the nurses has been inadquate	14/19 (74%)	2/19 (11%)	2/19 (11%)
11	I would activate the rapid response system for a patient I am worried about even if their vital signs are normal	6/19 (30%)	2/19 (11%)	11/19 (55%)
12	Medical staff support my decision to call a rapid response.	0/19 (0%)	1/19 (5%)	18/19 (95%)
13	When I call a rapid response, my peers support my decision	0/19 (0%)	1/19 (5%)	18/19 (95%)
14	Experienced nurses support my decision to call a rapid response call	0/19 (0%)	1/19 (5%)	18/19 (95%)
15	Using the rapid response system increase my workload when caring for a sick paitent.	7/19 (37%)	2/19 (11%)	5/19 (26%)
16	I understand my role during a rapid response calls.	1/19(5%)	1/19 (5%)	17/19 (89%)
17	The rapid response system reduces my skills in managing sick patients	12/19 (63%)	1/19 (5%)	1/19 (5%)
18	Rapid response calls teach me how to better manage sick patients in the medical surgical unit.	5/19 (25%)	1/19 (5%)	13/19 (68%)
19	The rapid response team responds to calls in an appropriate timeframe	0/19 (0%)	0/19 (0%)	19/19 (100%)
20	The rapid response team encourages teamwork.	3/19 (15%)	2/19 (11%)	14/19 (74%)

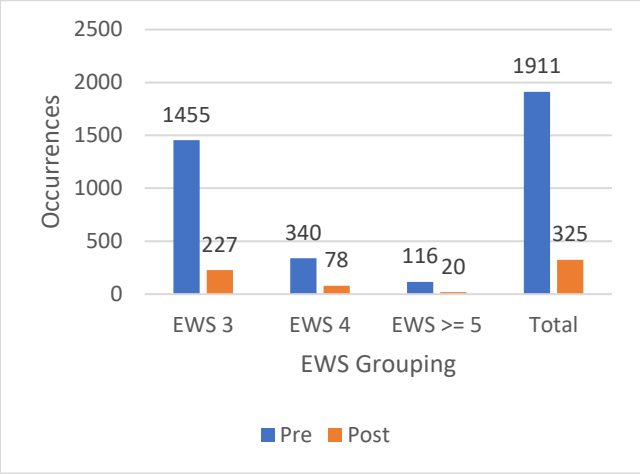
21	The rapid response team communicates effectively	3/19 (15%)	0/19 (0%)	16/19 (84%)
22	The ongoing plan for the patient is clearly documented after a rapid response call.	1/19 (5%)	2/19 (11%)	16/19 (84%)

Quantitative Data of Project

After completion of the project, analyzing pre and post data was intriguing. Figure 2 shows the differences experienced between the pre-project data of elevated EWSs and the lower occurrence rates of EWSs post implementation.

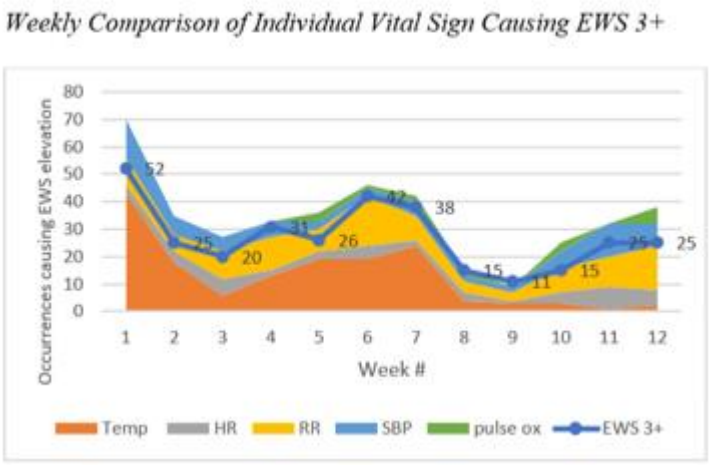
Figure 2

Comparison EWS occurrences pre vs post-project



Occurrences of an EWS of 3 had an 84% reduction, EWS of 4 had a 77% reduction, EWS of 5 or greater 83%, and a total reduction of 83% in elevated scores. Figure 3 helps tell the story of EWS occurrences and the impact of an individual vital sign can contribute to the elevation in scores. In the first week, the highest number of EWS occurrences were experienced during the project. In Figure 3, the EWS 3+ trendline and the stacked temperature trendline move in tandem. Temperature was the highest single vital sign contributing to the elevated of EWS. After week 8, each vital sign contributing to an elevation leveled out.

Figure 3



Figures 4 and 5 compare the total number of occurrences per vital sign causing an elevation in EWS. Temperature was the highest contributing factor causing an elevation of EWS at 55%, followed by respiratory rate at 35%, heart rate at 14%, systolic blood pressure at 9%, and pulse oximetry at 3%. One lesson learned early in the project was the use of the temporal artery thermometer. If the method of temporal artery thermometer was removed, only 26 temperatures would have fallen into the scoring criteria to elevate the temperature versus the 180 temperatures recorded in the data set. This would have reduced the percentage of contribution to EWS elevation from 55% to 15%.

Change in respiratory rate is an early indicator of clinical deterioration (Watkinson et al., 2018). The data recorded during this project supports the evidence in the literature as the respiratory rate was the indicator for elevation 35%. If the temporal artery temperatures were removed, respiratory rate would be the highest contributing factor to the EWS elevation at 69%.

Figure 4

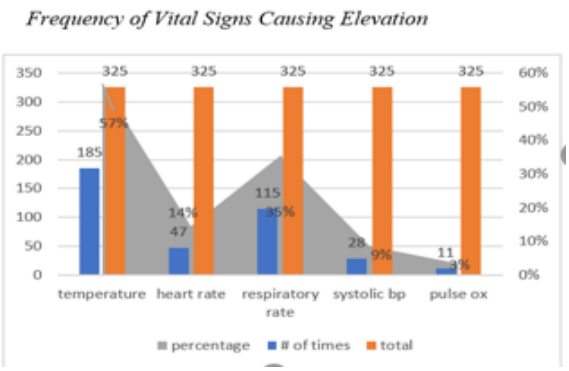
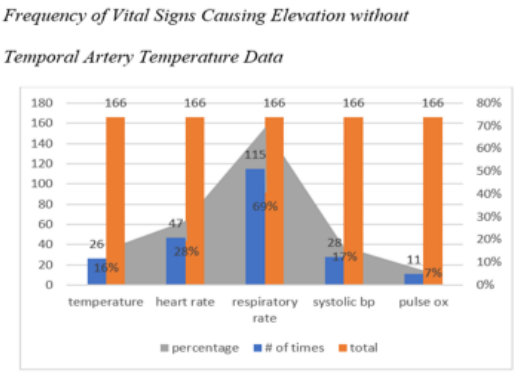


Figure 5



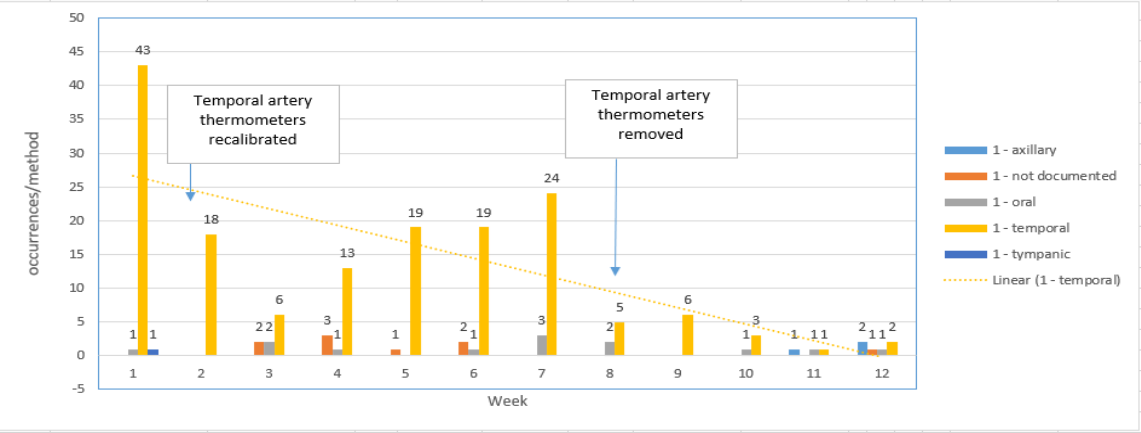
In the first week, 52 EWS of 3 or greater were created. Of the 52 elevated scores, 43 (83%) were contributed to temperatures obtained via the temporal artery thermometer (see Figure 6). The use of temporal artery thermometers in the acute care setting was standard practice pre-implementation and through week 8 of the project. Figure 6 demonstrates the rate of occurrences temperature was one of the vital signs contributing to an elevation in EWS. All methods were recorded in the data abstraction to identify potential trends.

During the first few weeks of data abstraction, the elevation in EWS was related to temperature being low (below 96.9°F) using the temporal artery thermometer. The biomedical engineering department calibrated the temporal artery thermometers. The biomedical engineer stated after calibrating the thermometer, the lens was extremely dirty and the alcohol wipes used to clean between patients would cause a film to build up. Nursing managers and nursing staff were reluctant to move away from this method. Education was provided on how to clean between patients in hopes to have accurate temperatures with this quick method of checking temperatures. After the calibration, a decrease in occurrences with this method was demonstrated.

Unfortunately, after only two weeks, the temporal artery temperatures again returned to being inaccurate per the biomedical engineer. The raw data was presented to nursing leadership and the local nursing practice council. At the beginning of week 8 of the project, this method of temperature obtainment was removed from the acute care setting. Resources were shifted to allocate different types of thermometers to the acute care setting and the temporal artery thermometer was removed. This action resulted in a quick decrease in EWS of 3 or greater due to temperature being the primary contributor.

Figure 6

Temperature Method Causing EWS 3+



During weeks 1 through 7, the percentage of temperatures by the temporal artery method accounted for the elevation 71% to 100% of the time. After the temporal artery thermometer was removed the number of occurrences decreased drastically (by 79%) from week 7 to week 8. The occurrences of temperature causing elevated EWS for the remaining weeks were very low in comparison to weeks 1 through 7. The temporal artery method accounted for 33% of the temperatures causing elevation, which is a steep decrease from the first seven weeks.

Part of the protocol established for this project included documenting complete sets of vital signs every 2 hours for 3 sets in response to patients with EWS of 3 or greater. Figure 7 shows the percentage of compliance week over week for the duration of the data collection.

Figure 7 could have an indirect correlation with Figure 6. As the number of elevated EWS scores due to the temporal artery thermometer source decrease in a week, the vital sign compliance increases. This could help validate the temporal artery temperatures being a driving force for false elevation in the EWS. When the temperature variable was controlled or removed by week 8, the overall vital sign compliance increased.

Continued education and follow up was also completed week after week. Individual RN compliance was not measured which could have identified individual practice trends. The DNP

student shared the opportunities to meet the protocol to the nursing managers to follow up with the individuals lacking compliance.

Figure 7

Weekly Vital Sign Compliance

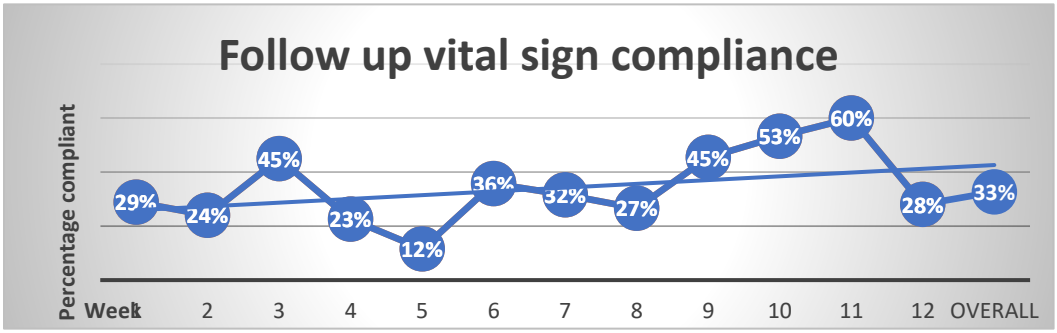
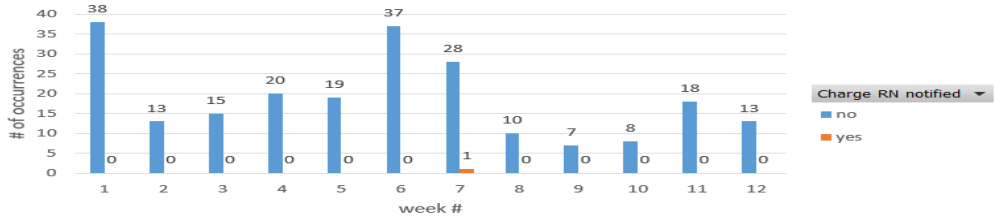


Figure 8 demonstrates the compliance documented when the EWS was a 3 and the charge RN was notified. The results are very low. Only one instance was documented when a RN communicated with the charge RN a patient with an EWS of 3. The EMR does not provide reminders or an easy way to document this piece of the protocol.

Figure 8

EWS 3 and Charge RN Notified



Two-sided Fisher's exact tests at the 5% significance level were performed to test the difference in frequencies of following the protocol in the pre-project data versus post-implementation data. Fisher's exact tests were used in lieu of Chi-squared tests due to the low frequencies of the events. Figure 9 is the cross-table key for the Fisher's exact test. The cross-table key identities the frequencies of data points from the master data set. The table displays raw

number of occurrences, the Chi-square contribution, the row total in decimal format, and finally the table total.

Figure 9

Cross-Table Key

Cell Contents
N
Chi-square contribution
N / Row Total
N / Col Total
N / Table Total

In the cross-table keys below, "0" is pre-project data occurrences and "1" is post-implementation data. In Figure 9, the table demonstrates 1,455 episodes of an EWS of 3 but the charge RN was not notified. In the third column of the table under "1", the figure displays 226 episodes in the post-implementation data demonstrating an EWS of 3 but the charge RN not notified. In the "yes" row, the pre-project data shows zero occurrences and the post-implementation data shows one occurrence when the EWS was 3 and the charge RN notified. Among EWS of 3, there was no statistically significant difference in charge RNs notified in pre-project data versus post-implementation data (p = 0.135).

Figure 10

EWS of 3 and Charge RN Notified

	data3$prepost		
data3$crn_notified	0	1	Row Total
no	1455	226	1681
	0.001	0.003	
	0.866	0.134	0.999
	1.000	0.996	
	0.865	0.134	
yes	0	1	1
	0.865	5.545	
	0.000	1.000	0.001
	0.000	0.004	
	0.000	0.001	
Column Total	1455	227	1682
	0.865	0.135	

```
Fisher's Exact Test for Count Data
------------------------------------------------------------
Sample estimate odds ratio:  Inf

Alternative hypothesis: true odds ratio is not equal to 1
p =  0.1349584
95% confidence interval:  0.164351 Inf

Alternative hypothesis: true odds ratio is less than 1
p =  1
95% confidence interval:  0 Inf

Alternative hypothesis: true odds ratio is greater than 1
p =  0.1349584
95% confidence interval:  0.3373518 Inf
```

The protocol for an EWS of 4 should trigger charge RN notification and provider notification. In post data only, there were two instances when the provider was notified of EWS of 4, but not the charge RN and two instances in the last week both the charge RN and the provider were notified (Figure 11). A limitation to gaining strong compliance with this metric is impacted by the EMR lacking prompts to follow the protocol.

Figure 11

EWS 4 Compliance -Charge RN and Provider Notification

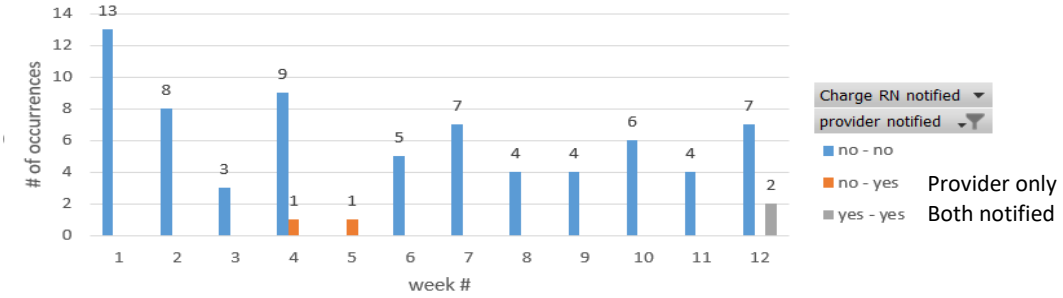


Figure 12 displays the data of EWS of 4 and notification to the provider. While statistical significance is found in the Fisher's exact test, the percentage of time the RN documented the provider was notified is very low at 5% (4/74), which is improved when compared to pre-project data of 0%.

Figure 12

EWS 4; Provider Notified

	data4$prepost		
data4$prov_notified	0	1	Row Total
no	339	70	409
	0.032	0.147	
	0.829	0.171	0.990
	1.000	0.946	
	0.821	0.169	
yes	0	4	4
	3.283	15.041	
	0.000	1.000	0.010
	0.000	0.054	
	0.000	0.010	
Column Total	339	74	413
	0.821	0.179	

```
Fisher's Exact Test for Count Data
-----------------------------------------------------------
Sample estimate odds ratio:  Inf

Alternative hypothesis: true odds ratio is not equal to 1
p =  0.0009631024
95% confidence interval:  3.104394 Inf

Alternative hypothesis: true odds ratio is less than 1
p =  1
95% confidence interval:  0 Inf

Alternative hypothesis: true odds ratio is greater than 1
p =  0.0009631024
95% confidence interval:  4.2265 Inf
```

Figure 13

EWS 4; *Charge RN Notified*

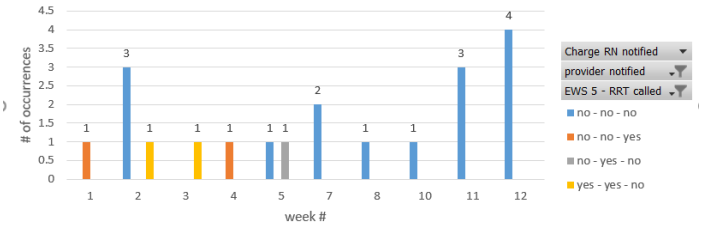
data4$crn_notified	data4$prepost 0	1	Row Total
no	339	77	416
	0.008	0.033	
	0.815	0.185	0.995
	1.000	0.975	
	0.811	0.184	
yes	0	2	2
	1.622	6.960	
	0.000	1.000	0.005
	0.000	0.025	
	0.000	0.005	
Column Total	339	79	418
	0.811	0.189	

```
Fisher's Exact Test for Count Data
-----------------------------------------------------------
Sample estimate odds ratio:  Inf

Alternative hypothesis: true odds ratio is not equal to 1
p =  0.03535162
95% confidence interval:  0.8108566 Inf

Alternative hypothesis: true odds ratio is less than 1
p =  1
95% confidence interval:  0 Inf

Alternative hypothesis: true odds ratio is greater than 1
p =  0.03535162
95% confidence interval:  1.244121 Inf
```

Among those with an EWS score of 4, a greater proportion of charge RN notifications occurred in the post group (2.5%), as compared to the pre group (0.0%); p = 0.035. While statistical significance was demonstrated, compliance to the protocol for notification was very low.

Figure 14

EWS 5+; Charge RN, Provider, and RRT called



When an EWS of 5 or greater is noted, the RN is to notify the charge RN, the provider, and activate the RRT. During the project, a variation of the three strategies exist; however, not all three were done for any occurrence. In Figure 14, the blue line represents no notification to any of the three; the red line demonstrates the RRT was activated but no documentation about the charge RN notified or the provider; the grey line represents the provider was notified, and the yellow line notes the charge RN and provider notified but not the RRT.

Figure 15

EWS 5+; Provider Notified

data5$prov_notified	data5$prepost 0	1	Row Total
no	116	17	133
	0.058	0.335	
	0.872	0.128	0.978
	1.000	0.850	
	0.853	0.125	
yes	0	3	3
	2.559	14.841	
	0.000	1.000	0.022
	0.000	0.150	
	0.000	0.022	
Column Total	116	20	136
	0.853	0.147	

```
Fisher's Exact Test for Count Data
-----------------------------------------------------------
Sample estimate odds ratio:  Inf

Alternative hypothesis: true odds ratio is not equal to 1
p =  0.002780217
95% confidence interval:  2.549518 Inf

Alternative hypothesis: true odds ratio is less than 1
p =  1
95% confidence interval:  0 Inf

Alternative hypothesis: true odds ratio is greater than 1
p =  0.002780217
95% confidence interval:  3.615763 Inf
```

Among those with an EWS score of 5 or higher, a greater proportion of provider notifications occurred in the post group (15.0%), as compared to the pre group (0.0%); p = 0.003. Eighty-five percent of the patients experiencing an elevated EWS of 5 or greater did not have a a provider notified.

Figure 16

EWS 5+; RRT called

data5$`EWS 5 - RRT called`	data5$prepost 0	1	Row Total
no	116	18	134
	0.025	0.148	
	0.866	0.134	0.985
	1.000	0.900	
	0.853	0.132	
yes	0	2	2
	1.706	9.894	
	0.000	1.000	0.015
	0.000	0.100	
	0.000	0.015	
Column Total	116	20	136
	0.853	0.147	

```
Fisher's Exact Test for Count Data
-----------------------------------------------------------
Sample estimate odds ratio:  Inf

Alternative hypothesis: true odds ratio is not equal to 1
p =  0.02069717
95% confidence interval:  1.118123 Inf

Alternative hypothesis: true odds ratio is less than 1
p =  1
95% confidence interval:  0 Inf

Alternative hypothesis: true odds ratio is greater than 1
p =  0.02069717
95% confidence interval:  1.718032 Inf
```

Among those with an EWS score of 5 or higher, a greater proportion of RRT notifications occurred in the post group (10.0%), as compared to the pre group (0.0%); p = 0.021. Only 10% of the patients qualifying for a RRT received this intervention. Demonstrating while statistical significance was found, the number of occurrences remain low.

Figure 17

Cardiopulmonary Arrests Outside the ICU

	June	July	August
pre (2019)	9	6	10
post (2020)	1	0	2

t-Test: Two-Sample Assuming Unequal Variances

	Pre-project	*Post-Project*
Mean	8.3333333	1
Variance	4.3333333	1
Observations	3	3
Hypothesized Mean Difference	0	
df	3	
t Stat	5.5	
P(T<=t) one-tail	0.0059148	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.0118296	
t Critical two-tail	3.1824463	

Figure 17 reveals the number of occurrences of cardiopulmonary arrests (CPA) outside the ICU in the same timeframe in 2019 compared to 2020. A decrease in every month is witnessed from pre-project to post-project. The total number per month of CPAs were abstracted from the inpatient setting. The objective was to witness a reduction in CPA outside the ICU due to increased monitoring with the EWS protocol. Using a *t*-Test assuming unequal variances and the one-tail statistic, the p=0.0059 allowing the null hypothesis to be rejected demonstrating a significant difference existing between the number of CPAs outside the ICU.

Missing Data

After conclusion of the project, additional data pieces could have helped in supporting this practice change as successful. One additional data point would be the number of emergent transfers to the ICU with and without RRT calls comparing pre-project to post-implementation. In reflecting on the data, one hypothesis would be the number of emergent transfers from medical surgical to the ICU would decrease due to increased monitoring of patients and earlier notification to the provider.

Documentation of provider notification was minimal when reviewing records, most records had new provider orders entered after the elevated EWS was recorded. The data

collection standards created included only taking documentation of notification from the nursing notes or comments within the flowsheet. Expanding this data collection criteria could have revealed more notification completed.

With the functionality of the EWS being auto-calculated within the EMR on set intervals, every hour on the minute, unique challenges existed. Collecting data demonstrating how often the RN manually calculated the EWS could be beneficial in furthering the request with the organization in practice within the EMR. This data could be easily found within the reports in the EMR.

Chapter V: Discussion

Findings

Prior to the implementation of this project, sensitivity around the EWS was low and not used as a tool in detecting clinical deterioration. With initial education and follow up, the EWS became more widely used throughout the timeframe of the project.

Objective #1

From the nursing education, post education tests will demonstrate an increase in knowledge on EWS scoring, important of respiratory rate accuracy, and follow up interventions for elevation in EWS prior to implementation of the project on the units. A completion rate of 74% (67/90) completed the education on time. Mean pre-test scores were 25%. Mean post-test scores increased to 75%. Significant improvement is noted when comparing the means pre-test and post-test.

Objective #2

RNs on 4E and 4W will demonstrate competence on the assessment of a patient with elevated EWS within the simulation lab. This objective was unable to be met due to state and organizational restrictions due to COVID-19 global pandemic. The inability to complete this in person simulation did have an impact on the ability to assess the EMR functionality of manual calculation. Team dynamics was also not allowed to be assessed in a controlled environment in discovering potential issues for activating the RRT.

Objective #3

Continued surveillance of patients with EWS of 3 or above will be audited weekly by DNP student and clinical educators to ensure adherence to the new practice. As shown in Figure 7, vital sign compliance in follow up to the elevated EWS showed improvement over the course

of the project. The rate of compliance varied week by week but showed a positive trendline over the twelve weeks.

Compliance of charge RN and provider notification for EWS of 3 and greater were difficult to capture. The EMR does not trigger for this documentation currently. A flowsheet row for easy documentation is not available. This barrier requires the RN to remember to place in a note or comment. Due to this potential barrier, compliance for notification could be higher than documented.

EWS of 5 or greater require a RRT call per the organization's policy. This part of the project was not a new procedure. Gaining compliance to calling the RRT has been met with resistance in the past. However, as shown in Figure 13, RRT calls remain a barrier for the RNs to call.

Objective #4

Rapid response calls will increase based on the EWS of 5 of greater. While statistical significance was demonstrated to show a difference in pre compared to post data, the actual amount of RRT calls did not increase. The number of occurrences of EWS of 5 or greater did decrease significantly with this project. A possible correlation could exist with the protocol providing increased interventions for patients with elevated EWS of 3 or 4, thus reducing the episodes of EWS of 5 or greater. This reduction and attention to the EWS contributed to improved patient outcomes.

Objective #5

Cardiopulmonary arrests outside of the ICU will reduce following the project's implementation. Figure 16 illustrates the statistical significances in pre compared to post data of CPA outside the ICU. In the post project data, no patient with an EWS of 5 or greater

deteriorated to a CPA. However, with the increase in sensitivity to the EWS tool and increased monitoring of patients, the EWS protocol could have contributed to the reduction in CPA outside the ICU.

Limitations

Limitation # 1

For the pre-project data, hospice and end of life patients are not able to be excluded. In the post-project data, these patients were out of scope for increased interventions. The patient population within the organization has not changed significantly, so the percentage of hospice and end of life patients could be retro-projected onto pre-project data.

Limitation # 2

Due to the COVID-19 global pandemic, simulations were not able to be completed as part of the educational plan for implementation. Daily rounds with the charge RNs and the clinical educators were completed instead; however, the team approach within the simulated environment could have reduced the hesitation in calling RRT. This simulation could have provided team building opportunities between the medical surgical RNs and the critical care RNs.

Limitation # 3

Because of the low participation rate on the Rapid Response System Staff Knowledge and Satisfaction survey, the ability to understand the majority of RNs' feelings regarding RRT is unknown. With the continued challenges in gaining overall acceptance to calling the RRT without hesitation in response to an EWS of 5 or greater, a larger participation rate in the survey could have leant to more information to provide greater understanding.

Implications for Practice Change

The results of the QI project suggested a standardized protocol for increased vital signs and care in response to elevating EWS will make a positive impact on patient outcomes. With increased monitoring, the number of episodes of patients with an EWS of 3 or higher reduced from pre-project data to post-project data by 83%.

Practice

This change in practice is sustainable in the current state. Real time documentation of vital signs is one of the biggest keys to success in quickly identifying the patient's score. Providing interventions to patients sooner decreases further deterioration or moves the patient to the appropriate level of care.

Modifications to the EMR would aid in easier use for RNs and PCTs. Requested modifications to the EWS would be to stop auto-calculation. Upon filing of the vital signs, an EWS would calculate in real time for immediate follow up with an easier workflow. When the EWS is elevated, a best practice alert would fire creating the work list for the RN or PCT to increase the vital sign monitoring, sending notifications to the charge RN and provider for the appropriate EWS, or call the RRT when appropriate.

Practice variances to the protocol will be referred to the local nursing peer review committee. This committee reviews cases referred to analyze the reasons for variation in practice compared to national or local hospital standards. EWS of 5 or greater without a RRT will be referred to the nursing peer review committee. The findings of the case are referred back to the nursing manager and RN to develop action plans for improving practice.

Another modification to the project includes creating greater engagement with the PCTs in the role of vital signs and EWS. PCTs received education at the same time as the RNs for the

implementation. A component missing is providing better alignment of the importance the PCT role and the impact on patient outcomes. The PCT frequently takes the vital signs for the RNs. Developing the PCTs knowledge in EWS process and the importance in accurate obtainment, documentation, and real time notification to the RN could provide further positive outcomes.

Generalizability or transferability of the intervention would require organization wide education and optimization of the EWS calculation and EMR workflows. The standardized interventions for elevated EWS are simple to transfer into nursing practice across multiple hospitals. The functionality of the EWS is widely underutilized to the fullest capability at this time within the organization as a whole.

Future Research

Frequency in vital sign monitoring is not well researched. A body of evidence does not exist to prove or disprove how often vital signs and assessments should be completed in the acute care medical surgical setting. Within the ICU, standards of care have been developed in response to medication therapy through titration/weaning or treatment responses, but the same types have not been well studied in medical surgical settings.

Future research could benefit the care delivery of the medical surgical population by studying variables impacting frequency of assessments, including vital signs. Multiple variables with the patient's past medical history, present illness, and medications can create a different needed frequency. Researching the best approach to this population of patients could provide improved patient outcomes. The DNP student believes further research could be completed identifying evidence-based standards for vital signs in the medical surgical patient in the acute care setting.

Nursing

Critical thinking and application of skills are foundational skill sets for experienced RNs. The health care environment is rapidly changing to keep up to date with the latest treatments and technologies. RNs continue to advance in educational endeavors to become advanced practice RNs. As RNs continue to progress through education and leave the bedside, nursing loses an experienced base from which to teach new graduate RNs how to critically think, prioritize, and apply skills. This project helps bring some objective data to a previously vague assessment skill of interpreting vital signs. The EWS is validated as an evidence-based tool. Thorough assessment and standardization of processes help decrease the lack of knowledge and delays in recognition (Mullany et al., 2016).

As identified in the *Rapid Response System Staff Knowledge and Satisfaction Survey*, those RNs who responded felt the RRT provided learning experiences to increase the knowledge base of caring for more acutely and complex patients. Calling a RRT can be a distressing situation for the newer RN. Providing clear guidance to the new RN on RRT expectations increases the chance of improving patient outcomes and empowering the RN to not be afraid to call for help. Providing comprehensive education involving the EWS, such as how to interpret the score with the patient's condition and effective communication to provider and/or RRT, increased RNs' competence in using the EWS tool (Jensen et al., 2017; Saab et al., 2017).

Health Care Policy

Regulatory bodies, like The Joint Commission (TJC), have published standards on patient safety programs to optimize quality of care within the acute care setting. Decreasing variation, using evidence-based practices, and achieving better outcomes are important aspects to a quality management program (The Joint Commission, 2016). This DNP project supported TJC's

recommendations of a patient safety program by creating a standard procedure for patients with an elevated EWS to follow to alert the chain of command and provider. Close calls are events in which a situation was recognized as potentially unsafe but corrected not causing harm to the patient. Utilization of the standard procedure for elevated EWS assists RNs and PCTs in identifying a potential safety event in the patient is deteriorating during their hospitalization.

The EWS provides valuable information to the bedside RNs. Without this project, no standard protocol or procedure existed outlining the actions the RN should take in response to the elevated EWS. This gap creates variability in practice and decreased team work. To become a high reliability organization, a strong culture of safety must be present along with the engagement of staff to focus on improvement (TJC, 2016).

The Centers for Medicare and Medicaid (CMS) started reporting publicly the amounts of deaths considered preventable (failure to rescue) while hospitalized in 2010 (Agency for Healthcare Research and Quality [AHRQ], 2019). Increased rates of failure to rescue causes include lower RN staffing, communication issues, and volume of patients (AHRQ, 2019). In organizations with lower failure to rescue rates, common themes identified include lower patient to RN ratio; increased surveillance from nursing; improved culture of safety, increased and effective communication, and interprofessional teamwork (AHRQ, 2019). This DNP project demonstrated an increase of a culture of safety by meeting those common themes identified in successful organizations with lower failure to rescue rates.

At the system level of the organization, further policy and procedure development and adoption needs to occur. Currently, only the test site has a standard procedure to respond to patients with elevated EWS. This DNP project could have the potential to save multiple patients from further deterioration across multiple hospitals.

Chapter VI: Conclusion

Value of Project

This project demonstrated the value of using an evidence-based tool creating a positive impact on patient outcomes. The number of patients experiencing an EWS of 3 of greater decreased substantially from pre-project to post-project. This decrease created more trust around the validity of the EWS.

Methods of accurate temperature obtainment was another improvement in patient care. The data from this project again validated the evidence-based practices established in prior literature. RNs and PCTs started to embrace the change in practice. Providing actual data of the inaccurate body temperatures creating falsely elevated EWS scores solidified the need for the removal of the temporal artery thermometer. This method was creating an increased need for additional interventions erroneously.

Detailed analysis of the EWS has created an opportunity with examples on improvements needed in how the score is and can be calculated. The auto-calculation feature is detrimental to care delivery and caregiver notification. With the auto-calculation, the score does not populate until the hour and one minute. Manually filing the vital signs to create the EWS at the time of documentation is cumbersome and multi-stepped. Creating a comprehensive flowsheet for vital signs with EWS calculation at the time of documentation would increase the visibility of the score when documentation is occurring. Understanding the complexity and barriers for real time documentation, the tools must be user friendly to assist in care delivery.

DNP Essentials

DNP Essential I

The first Essential involves using the scientific underpinnings of practice to create improved outcomes and patient care delivery (AACN, 2006). During this project, the Engstrom's Activity Theory was applied to drive the change in interventions in response to the EWS. This theory allowed for clear division of outputs for education delivery and outcomes of patient care. New practice approaches developed and delivered will improve patient outcomes.

DNP Essential II

The second Essential focuses on organizational and systems leadership to drive change for improvement in patient outcomes (AACN, 2006). Standard protocol in response to an elevated EWS score provided interventions quicker to a patient in early deterioration. This project was a QI project focused on improving patient outcomes when an elevation in EWS occurred. During the development of the education and implementation, multiple disciplines were involved to ensure all aspects of care delivery were addressed. RNs and PCTs received education on the importance of vital sign obtainment and accuracy of documentation. Providers (advance practice providers and physicians) were informed of the project and provided input to the interventions and education. This project allowed for the development of a standard procedure to apply to a specific patient population to positively affect patient outcomes.

DNP Essential III

The third Essential demonstrates the ability to translate research into evidence-based practices (AACN, 2006). During this project, real time analysis of trends in data allowed for alterations to be performed to positively affect the patient outcomes. In review of the EWS, a common trend noted was elevated EWS due to a low temperature obtained through the use of the

temporal artery thermometer. This data was presented to the local nursing practice council and nursing managers, who both supported the removal of this method of temperature.

DNP Essential IV

The fourth Essential connects the use of information technology systems and transformation of health care (AACN, 2006). This project identified issues with the EMR functionality of auto-calculation of the score. The auto-calculation formula creates several issues. In nursing practice, real time documentation can be difficult to accomplish with competing priorities. With the auto-calculation, when back charting in the EMR, the EWS will show hours past the actual time of the vital signs. The EWS provides an objective score for RNs to use to demonstrate potential deterioration.

DNP Essential V

The fifth Essential focuses on health care policy development (AACN, 2006). During the implementation of the project, a local policy and procedure was created and approved to support the interventions in response to an elevation in EWS. This policy and procedure will help create accountability to practice. After the implementation, further work needs to be completed with the organizational to embed the policy within the EMR to increase ease of use for the RN.

DNP Essential VI

Interprofessional collaboration is imperative to creating improved patient outcomes, which is Essential VI (AACN, 2006). During the project implementation, interprofessional teamwork was essential in making the process work well. Even though the number of RRTs did not increase, the number of episodes with elevated scores decreased demonstrating an improvement in providing interventions. Cases not following the protocol interventions are being referred to the nursing peer review group to continue to identify gaps in practice and barriers.

DNP Essential VII

The seventh Essential involves clinical prevention and improving population health (AACN, 2006). During this project, the population of focus was the hospitalized population outside of the ICU and preventing further deterioration. Using the data abstracted from the project, trends were able to be aggregated to provide real time feedback to nursing staff and leadership on the progress of the care.

DNP Essential VIII

The eighth Essential involves the application of advance nursing practice to assess and practice in area of specialty (AACN, 2006). During this project, this competency was fulfilled by evaluating the therapeutic interventions in response to EWS. An exciting piece of this project will be the further investigation into the current EWS tool and how the EMR calculates the score. By analyzing the multiple aspects of the scoring and barriers encountered with accurate scoring, this information can be shared to create positive change for multiple hospitals within the organization, increasing the number of lives potentially impacted.

Plan of Dissemination

The project's findings will be shared with the local organization's leadership and nursing staff. The findings will also be shared with the organization's system wide Professional Practice Council. This council has nursing leadership representation from all thirteen hospitals. The findings of this project can be applied in all hospitals to drive improved outcomes in patient care.

Annually the organization hosts an evidence-based practice (EBP) symposium. This year's symposium was cancelled due to the COVID-19 global pandemic. After presenting at the system Professional Practice Council, the DNP student will present at the next EBP symposium.

The DNP student will submit to a poster presentation through American Organization of Nursing Leaders.

Attainment of Personal and Professional Goals

Identifying an objective score to help support potential deterioration in hospitalized patients is an important tool for RNs to routinely use. Providing follow up interventions with an elevated score creates standardized approach in patient care. Utilizing the EWS in a more robust fashion creates a safer care delivery for the highly complex patients seen in hospital's medical surgical units. With my critical care background and personal experiences in seeing early signs of deterioration, this project has been very important to me. Many times, earlier interventions can create an entirely different patient outcome.

For new RNs, the EWS provides a more tangible tool to explain potential deterioration when the score is elevated. In my past experiences, new RNs crave a solid tool to help navigate care delivery. This project has demonstrated positive outcomes with the use of EWS. Critical thinking skills are learned through a variety of different experiences throughout a RN's career. The EWS allows for the use of a standardized approach in escalating care when the patient starts to deteriorate.

References

Agency for Healthcare Research and Quality. (2019). *Failure to rescue.* https://psnet.ahrq.gov/primer/failure-rescue#:~:text=As%20a%20safety%20and%20quality,on%20the%20second%20postoperative%20day.

Alshehri, B., Ljungberg, A. K., & Ruter, A. (2015). Medical surgical nurses' experiences of calling a rapid response team in a hospital setting: A literature review. *Middle East Journal of Nursing, 9*(3), 3-23.

American Association of Colleges of Nursing. (2006). The essentials of doctoral education for advanced nursing practice. Washington, DC: Author.

Australian Commission on Safety and Quality in Health Care. (2012). *Rapid response system staff knowledge and satisfaction survey.* http://www.safetyandquality.gov.au/.

Bonnici, T., Gerry, S., Wong, D., Knight, J., & Watkinson, P. (2016). Evaluation of the effects of implementing an electronic early warning score system: Protocol for a stepped wedge study. *BMC Medical Informatics and Decision Making, 16*(19). https://doi.org/10.1156/s12911-016-0257-8

Bunyaphatkun, P., Sindhu, S., Davidson, P., Utriyaprasit, K., Viwatwongkasem, C., & Chartbunchachai, W. (2017). Factors influencing clinical deterioration in persons with sepsis. *Pacific Rim International Journal of Nursing Research, 21*(2), 135-147.

Christofidis, M., Hill, A., Horswill, M., & Watson, M. (2015). Less is more: The design of early-warning scoring systems affects the speed and accuracy of scoring. *Journal of Advanced Nursing, 71*(7), 1573-1586. https://doi.org/10.1111/jan.12618

Churpek, M., Carey, K., Merced, N., Prister, J., Brofman, J., & Edelson, D. (2019). Validation of early warning scores at two long-term acute care hospitals. *Society of Critical Care Medicine, 47*(12), 962-965.

Douw, G., Huisman-de Waal, G., van Zanten, A., G., v. d., & Schoonhoven, L. (2016). Capturing early warning signs of deterioration: The dutch-early-nurse-worry-indicator score and its value in the rapid response system. *Journal of Clinical Nursing, 26*, 2605-2613. https://doi.org/10.1111/jocn,13648

Douw, G., Schoonhoven, L., Holwerda, T., Huisman-de Waal, G., van Zanten, A. R., van Achterberg, T., & van der Hoeven, J. G. (2015). Nurses' worry or concern and early recognition of deteriorating patients on general wards in acute care hospitals: A systematic review. *Critical Care, 19*(230). https://doi.org/10.1186/s13054-015-0950-5

Downey, C., Tahir, W., Randell, R., Brown, J., & Jayne, D. (2017). Strengths and limitations of early warning scores: A systematic review and narrative synthesis. *International Journal of Nursing Studies, 76*, 106-119. https://doi.org/10.1016/j.ijnurstu.2017.09.003

Engestrom, Y. (1987). *Learning by Expanding.* Helsinki: Orienta-Konsultit.

Epic. (2020). *EWS 5 or greater.* Retrieved January 20, 2020

Gagne, C., & Fetzer, S. (2017). Early warning score communication bundle: A pilot study. *American Journal of Critical Care, 27*(3), 238-242. https://doi.org/10.4037/ajcc2018513

Haegdorens, F., Monsieurs, K. G., De Meester, K., & Van Bogaert, P. (2018). An intervention including the national early warning score improves patient monitoring practice and

reduces mortality: A cluster randomized controlled trial. *Journal of Advanced Nursing*(75), 1996-2005. https://doi.org/10.1111/jan.14034

Heal, M., Silvest-Guerrero, S., & Kohtz, C. (2016). Design and development of a proactive rapid response system. *Computers, Informatics, Nursing*, *35*(2), 77-83. https://doi.org/10.1097/CIN.0000000000000292

Jensen, J. K., Skar, R., & Tveit, B. (2017). The impact of early warning score and rapid response systems on nurses' competence: An integrative literature review and synthesis. *Journal of Clinical Nursing*, 1256-1274. https://doi.org/10.1111/jocn.14239

Ludikhuize, J., Borgert, M., Binnekade, J., Subbe, C., Dongelmans, D., & Goossens, A. (2014). Standardized measurement of the modified early warning score results in enhanced implementation of a rapid response system: a quasi-experimental study. *Resuscitation, 85*, 676-682. https://doi.org/10.1016/j.resuscitation.2014.02.009

Mok, W., Wang, W., Cooper, S., Neo Kim Ang, E., & Ying Liaw, S. (2015). Attitudes towards vital signs monitoring in the detection of clinical deterioration: Scale development and survey of ward nurses. *International Journal for Quality in Health Care, 27*(3), 207-213. https://doi.org/10.1093/intqhc/mzv019

Mullany, D., Ziegenfuss, M., Goleby, M., & Ward, H. (2016). Improved hospital mortality with a low MET dose: The importance of a modified early warning score and communication tool. *Anaesthesia & Intensive Care, 44*(6), 734-741.

OSF Healthcare. (2019). *Key Results*. one.osfhealthcare.org

Pazar, B., & Yava, A. (2013). Evaluation of early warning scoring system and nursing guide application in the post-anaesthesia care unit. *Turkish Journal of the Anaesthesiology and Reanimation, 41*, 216-222.

Saab, M. M., McCarthy, B., Andrews, T., Savage, E., Drummond, F. J., Walshe, N., . . . Hegarty, J. (2017). The effect of adult early warning systems education on nurses' knowledge, confidence and clinical performance: A systematic review. *Journal of Advanced Nursing*, 2506-2521. https://doi.org/10.1111/jan.13322

Sadeghi, P., Andreev, P., Benyoucef, M., Momtahan, K., & Kuziemsky, C. (2014). Activity theory driven system analysis of complex healthcare processes. *Proceedings of the European Conference on Information Systems (ECIS).* Tel Aviv: Assocation for Information Systems.

Scott, L. J., Redmond, N., Garrett, J., Whitig, P., Northstone, K., & Pullyblank, A. (2019). Distributions of the National Early Warning Score (NEWS) across a healthcare system following a large-scale roll-out. *Emergency Medicine Journal, 36,* 287–292.

Stevenson, J. E., Israelsson, J., Nilsson, G. C., Petersson, G. I., & Bath, P. A. (2016). Recording signs of deterioration in acute patients: The documentation of vital signs within electronic health records in patients who suffered in-hospital cardiac arrest. *Health Informatics Journal, 22*(1), 21-33. https://doi.org/10.1177/1460458214530136

Stewart, J., Carman, M., Spegman, A., & Sabol, V. (2014). Evaluation of the effect of the modified early warning system on the nurse-led activiation of the rapid response system. *Journal of Nursing Care Quality, 29*(3), 223-229. https://doi.org/10.1097/NCQ.0000000000000048

Sutherasan, Y., Theerawit, Pongdhep, Suporn, A., Nongnuch, A., Phanachet, P., & Kositchaiwat, C. (2018). The impact of introducing the early warning scoring system and protocol on clinical outcomes in tertiary referral university hospital. *Therapeutics and Clinical Risk Management, 14*, 2089-2095.

The Joint Commission. (2016). *Patient safety systems (PS).* https://www.jointcommission.org/-/media/deprecated-unorganized/imported-assets/tjc/system-folders/topics-library/psc_for_webpdf.pdf?db=web&hash=1D79BF046A319BE99A20BE459982387F

Vincent, J.L., Einav, S., Pearse, R., Javer, S., Kranke, P., Overdyk, J.F., Whitaker, D.K., Gordo, F., Dahan, A. & Hoeft, A. (2018). Improving detection of patient deterioration in the general hospital ward environment. *European Jounal of Anaesthesiology, 35*, 325-333.

Watkinson, P., Pimentel, M. A., Clifton, D. A., & Tarassenko, L. (2018). Manual centile-based early warning score derived from statistical disctributions of observational vital-sign data. *Resuscitation*, 55-60. https://doi.org/10.1016/j.resuscitation.2019.06.003

Wood, C., Chaboyer, W., & Carr, P. (2019). How do nurses use early warning scoring systems to detect and act on patient deterioration to ensure patient safety? A scoping review. *International Journal of Nursing Studies, 94*, 166-178. https://doi.org/10.1016/j.ijnurstu.2019.03.012

Appendices

Appendix A – Rapid Response System Staff Knowledge and Satisfaction survey

rapid response system staff knowledge and satisfaction survey

Clinical area:	
Discipline:	☐ Medical ☐ Nursing ☐ Other_____
Years of clinical experience:	☐ Less than 1 ☐ 1 to 3 ☐ 4 to 5 ☐ 6 to 10 ☐ more than 10
I have received education related to our rapid response system in the last 12 months	☐ Yes ☐ No
I have a good understanding of the abnormal observations that require me to activate the rapid response system	☐ Yes ☐ No

PLEASE CONSIDER THE STATEMENTS BELOW AND CIRCLE YOUR RESPONSE. THERE IS SPACE TO WRITE ANY COMMENTS OR SUGGESTIONS YOU HAVE ABOUT THE RAPID RESPONSE SYSTEM AT THE END OF THE SURVEY.

Patients in the hospital have complex medical problems	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Patients receive effective emergency assistance from the rapid response team	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
I feel confident activating the rapid response system	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
The rapid response system allows me to seek help for my patients when I am worried about them	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
The rapid response system is not helpful in managing sick patients on the ward	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
When one of my patients is sick I call the covering doctor before calling the rapid response team	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
If I cannot contact the covering doctor about my sick patient I activate the rapid response system	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
I am reluctant to activate the rapid response system for my patients because I will be criticised if they are not that unwell	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Rapid response system calls are required because the management of the patient by the doctors has been inadequate	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Rapid response system calls are required because the management of the patient by the nurses has been inadequate	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○

I would activate the rapid response system for a patient I am worried about even if their vital signs are normal	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
If my patient meets rapid response system calling criteria but does not look unwell I would not make a rapid response call	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Junior doctors support my decision to call a rapid response	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Senior doctors support my decision to call a rapid response	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Ward/unit nurses support my decision to call a rapid response	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Senior nurses support my decision to call a rapid response	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Using the rapid response system increases my work load when caring for a sick patient	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
I understand my role during rapid response calls	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
The rapid response system reduces my skills in managing sick patients	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Rapid response system calls teach me how to better manage sick patients in my ward	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
The rapid response team respond to calls in an appropriate timeframe	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
The rapid response team encourage effective teamwork	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
The rapid response team communicate effectively	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
The ongoing plan for the patient is clearly documented after a rapid response call	Strongly disagree ○	Disagree ○	Uncertain ○	Agree ○	Strongly agree ○
Additional comments:					

Appendix B - written approval for survey

Re: FW: Request for approval to use survey [SEC=OFFICIAL] Inbox ×

ACSQHC Advice Centre <support@accreditation.freshdesk.com> Jan 27, 2020, 11:16 PM (10 hours ago)
to me

Dear Danielle

Thank you for emailing the NSQHS Standards advice line to ask about the use of the Rapid Response System Staff Knowledge and Satisfaction Survey.

The survey was designed to provide acute care facilities with a tool for evaluating staff perceptions of the rapid response system. The survey can be adapted to suit local requirements.

If you have any follow-up questions or require clarification, please contact the NSQHS Standards Advice Centre on 1800 304 056 or email accreditation@safetyandquality.gov.au

We are currently conducting a NSQHS Standards advice centre user satisfaction survey. This survey seeks to understand your experiences and satisfaction with the service you received from your most recent contact with the NSQHS Standards advice centre. This will take less than 10 minutes to complete and will help to evaluate and inform our service.

If you would like to participate in the survey it can be accessed here: https://www.surveymonkey.com/r/ZHYSM9C

Kind regards

NSQHS Standards Advice Line

National Standards Program
Australian Commission on Safety and Quality in Health Care
GPO Box 5480 Sydney NSW 2001 | Level 5, 255 Elizabeth Street, Sydney NSW 2000
T 1800 304 056 | F (02) 9126 3613 | www.safetyandquality.gov.au
Follow us on Twitter @ACSQHC

Privacy statement: The Australian Commission on Safety and Quality in Health Care has collected the personal information you provided in your contact with the Advice Centre to enable u to process your enquiry and to collect information on the types of enquiries received by the Advice Centre. You may also be contacted to assist in the ongoing improvement of the NSQHS Standards and the Accreditation Scheme. If you do not wish to provide your personal information or be contacted by the Commission please inform the staff member attending to your enquiry. Your personal information will not be used for any other purpose. It will not usually be disclosed to anyone else unless this is necessary to complete your enquiry or comply with legislation. For more information about our privacy practices, including how to access or correct your personal information or make a complaint see our Privacy Policy or contact us at Australian Commission on Safety and Quality in Healthcare, PO BOX 5480, Sydney NSW 2001.

On Tue, 28 Jan at 3:47 PM , Danielle <dmolina2@mail.bradley.edu> wrote:
Hi advice line,

Would you know which team this query is for?

Thanks
Chandni

From: Danielle Molina <dmolina2@mail.bradley.edu>
Sent: Monday, 27 January 2020 8:27 AM
To: Safety and Quality <mail@safetyandquality.gov.au>
Subject: Request for approval to use survey [SEC=No Protective Marking]

To whom it may concern:

I am a DNP-L candidate working on my scholarly project on the Early warning scoring and RRTs. I am writing to request permission to use the survey *Rapid Response Survey Staff Knowledge and Satisfaction Survey*_

Thank you for your consideration and time!

Danielle Molina, RN MSN
Bradley University
Peoria IL, United States

The Australian Commission on Safety and Quality in Health Care acknowledges the traditional owners of country throughout Australia, and their continuing connection to land, sea and community. We pay our respects to them and their cultures, and to elders both past and present.
Important: This transmission is intended only for the use of the addressee and may contain confidential or legally privileged information. If you are not the intended recipient, you are notified that any use or dissemination of this communication is strictly prohibited. If you receive this transmission in error please notify the author immediately and delete all copies of this transmission.

ACSQHC Advice Centre powered by Freshdesk

Appendix C – Education Outline

Education Outline	Audience:	Time:
I. Introduction to EWS concept a. Early Warning Score review b. EWS parameters and correlating score	4E/4W RNs and PCTs	10 mins
II. Review of vital sign changes a. Importance of accurate respiratory rate measurement b. Temperature methods for accuracy	4E/4W RNs and PCTs	10 mins
III. Early Warning Score Functionality a. Calculating an EWS within Epic b. Tracking and trending EWS	4E/4W RNs and PCTs	10 mins
IV. Early Warning Score Interventions a. EWS of 1 or 2 b. EWS of 3 or 4 i. Frequency of increased vital signs ii. Charge RN notification iii. Provider notification c. EWS of 5 or higher i. RRT call ii. RRT scripting for clear communication iii. Review of roles in RRT d. Chronically elevated EWS	4E/4W RNs and PCTs 4E/4W RNs and PCTs/RRT 4E/4W RNs and PCTs/RRT	30 mins
V. Post RRT interventions	4E/4W RNs and PCTs/RRT	10 mins
VI. Measures of success a. Decrease cardiopulmonary arrests outside the ICU b. Increase in RRT calls c. Earlier recognition of patient deterioration	4E/4W RNs and PCTs/RRT	5 mins
VII. Charge RN Role in EWS	ICU/4E/4W Charge RNs	10 mins
VIII. Critical Care Charge RN role in EWS	ICU/4E/4W Charge RNs	10 mins

VIII. Provider Education a. EWS parameters and scores b. Nursing interventions for EWS of 3, 4, 5 or higher	Providers	10 mins

Appendix D– Pre/Post test

Pre/Post Test for RNs, PCTs, and RRT responders:

1. What is an Early Warning Score? (1 pt)
   a**. an evidence-based score demonstrating a patient is having altered vital signs**
   b. created by Epic
   c. calculate a score based on missing documentation

2. What vital sign alters first to compensate? (1 pt)
   a. heart rate
   b. blood pressure
   c. temperature
   d. respirations

3. Within Epic, how is the early warning score calculated? Check all that apply. (2 pts)
   a. hourly Epic pulls a complete set of vital signs to score
   b. manually by clicking on "file" on the patient list
   c. every 4 hours
   d. in a report

4. How can you view the trending of early warning scores in Epic? Check all that apply. (2 pts)
   a. looking through the flowsheet rows
   b. view the Vital Signs graph on the patient list
   c. a SAP portal report
   d. charge RN dashboard

5. Match the early warning score with the correct intervention: (13 pts)

Score	Intervention
0___**C**___	A. Rapid Response call
1__ **C** ____	B. Vital signs every 2 hours x 3 sets
2___ **C** ___	C. Routine or as ordered vital signs
3___**B, D, E**_	D. Charge RN notification
4_ **B, D, E** _	E. Provider notification
5__ **B, D, E, A**	

6. True **False** If a Rapid Response is called, the patient must transfer to ICU.

7. A rapid response call occurred, the patient is staying on 4E or 4W, what frequency of assessment does the RN now? (1 pt)
   a. continue to monitor EWS and complete vital signs per EWS protocol
   b. check vital signs again in 8 hours
   c. ask for a sitter
   d. notify charge RN

8. How will this EWS standard protocol affect the patients? Check all that apply. (4 pts)

a. provide increased patient assessments
b. decrease cardiopulmonary arrests outside the ICU
c. increase rapid response calls
d. provide faster interventions for patients at-risk of deterioration

Appendix E – Simulation Scenario

Environment: in the simulation lab, 4 people per skill validation (combination of RNs, Charge RN, RRT responder and PCTs)

Scenario: Patient admitted for cellulitis. Vital signs creating an EWS of 3. Temp 99.8; Heart rate 135; RR 16; SBP 110; oxygen saturation 98%.

Expectations: Primary RN completes assessment. Patient has complaints of warm, painful leg where cellulitis started.

Team identifies appropriate actions in response to EWS of 3:

1. Vital signs frequency increases to every 2 hours x 3 sets with EWS calculation

2. Charge RN notification

Scenario change: Upon the second set of vital signs, temperature now 102.4; Heart rate 140; RR 20; SBP 105; oxygen saturation 97%.

Team identifies EWS of greater than 5; appropriate actions in response:

1. Call RRT

2. Charge RN notification

3. Provider notification

Primary RN and RRT have clear communication using script for RRT call.

Rapid Response responder activates the appropriate standing order.

Appendix F– EWS tracking

	EWS tracking																
MRN	Admit date	EWS score 3, 4, 5	Date	Time	Admitting DX	VS q2h completed?	Temp	HR	RR	SBP	Pulse Ox	Charge Nurse Notified	Provider Notified	EWS 5 - RRT called	RRT outcome	CPA on medsurg unit	Patient discharge disposition
ex. 012345	*1/20/2020*	*3*	*1/22/2020*	*1900*	*pneumonia*	*Y*	*100.5*	*130*	*25*	*180*	*85%*	*Y*	*Y*	*Y*	*fluid bolus; stayed on med/surg unit*	*No*	*home with home health*

Appendix G – EWS Procedure

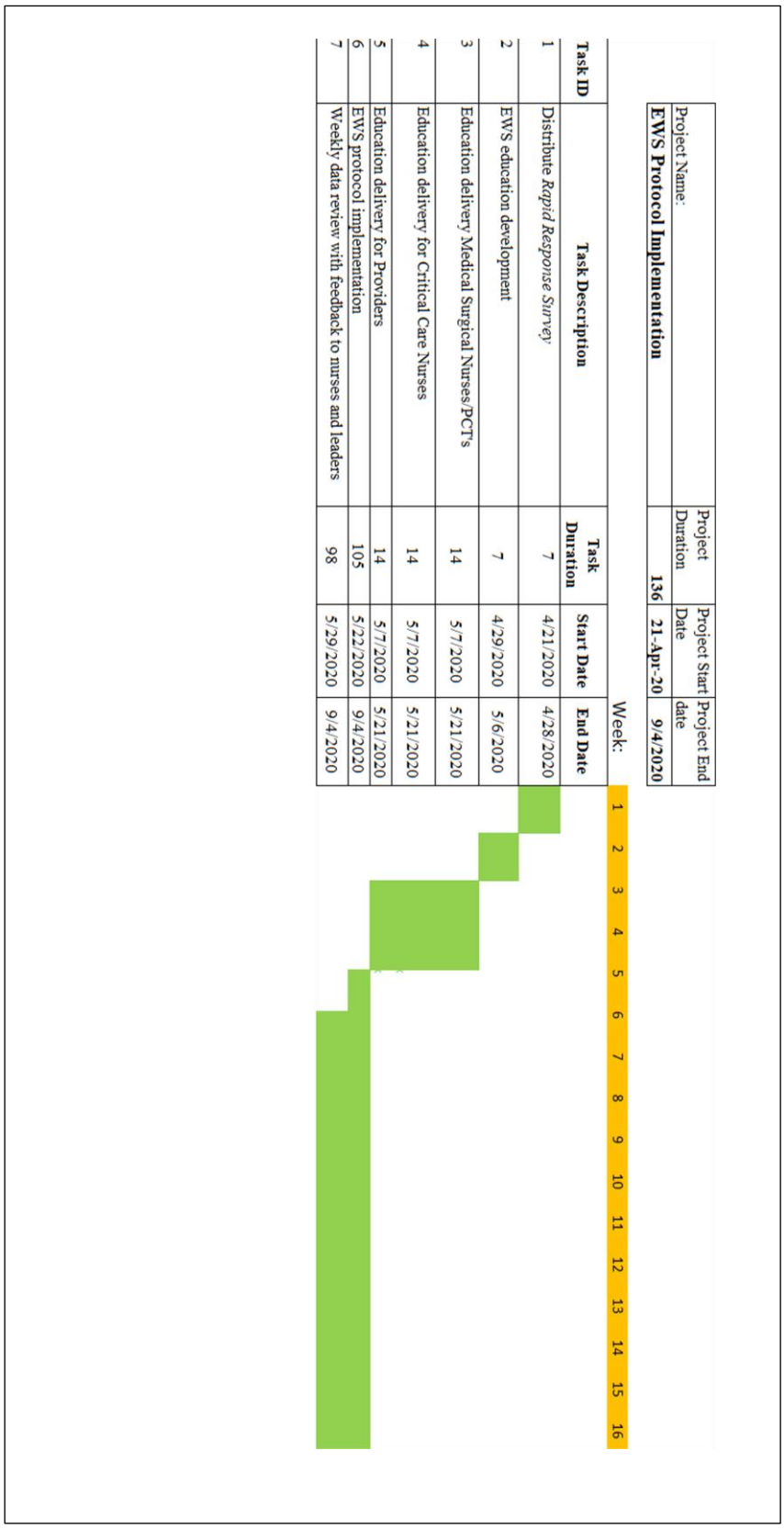
Introduction/Purpose:

To give direction on appropriate level of reassessment based on EWS.

Procedure:

1. EWS of 0-2: Continue monitoring.
2. EWS of 3
    - complete vital signs every two hours for three times with EWS calculation
    - notify the charge RN
3. EWS of 4
    - complete vital signs every two hours for three times with EWS calculation
    - charge notification
    - physician or provider notification
4. EWS of 5 or greater
    - complete vital signs every two hours for three times with EWS calculation
    - charge notification
    - physician or provider notification
    - rapid response is called

Appendix H – Timeline



Project Name:	Project Duration	Project Start Date	Project End date
EWS Protocol Implementation	**136**	**21-Apr-20**	**9/4/2020**

Task ID	Task Description	Task Duration	Start Date	End Date
1	Distribute *Rapid Response Survey*	7	4/21/2020	4/28/2020
2	EWS education development	7	4/29/2020	5/6/2020
3	Education delivery Medical Surgical Nurses/PCTs	14	5/7/2020	5/21/2020
4	Education delivery for Critical Care Nurses	14	5/7/2020	5/21/2020
5	Education delivery for Providers	14	5/7/2020	5/21/2020
6	EWS protocol implementation	105	5/22/2020	9/4/2020
7	Weekly data review with feedback to nurses and leaders	98	5/29/2020	9/4/2020

Week: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Appendix I – Organizational and Community Approval Form

Organizational Approval:

[redacted] Research Administration Update: Permission for EWS Project

[redacted]

Fri 3/20/2020 4:01 PM

To: Molina, Danielle M. <Danielle.M.Molina@osfhealthcare.org>;

Cc: 'Deborah Erickson' <erickson@bradley.edu>; Andrew Strubhar <ajs@fsmail.bradley.edu>; [redacted]

Importance: High

Good afternoon, Danielle,
I write to inform you that [redacted] has granted permission for your new project titled, "Effects of EWS Protocol on Patient Outcomes." You should now proceed with formal application to the [redacted] IRB. I have copied this message to the [redacted] IRB staff in order to apprise the staff of developments.

NOTE: [redacted] permission is NOT authorization to begin project-related activities. You must obtain certification of IRB review/approval prior to initiation of project activities.

NOTE: [redacted] has granted permission on the preliminary determination that your project is quality/process improvement, and, as such, is NOT research, thus, human subject research. Because [redacted] does not have an internal IRB, [redacted] relies on the [redacted] IRB to make official determinations. Thus, you must submit your project to the [redacted] IRB. The IRB has the authority and responsibility to require modifications prior to final determination/approval. Contact the [redacted] IRB staff with questions/concerns about the application process, and IRB review procedures and timelines.

Community IRB Approval:

[redacted]

FWA 00005172

IRB #00000688
IRB #00000689

DATE: April 15, 2020

TO: Danielle Molina, MSN
FROM: [redacted] IRB 1

STUDY TITLE: [1585354-1] Effects of EWS Protocol on Patient Outcomes
IRB REFERENCE #:
SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF NOT RESEARCH
DECISION DATE: April 15, 2020

Thank you for your submission of New Project materials for this research study. U[redacted] IRB 1 has determined this project does not meet the definition of research under the purview of the IRB according to federal regulations.

We will put a copy of this correspondence on file in our office.

If you have any questions, please contact M[redacted]. Please include your study title and reference number in all correspondence with this office.

cc:

Appendix J – Budget

Budget Projection							
Expense							
	DNP student	Clinical Educator	Charge RN	RN	PCT	Statisician	Total
Average hourly rate	$60.00	$34.00	$33.00	$28.00	$14.00	$30.00	
Hours required	12	40	2.5	1.5	1	10	
Total Employee	1	2	12	90	20	1	
Total/Job	$720.00	$2,720.00	$990.00	$3,780.00	$280.00	$300.00	$8,790.00