Summer 2022

# Using a Deterioration Index Score to Improve Patient Outcomes

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# Using a Deterioration Index Score to Improve Patient Outcomes

by

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A project submitted to the faculty of
Gardner-Webb University Hunt School of Nursing
in partial fulfillment of the requirements for the degree of
Doctor of Nursing Practice

Boiling Springs, NC

2022

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| 06/30/2022 | 06/30/2022 |
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## Approval Page

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06/30/2022
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## Abstract

Quick recognition and response to clinical deterioration have a significant impact on patient mortality and outcomes. Nurses' confidence in their ability to recognize signs and symptoms of deterioration and activate rapid response teams (RRT) is vital in preventing code blues and transfers to a higher level of care. The objective of this project was to determine the effect of an educational intervention on nurse acknowledgment of the deterioration index score and nurse confidence in intervening to improve patient outcomes by alerting the Rapid Response Team (RRT) within two months for adult patients on a medical-surgical unit. Findings from the project revealed nurses' confidence improved in recognizing and responding, and assessing for clinical deterioration, but did not improve nurse confidence in intervening and evaluating interventions. The deterioration index (DI) score best practice advisory (BPA) acknowledgment did not improve post-educational intervention as nurses dismissed 100% of the BPAs. Rapid response team calls slightly improved by 10% post-intervention than pre-intervention with slightly less patients requiring transfer to a higher level of care. Staffing shortages and years of experience may have influenced the nurse's ability to effectively recognize and respond to clinical changes. Without proper training and support nurses' confidence in recognizing and responding to deterioration may be delayed, resulting in unwanted patient outcomes. Although this project did not produce the intended outcomes, it did identify an opportunity to improve internal training and enhance the current process.


*Keywords*: deterioration, RRT, early warning system**,** confidence

**Acknowledgments**

I appreciate and owe thanks to many individuals who encouraged and supported me along this educational journey. God has given me the strength and endurance to complete this journey and for that, I am grateful and humbled. I am blessed and beyond grateful for my husband, Michael, and two boys who have supported me along the way. My work family is owed many thanks as well for all the support, encouragement, and guidance over the past two years.

I also want to give an extended thank you to my committee for the support of this project. Dr. Lesa Smith my mentor and friend, thank you for being my project partner and guiding me along this journey. Dr. Gloria Walters, thank you for the remarkable support and guidance during this process. To Dr. Daria Kring, thank you for your endless support and words of encouragement to push through and never stop. To Dr. Gayle Casterline, you are an amazing woman, leader, and friend. Thank you for your endless support, guidance, words of encouragement, and for answering all my questions along the way. I could not have made this journey without each of you and owe you all sincere gratitude for your support.

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## Problem Recognition

Early recognition of patients at risk for clinical deterioration is key in preventing unforeseen events such as cardiac arrest and death. Patients who clinically deteriorate outside of non-intensive care units (ICU) have higher morbidity and mortality rates (Escobar et al., 2020). In many instances, data from the electronic health record (EHR) can be used by clinicians, such as providers and nurses, to determine the severity of a deteriorating patient. An early warning system (EWS) is a tool incorporated into the EHR that provides a numeric deterioration score based on patient data entered (Capan et al., 2017). This score, if used in combination with assessment, recognition of clinical changes, and early intervention, may prevent unwanted clinical outcomes.

Clinical deterioration is defined as "worsening conditions or acute onset of serious physiological disturbance" (Padilla & Mayo, 2017, p. 1362). Often, deterioration can be detected hours before an event occurs (Churpek et al., 2014). Changes in vital signs such as blood pressure, heart rate, respiratory rate, oxygen level, and temperature can be early indicators of deterioration (Allen, 2020). Deterioration of patients has been reported in multiple studies as a predictor of events such as cardiac arrest, unplanned transfers to the ICU, and death (Parrish et al., 2017).

Early warning systems were first introduced in 1997 by Morgan, Williams, and Wright (Mathukia et al. 2015). They developed the EWS to monitor outcomes and alert clinicians of deterioration based on five physiological parameters: "heart rate, respiratory rate, systolic blood pressure, temperature, and conscious level" (Mathukia et al., 2015, p. 2). Different forms of EWS are used within organizations. The Modified Early Warning System (MEWS) was first used in the United Kingdom and is an aggregate weighted

scoring system (AWSS), meaning the system provides a score using vital signs and other indicators based on degrees of abnormality (Mathukia et al., 2015). Early warning systems are either integrated into the electronic health record or manually calculated on paper (Subbe et al., 2001). This tool can be used by clinicians to recognize clinical deterioration of patients, and intervene early to prevent transfers to ICU, cardiac arrest, increased length of stay (LOS), and death.

Clinicians that utilize the EWS in conjunction with other assessment data recognize signs of deterioration more efficiently (Fasolino & Verdin, 2015). The sole use of the EWS alone does not provide enough insight into the patient's condition to determine if RRT or provider notification is warranted. Conversely, clinicians that do not utilize the EWS score as part of their assessment data are missing important clinical factors that may impact the clinician's next action. A combination of nurse assessment and the EWS score are critical components in effectively identifying, recognizing, and treating clinical deterioration (Fasolino & Verdin, 2015).

In an acute care community hospital located in the southeastern United States, a deterioration index (DI) model is used as part of the electronic medical record system. This model is like an early warning system, such as MEWS, but includes additional data points and an algorithm that is different from what other EWS use (EPIC, 2020). Variables used in the data include age (in years), systolic blood pressure, temperature, pulse, respiration rate, oxygenation level, lab values, and assessment data such as the Glasgow Coma Score (GCS), neurological assessment, abnormal cardiac rhythm, and oxygen use (EPIC, 2020). This cumulative link model improves the recognition of deteriorating patients by up to 50% as compared to other EWS (EPIC, 2020). An overall

acuity score is provided in a range format and corresponds with different outcomes such as ICU admission or death (EPIC, 2020).

The purpose of the DI model is to identify patients that have a greater than 85% likelihood of having a significant event such as cardiac arrest (code blue), escalation in the level of care, or rapid response team (RRT) call-in the next 38 hours. A best practice advisory (BPA) fires for adult patients with a score greater than or equal to 75 and recalculates every 60 minutes. The BPA directs clinicians to re-evaluate the patient and consider notifying the provider or RRT of any change in condition.

Nurses in medical-surgical units do not utilize the DI score despite its availability. Communication with nurses on multiple medical-surgical units revealed few nurses are aware of or use the deterioration score as part of their assessment. Organizational data, as indicated in Figure 1, shows the DI score BPA was canceled or "dismissed" 88% of the time by medical-surgical nurses between September 2020-September 2021. Canceling or dismissing the BPA means the information accounting for the patient's high-risk score and advice on steps to take were not reviewed or considered by the nurse.

**Figure 1**

*Deterioration Index Score Best Practice Advisory Numbers*

## Problem Statement

In 2017, an acute care facility located in the southeastern United States implemented the deterioration index (DI) score which identifies patients at risk of experiencing an unforeseen event, such as cardiac arrest or death, within a 38 hour time frame. Although the DI model is available in the EHR and provides valuable data for clinicians, it is rarely used as part of the nursing assessment in determining potential care that would alter the probability of further deterioration.

## Literature Review

A review of the literature was conducted to assess the relationship between the deterioration score, nursing assessment, and patient outcomes. Online databases such as PubMed and CINAHL were used. Key search terms were early warning systems, deterioration, deterioration index score, medical-surgical, and predicting patient outcomes. Studies were included if they were published in English and the United States and peer-reviewed.

## Needs Assessment

More than “200,000” inpatient cardiac arrests occur in hospitalized adults each year (Padilla & Mayo, 2017; Stewart et al., 2014, p. 223). Most heart attacks start slowly with early signs presenting as chest discomfort, shortness of breath, and pain (American Heart Association, 2021). In hospitals, early signs may also include a subtle change in vital signs such as blood pressure, heart rate, and respiration (Stewart et al., 2014, p. 224). Failure to recognize and respond to deteriorating changes quickly increases the patient’s risk of death (Parker, 2014).

According to Hall et al. (2013), hospital deaths decreased by eight percent between 2000-2010 for patients that had a diagnosis such as respiratory failure, cancer, stroke, and heart disease (2013). However, death rates increased for patients with septicemia by 17% (Hall et al., 2013). Septicemia or "sepsis" occurs when an infection spreads throughout the body (Centers for Disease Control [CDC], 2020). Risk can be minimized through proper infection prevention practices such as hand washing and reducing contamination of contact points in devices like urinary catheters and central venous access devices (CDC, 2020). Many organizations have implemented initiatives to reduce healthcare-associated infections which can contribute to a patient's risk of developing sepsis (The Leapfrog Group, n.d.). Regardless of these initiatives, nurses are the first-line responders in recognizing and responding to prevent further patient deterioration.

In 2004, rapid response teams (RRT) were formed in response to a need to recognize and respond to patients more quickly (Parker, 2014). This occurred after the "100,000 Lives Campaign was launched by the Institute for Health Care Improvement" (IHI) (Parker, 2014, p. 159). RRT is an additional resource for nurses and is activated when patients exhibit signs of deterioration based on facility criteria or when nurses or family members have a concern (Parker, 2014; Stewart et al., 2014). However, RRT activation often occurs late, after noticeable changes in the patient's condition are more apparent (Stewart et al., 2014). Although RRT has improved patient outcomes there is still an opportunity to improve the timing of recognition and intervention before RRT activation. According to Fasolino and Verdin (2015), RRT activation improved cardiopulmonary arrest outside of the intensive care unit by 33.8% but did not lower

hospital mortality, indicating by the time RRT is called the patient's deterioration is more noticeable. This also puts the patient at a higher risk for mortality or experiencing an adverse event. A need to improve nurses' failure to respond through early recognition of clinical deterioration and response before RRT is indicated.

Recognition, reporting, and intervening promptly to patient deterioration are essential roles for nurses (Fasolino & Verdin, 2015). Increased patient acuity coupled with workload impact the nurse's ability to perform these roles (Allen, 2020). Vital signs are a routine part of the assessment and provide data points that can be primary indicators of deterioration (Allen, 2020). Nurses often view blood pressure changes as an early indicator of deterioration, yet it is a late sign according to Allen (2020). The hectic pace of nursing often leaves little time for the interpretation and evaluation of patient data trends that are the early indicators of deterioration.

The EWS was designed to alert clinicians of changes in patient conditions. An EWS analyzes multiple data points, such as vital signs, and provides a score that indicates the likelihood of a patient experiencing an unforeseen event in a specific time frame (EPIC, 2020). Integration of data from the electronic health records (EHR) into an EWS transforms information into knowledge that can be used to improve patient outcomes and care (Capan et al., 2017). Additional nursing assessment data, such as neurological assessment, are being incorporated into EWS scores and more information on patient deterioration changes (Capan et al., 2017).

In summary, adverse events and hospital deaths are preventable if recognized quickly. Many organizations have implemented best practices to reduce the chances of an adverse event and improve patient outcomes. Integration of an EWS into the EHR is one

method for alerting clinicians of change and prompting intervention, such as RRT notification. RRT is a resource but is often activated once the patient is exhibiting late signs of deterioration. Thus, early recognition through the utilization of the data with other assessment findings and alerting response teams is important in the prevention of adverse events by clinicians.

**PICOT Statement**

What is the effect of an educational intervention on nurse acknowledgment of the deterioration index score and nurse confidence in intervening to improve patient outcomes by alerting the Rapid Response Team (RRT) within two months for adult patients on a medical-surgical unit?

**Sponsors and Stakeholders**

This project was conceptualized after a meeting with organizational leaders on opportunities to improve the functionality of the DI score. The DI score places patients into three categories: low (green), medium (yellow), and high (red). The BPA fires for patients with a score in the high or red category. Utilization at the time was perceived as low without having official data. Multiple communications had been shared with nurses about the DI score and purpose, but usage remained low. Currently, nurses do not receive education on the DI score upon hire or annually. It is dependent upon the nurse preceptor to provide education about the DI score and how to address it. This intervention will provide education to all nurses on the project unit and hopefully set a standard for use during onboarding education in the future.

Implementation of this project required assistance from multiple stakeholders. The Nurse Scientist for the health care organization was involved with project oversight

and facility institutional review board (IRB) approval. The clinical informatics team that oversees the EHR and DI score was an important stakeholder in improving the utilization and enhancement of the DI score. Other supporters included nursing administration and managers from medical-surgical units. Key stakeholders for the project also included medical-surgical nurses, nurse managers and leaders, hospital administration, and the RRT team. The DNP student served as the project leader. The DNP project chair is Ph.D. prepared and a professor with the University. The project partner is DNP prepared and a Clinical Practice Specialist at the project facility.

**Organizational Assessment Utilizing SWOT Analysis**

An analysis of the project facility's strengths, weaknesses, opportunities, and threats (SWOT) was part of the project-planning phase (Table 1).

**Table 1**

*SWOT Analysis*

| SWOT Analysis | |
|---|---|
| Strengths | Weaknesses |
| • Deterioration Index Score is part of the electronic health record<br>• Best practice advisory (BPA) alert triggered when the patients DI score is > 75<br>• Rapid Response Team available<br>• Clinical Informatics support<br>• RRT and ICU transfer unit-specific data<br>• Nursing leadership support<br>• Commitment to employee | • High turnover rate for medical surgical nurses/nurse shortages<br>• Increased workload/patient acuity<br>• Medical-surgical nurses unaware of or not using DI score<br>• DI score not included in onboarding training |

SWOT Analysis

education

| Opportunities | Threats |
| --- | --- |
| • EPIC support for assistance with data extraction | • Pandemic increasing patient acuity and nursing shortages<br>• Individuals hesitant to seek care or go to the hospital due to the pandemic.<br>• Seasonal increase (Flu, COVID) |

***Strengths***

The project facility implemented the predictive DI score within the EHR in 2017. This predictive score runs in the background of the EHR based on patient data imputed by clinicians. A BPA alert triggers nurses and providers when the patient's score is greater than 75 and provides a summary of patient data that is contributing to the score along with actions to consider. One of the actions to consider is a notification of RRT. The project facility has a strong RRT program, with multiple responders on hand 24 hours a day. The facility also collects data on the number of RRT calls and patient transfers to the ICU.

The project facility has several resources to support the project. There are multiple medical-surgical units with varying patient populations within the facility. Nurse leaders are supportive of improving patient outcomes and getting nursing team members to attend education and training. The professional practice and development department has several nurse and simulation educators that can assist in the design of the training.

The nurse scientist can provide data and statistical support at the project facility. Clinical informatics has analyst support with reviewing reports and trends of documentation in the electronic health record.

***Weaknesses***

Although the project facility has multiple medical-surgical units to conduct this project on, the turnover of nurses is currently high due to the COVID-19 pandemic. There are more travel nurses being hired to fill the demand. The use of the predictive DI score varies among organizations that use the EPIC system, so travel nurses may not be as knowledgeable. The organization currently does not provide education about the DI score during new hire onboarding training or have any educational materials created for just-in-time learning. Any new nurse entering the organization would be dependent on a nurse preceptor or co-worker to educate them. An increase in patient acuity and nursing workload is impacting the DI score and nurses' ability to recognize deterioration quickly.

***Opportunities***

The organization's contract with EPIC systems is a positive opportunity for this project. EPIC system support assistance with data extraction of the DI score BPA was necessary for obtaining the correct data needed to solidify the problem. This partnership will also be useful if future changes are identified.

***Threats***

A few external threats to the project are all related to the pandemic. The pandemic creates surges in patient hospitalizations, which in turn increases the acuity and demand for nursing. This also places the patient at higher risk for deterioration. Individuals have been hesitant to see their provider or visit urgent care or emergency room during the

pandemic. This delay in seeking care also puts the patients at higher risk for experiencing an adverse event once they get to the hospital. Seasonal illnesses such as Influenza may also impact the patient type and risk for deterioration in the project facility.

The strengths and opportunities outweigh the weakness and threats of this project. Nurse leadership is supportive and team members are engaged despite the COVID-19 pandemic. Organizational data is available and accessible for ongoing evaluation and review of progress. There is an opportunity to standardize and deliver education on the DI score to all new hires that enter this organization. This project can develop into the needed education and be sustained for many years.

**Cost/Benefit Analysis**

The major benefit of this project was the potential to change practice that has a positive impact on the recognition and response to patient deterioration. The cost for a hospital stay is averaged at "$2,607 per day" throughout the United States, with the cost increasing for overnight and extended stays, such as a transfer to the ICU (Fay, 2021, p.1). The cost of an ICU stay varies based on the patient's care needs, age, and length of stay (Frank et al., 2020). Dasta et al. (2005) noted the first 2 days of an ICU stay cost the most, with subsequent days being less. The cost of an ICU stay varies from "$12,931 to as much as $42,570" depending on the care, such as if mechanical ventilation were required (Dasta et al., 2005, p. 1276). Recognition and early response to changes in clinical deterioration are key in improving the outcomes for patients and keeping the cost of care down. The cost of this project is minimal compared to the cost a patient may accrue during an ICU stay.

## Goals, Mission, and Objectives

## Goals of Project

The goal of this project was to increase nursing acknowledgment of the deterioration index score BPA and nursing confidence in recognition and response to clinical deterioration. Organization data shows in the past year, from September 4, 2020, to September 3, 2021, the BPA fired 164,811 times. At the project facility alone, the BPA fired 56,661 times and specifically in medical-surgical units, 9,917 times. Medical-surgical nurses canceled or "dismissed" the BPA 8,782 times, which is 88% of the BPAs fired versus 12% that acknowledged or acted on the BPA. This project will focus on improving nurse acknowledgment of the BPA warning and earlier response and recognition of clinical deterioration.

## Mission of Project

The mission of this project was to improve patient care through nurse utilization of the deterioration index score. Early identification of clinical deterioration improves patient outcomes and mortality. Providing an educational intervention to nurses in a medical-surgical unit will increase knowledge of the DI score and its use with daily clinical assessment. This will be used to determine if early intervention from the provider or RRT is warranted and to prevent transfers to the ICU or adverse events such as a code blue.

## Process/Outcome Objectives

The objectives for this project were:

1. By March 2022, the number of BPA dismissals will decrease by 50% after nurses complete the educational intervention.

2. By March 2022, the number of BPA acknowledgments will increase by 50% after nurses complete the educational intervention.
3. By March 2022, the number of RRT calls will increase by 10% after the unit receives the educational intervention.

## Theoretical Underpinnings

The theoretical underpinning for this project were guided by Dr. Joanne Duffy's Quality Caring Model (QCM) (Duffy, 2018). The QCM was developed in 2003 "with the intention of integrating the caring process with quality concepts to promote excellence in nursing practice" (Andrus & Shanahan, 2016, p. 595). Duffy envisions caring relationships at the center of the model, surrounded by eight caring behaviors used as guides for understanding and practicing the QCM (Duffy, 2018). The eight behaviors are "mutual problem solving, attentive reassurance, human respect, encouraging manner, appreciation of unique meanings, healing environment, basic human needs, and affiliation needs" (Duffy, 2018, p. 50). When these caring behaviors are used to form relationship-centered professional encounters, the recipients of that care feel cared for and a healing environment is formed (Duffy, 2018).

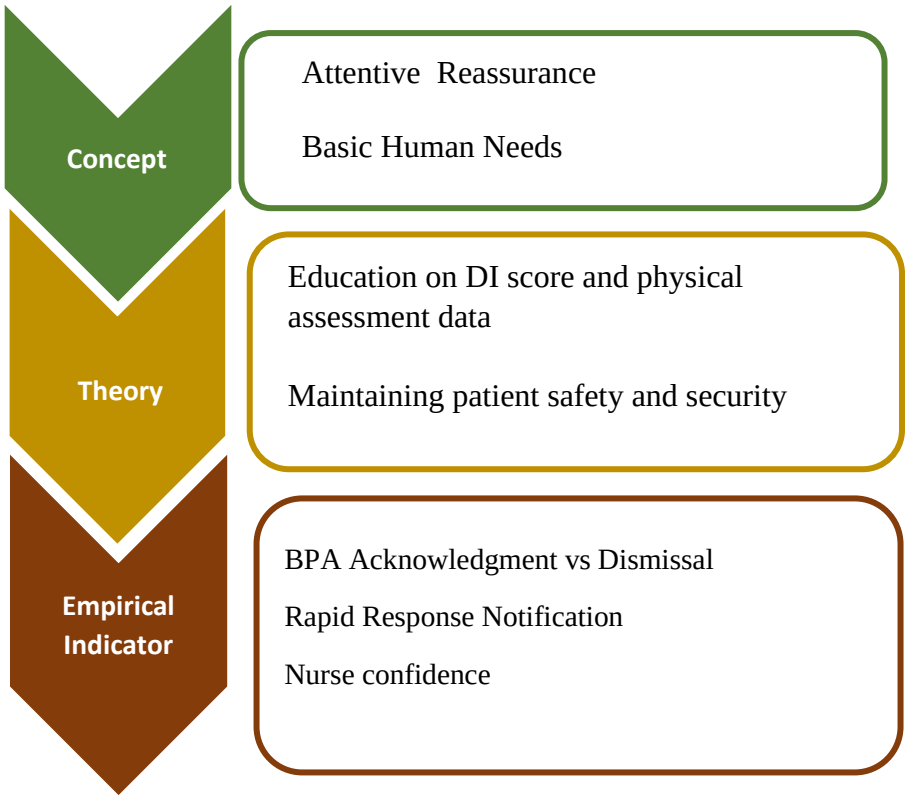
Health care challenges such as nursing shortages, advancing technology, and increasing chronic disease have created many barriers for nurses to foster a caring relationship (Duffy & Hoskins, 2003). Many studies suggest quality nursing care directly impacts patient outcomes (Duffy & Hoskins, 2003). While advances have been made to improve patient outcomes, predictable and preventable human errors still account for thousands of hospital patient deaths annually (Duffy, 2018). Adverse events are

preventable but still occur and are the main cause of harm, death, and disability (Duffy, 2018).

The predictive DI score provides nursing professionals with real-time data indicative of impending clinical decline or experiencing an adverse event. Awareness and reaction to this data fulfill the caring behavior of attentive reassurance. The nurse is reliable and pays attention to changes in the patient (Duffy, 2018). The attentiveness may come in the form of an assessment or notification of RRT or the provider for additional care needs. This project will also foster the caring behavior of attending to basic human needs by maintaining the patient's safety and security. If the patient perceives that the nurse's caring actions prevent a decline in health the patient will more likely feel safe and secure in their environment. Applying the QCM to this project will guide nurses toward patient-centered practice changes, the creation of a healing environment, and the improvement of patient outcomes. Figure 2.

**Figure 2**

*C-T-E Diagram Using Dr. Joanne Duffy's Quality Caring Model*



## Project Plan

This project was implemented in a 900-bed acute care community hospital located in the southeastern United States. The project site was a 35-bed general medical-surgical unit staffed by roughly 32 nurses. This unit was chosen because they have a high number of DI score BPA dismissals for a med/surg unit in this facility. The utilization of the project site was approved by the nurse manager overseeing the unit via email. Nurse leadership requested education on the appropriate use of the DI score be mandatory for all nurses. After Institutional Review Board (IRB) approval, multiple in-person educational offerings were scheduled for two weeks in February 2022. Nurse leadership on the unit was consulted regarding the times and locations of these offerings. Nurses were informed of the educational offerings using a flyer sent by email by the nurse leaders. The flyer provided the location, duration, and objectives of the course offering.

Education was delivered using a PowerPoint presentation. The education covered information on the deterioration index score, factors contributing to the score, and incorporation of data with assessment findings to intervene, for example, notification of RRT or the provider. Each 30-minute session was taught by the DNP Project Leader. Four educational sessions were provided initially. Two for dayshift and two for night shift. Two additional classes were planned, one for dayshift and one for nightshift, for staff nurses unable to attend one of the four initial classes.

An anonymous, confidential pre/post survey using Qualtrics was used to assess the nurse's current confidence level in recognizing change and ability to make clinical decisions based on assessment data. While the education was mandatory, nurses were asked to volunteer to participate in completing the survey. Prior to the educational

intervention, the survey consent was provided and reviewed with staff nurses. The project lead fully explained the mandatory education project and the voluntary survey before the education began. The Qualtrics survey was embedded in a QR code for nurses to scan and complete the survey if they consented. After the survey consent was reviewed and participants had a chance to ask questions, the project lead left the room to allow staff nurses to scan the QR code and either agree or disagree to participate in the survey. Staff nurses were given 10 minutes to complete the survey prior to the educational intervention. Four weeks after the last educational intervention, the post-survey was sent out via work email. Nursing leadership on the unit shared the email with staff nurses. The post-survey was open for two weeks for team members to participate. Staff nurses received a reminder of the post-survey one week after the initial email was sent by nursing leadership.

The Gantt Chart (Figure 3) and work breakdown structure (Table 2) display the projected timeline of project events. After IRB approval, pre-project data were collected during December 2021 and January 2022. The educational intervention was implemented in February 2022, with a post-survey four weeks after the last educational session offering. Data collection and analysis occurred in mid-March and April 2022.

**Figure 3**

*GANTT Chart*

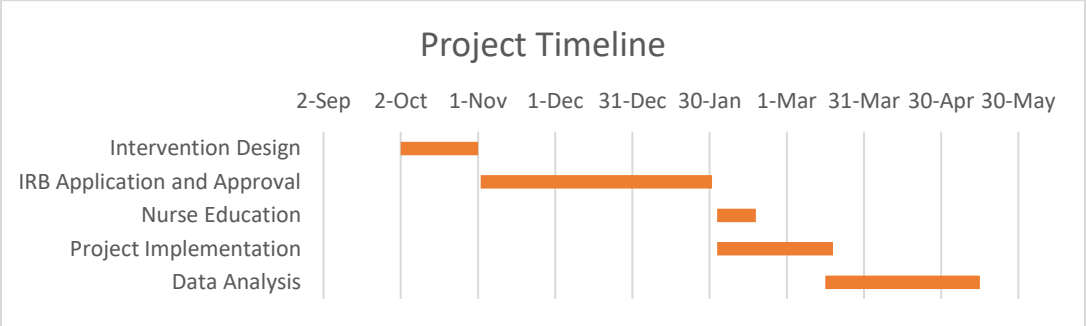


**Table 2**

*Work Breakdown Structure*

| Task | Estimated Start | Estimated Length to Completion | Sequential or Parallel | Dependent Upon |
|---|---|---|---|---|
| A. Intervention Design | 24-Sep-21 | 5 weeks | Parallel | None |
| B. IRB Application and Approval | 1-Nov-21 | 12 weeks | Parallel | Task A |
| C. Nurse Education | 1-Feb-22 | 2 weeks | Sequential | Task B |
| D. Project Implementation | 1-Feb-22 | 4 weeks | Parallel | None |
| E. Data Analysis | 1-Mar-22 | 8 weeks | Sequential | Task D |

Table 3 displays the anticipated cost to implement this project. All the expenses are currently integrated into the facility's operational budget. There are no anticipated out-of-pocket costs for this project implementation.

**Table 3**

*Budget*

| Direct and Indirect Cost of Project Implementation | | | |
|---|---|---|---|
| Budget item | Description | Estimated total | Currently integrated into facility operation budget (yes/no) |
| Direct Costs | | | |
| Salary- Medical surgical nurse | 32 nurses<br>Average salary $30.00/hour<br>Estimated time of training= 1.5 hours<br>Total classes= 5 | $1,440 | Yes |
| Salary- Assistant nurse manager Pre/post-training | 3 ANM<br>Average salary $40.00/hour | $240 | Yes |

Direct and Indirect Cost of Project Implementation

| | | | |
|---|---|---|---|
| briefing | Estimated time= 2 hour | | |
| Salary-Nurse manager Pre/post-training briefing | 1 NM Average salary $50.00/hour Estimated time= 2 hour | $100 | Yes |
| Salary- Clinical Analyst Pre/post-data extraction | 1 clinical analysist Average salary $50.00/hour Estimated time= 5 hours | $250 | Yes |
| Indirect Costs | | | |
| Electronic Survey (Qualtrics) | Use of universities Qualtrics application. | $0 | Yes |
| Handouts/Materials | Copy of presentation for 40 participants plus extras. | $100 | Yes |
| Total | | $ 2,130 | |

**Project Evaluation**

The purpose of this project was to improve nurse utilization and confidence in the DI score as part of the nurse assessment in recognition and response to clinical deterioration. As a result of clinical education, nurses will be more confident in their ability to recognize and respond to clinical change and acknowledge and respond to the BPA instead of canceling or dismissing it. This change in practice will improve nurse response, recognition, and intervention of care, as well as potentially improve patient morbidity and mortality. Project evaluation was performed using the following

quantitative data collected over two months: DI score BPA dismissal/acknowledgment data retrieved from the EHR, RRT call data retrieved from nursing leadership, and pre- and post-survey results from the Clinical Decision-Making Self Confidence Scale (CDMSCS).

**Clinical Decision-Making Self-Confidence Scale (CDMSCS)**

The CDMSCS was initially developed by Frank Hicks in 2006 to measure student nurses' self-confidence in "recognizing, assessing, intervening, and evaluating intervention effectiveness in clinical deterioration events" (Hart et al., 2014, p. 315, Warren et al., 2020). The instrument was piloted and tested through a study sponsored by the National Council of State Boards of Nursing in 2009 (Hart et al., 2014). Hicks et al. (2009) reported a significant increase in students' self-confidence ($p < 0.05$) in taking care of patients with acute changes after completing simulation and clinical training versus solely classroom instruction (2009).

Hart et al. (2014) further examined the psychometric testing of the CDMSCS tool (2014). The sample consisted of data from two previous studies of medical-surgical registered nurses and Bachelor of Science in Nursing (BSN) students. Both groups received the same study questionnaires examining confidence in recognizing and responding to clinical change (Hart et al., 2014). Findings from the Hart et al. (2014) study showed high instrument reliability with Cronbach's alpha coefficients for nurses at 0.95, BSN students at 0.89, and combined groups at 0.98 (2014). "Construct validity was further supported by statistically significant differences between nurses and BSN students' self-confidence level in handling deterioration events" (Hart et al., 2014, p. 312). Overall, the CDMSCS tool was found to be effective in assessing levels of self-

confidence in nurse recognition and response to patients experiencing deterioration (Hart et al., 2014; Warren et al., 2020).

Hart et al. (2014) published another study in which the CDMSCS was used to explore medical-surgical nurses' perceived self-confidence in recognizing and responding to clinical deterioration prior to RRT arrival (2014, p. 2769). Results from the 148 nurses that participated in the study revealed a mean self-confidence score of 52.38, a range of 33-60, indicating that nurses felt very confident in responding to deterioration. More nurses felt confident in recognizing respiratory and cardiac events than they did neurological events and patients with chest pain (Hart et al., 2014). The reliability of the CDMSCS resulted in a Cronbach's reliability coefficient of 0.95 (Hart et al., 2014).

**Plan, Do, Study, Act**

Pre-implementation data was collected during December 2021 and January 2022 on the DI score BPA cancellations and acknowledgments, and RRT notifications. Prior to the educational intervention, all project unit staff nurses were offered the opportunity to voluntarily complete the CDMSCS. The education was offered during February, followed by the post-education CDMSCS survey in Qualtrics four weeks after the last educational session is offered. Two months following the post-survey, mid-March and April 2022, data collected from the Qualtrics pre/post survey using the CDMSCS scale was reviewed, along with the DI score BPA values and RRT notifications. After evaluation of the project, a sustainable course for all medical surgical nursing new hires was developed for completion during orientation. This course will include information used in the program intervention.

## Implementation

Project implementation began after receiving approval from the University and facility IRBs. Nurse leaders on the project unit were consulted on session dates and appropriate times to conduct the educational intervention. These sessions were scheduled with nurse leaders prior to implementation. Nurses were made aware of the mandatory educational session dates and times by a flyer emailed and posted in the unit by the nurse manager. The project lead also attended a virtual staff meeting prior to the first educational session to share the project plan and timeline for completion. Immediately prior to the educational intervention nurses were informed of the project scope and voluntary consent to complete the CDMSCS pre-survey. Participants were provided 10 minutes to complete the pre-survey without the project lead in the room. After 10 minutes had passed, the educational intervention was started and lasted approximately 20 minutes.

Four educational sessions were initially offered with two backup sessions for those unable to attend the initial four sessions. Nursing leadership support in advertising and assisting with participant attendance of classes was a positive implementation experience. The classes were held in the unit using a classroom space. This was very accommodating to the participants not having to leave the unit for the education. Nurses' willingness to complete the pre-survey was an essential part of the success of this project. Nurses verbalized after the educational intervention that the information was needed and very much appreciated.

Participants received education in person using a PowerPoint presentation. The presentation included information on recognizing the signs of clinical deterioration using a rapid assessment technique, DI score levels, details, and response methods. Emphasis

was placed on the DI score high warning and the use of the rapid assessment technique to determine what type of intervention is needed. Education also focused on the response to the DI score BPA alert. This BPA should be reviewed, acknowledged, and accepted versus dismissed when the nurse receives the BPA. Participants were also educated on how to locate the DI score and observe patient trends within the electronic health record (EHR). See Table 4 for an outline of educational content.

**Table 4**

*Recognizing and Responding to Clinical Deterioration Education*

| Topic | Content |
|---|---|
| Clinical deterioration | • Identifying signs and symptoms of deterioration.<br>• Using "ABCDE" method to perform a rapid assessment. |
| Deterioration index score | • The purpose of the score and how it was developed.<br>• Three levels of DI score.<br>• Data that contributes to the score.<br>• Using the score with patient assessment.<br>• Tracking trends.<br>• Best practice advisory notification. |
| Responding to clinical deterioration | • Resources to help address changes.<br>• Communicating changes. |
| Clinical Scenario | • Using a patient scenario to apply methods of recognizing and responding to clinical deterioration. |

**Threats and Barriers**

Staffing shortages due to the current COVID-19 pandemic were a threat to the implementation of this project. Initially, the educational intervention was planned for 60 minutes. However, based on the current facility status and staffing during the COVID-19

surge, the educational intervention time frame was decreased to 30 minutes. Sessions were scheduled on dayshift following interdisciplinary rounds and all nurses working these days stayed after rounds to participate in the education. This time was requested by nursing leadership but seemed to be a busy time for participants to be engaged. On the night shift, rounds were scheduled at 5:00 in the morning right before they began their last rounds before shift change. This time worked well, and night shift participants were very engaged and appreciative of the education. Overall, each session had roughly five to seven nurses participating in the initial four sessions. The two additional sessions were held after the initial week of class offerings. One day and night shift class was held to accommodate most remaining participants. A virtual educational session only was offered for the participants that were unable to attend one of the six classes. This virtual offering was at the request of nurse leaders on the project unit. These participants were not offered an opportunity to complete the pre-survey but were able to complete the post-survey.

**Monitoring of Implementation**

The timeline for this project was strictly followed. The IRB approval process began with submission to the University IRB in November 2021. Pre-approval was obtained in November 2021 and submitted to the facility Nursing Research Council (NRC) and IRB. NRC approved the project in December 2021 and facility IRB approval was obtained in January 2022. Full University IRB approval was obtained at the end of January 2022. After IRB approval was obtained, pre-project DI score BPA and RRT data were collected for December 2021 and January 2022. The educational intervention was implemented from February 2 through February 10, 2022. The post-survey was emailed

to participants by the nurse manager on the project unit four weeks after the last educational session offered on March 10, 2022. Participants were provided two weeks to voluntarily complete the post-survey, with a reminder email sent on March 17, 2022. DI score BPA and RRT post-implementation data were collected from February 10 to April 7, 2022. Data analysis occurred between April and May 2022.

### Project Closure

After data analysis, a meeting was planned with nurse leaders on the project unit to disseminate project findings. The project lead attended staff meetings on the project unit to disseminate findings. The project lead disseminated findings to the facility nursing research council, the University IRB research council, and at the University's Scholars Day. The nurse manager on the project unit will continue to monitor DI score BPA and staff notification of provider and/or RRT after project completion. Information from this project will also be used to develop future ongoing education for all medical-surgical nurses at the facility.

## Interpretation of Data

The objective of this project was to determine the effect of an educational intervention on nurse acknowledgment of the deterioration index score and nurse confidence in intervening to improve patient outcomes by alerting the Rapid Response Team (RRT) within two months for adult patients on a medical-surgical unit. Six educational sessions were held between February 2, 2022, to February 10, 2022, with a total of 33 participants (94% attendance). Twenty-six participants completed the pre-survey, response rate of 78%, and 13 completed the post-survey, response rate of 39%. The IBM® Statistical Package for the Social Sciences® (SPSS) version 27 was used to

analyze the data collected from the surveys. DI score BPA and RRT data were also collected and analyzed pre and post-educational intervention.

**Nurse Confidence**

A comparison of the pre- and post-survey results revealed that participants' confidence improved after the educational intervention in the categories of recognizing signs and symptoms (questions 1-3) and accurately assessing (questions 4-6) patients with cardiac, respiratory, and neurological changes. Post educational intervention, confidence levels in the categories of appropriately intervening (questions 7-9) and evaluating the effectiveness of interventions (questions 10-12) in patients with cardiac, respiratory, and neurological events decreased or stayed the same when compared with pre-survey responses.

Confidence levels, in general, were highest among respiratory-related events followed by cardiac events. The lowest confidence levels among participants were noted in all areas of neurological events or mental status changes. Table 5 provides a comparison of the pre- and post-survey percentage of participants who selected moderately or very confident for each question. A Cronbach's alpha was calculated to assess the reliability of this sample using the Clinical Decision-Making Self Confidence Scale (Hicks et al., 2009). The Cronbach's alpha was 0.948, indicating the instrument is reliable and consistent with previous samples reported in the literature.

**Table 5**

*Clinical Decision-Making Self-Confidence Scale (CDMSCS) Responses*

| Question | Pre-Survey % answered moderately confident (4) and very confident (5) | Post-Survey % answered moderately confident (4) and very confident (5) |
|---|---|---|
| Q1: How confident are you that you can recognize signs and symptoms of a cardiac event? | 53%, n=14 | 68%, n=9 |
| Q2: How confident are you that you can recognize signs and symptoms of a respiratory event? | 77%, n=20 | 91%, n=12 |
| Q3: How confident are you that you can recognize signs and symptoms of a neurological event? | 57%, n=15 | 69%, n=9 |
| Q4: How confident are you that you can accurately assess an individual with chest pain? | 65%, n=17 | 69%, n=9 |
| Q5: How confident are you that you can accurately assess an individual with shortness of breath? | 84%, n=22 | 91%, n=12 |
| Q6: How confident are you that you can accurately assess an individual with changes in mental status? | 79%, n=21 | 77%, n=10 |
| Q7: How confident are you that you can appropriately intervene for an individual with chest pain? | 69%, n=18 | 53%, n=7 |
| Q8: How confident are you that you can appropriately intervene for an individual with shortness of breath? | 80%, n=21 | 69%, n=9 |
| Q9: How confident are you that you can appropriately intervene for an individual with changes in mental status? | 80%, n=18 | 53%, n=7 |
| Q10: How confident are you that you can | 69%, n=31 | 61%, n=8 |

| Question | Pre-Survey % answered moderately confident (4) and very confident (5) | Post-Survey % answered moderately confident (4) and very confident (5) |
|---|---|---|
| evaluate the effectiveness of your interventions for an individual with chest pain? | | |
| Q11: How confident are you that you can evaluate the effectiveness of your interventions for an individual with shortness of breath? | 76%, n=20 | 76%, n=10 |
| Q12: How confident are you that you can evaluate the effectiveness of your interventions for an individual with changes in mental status? | 68%, n=18 | 53%, n=7 |

**RRT Calls Pre-Intervention**

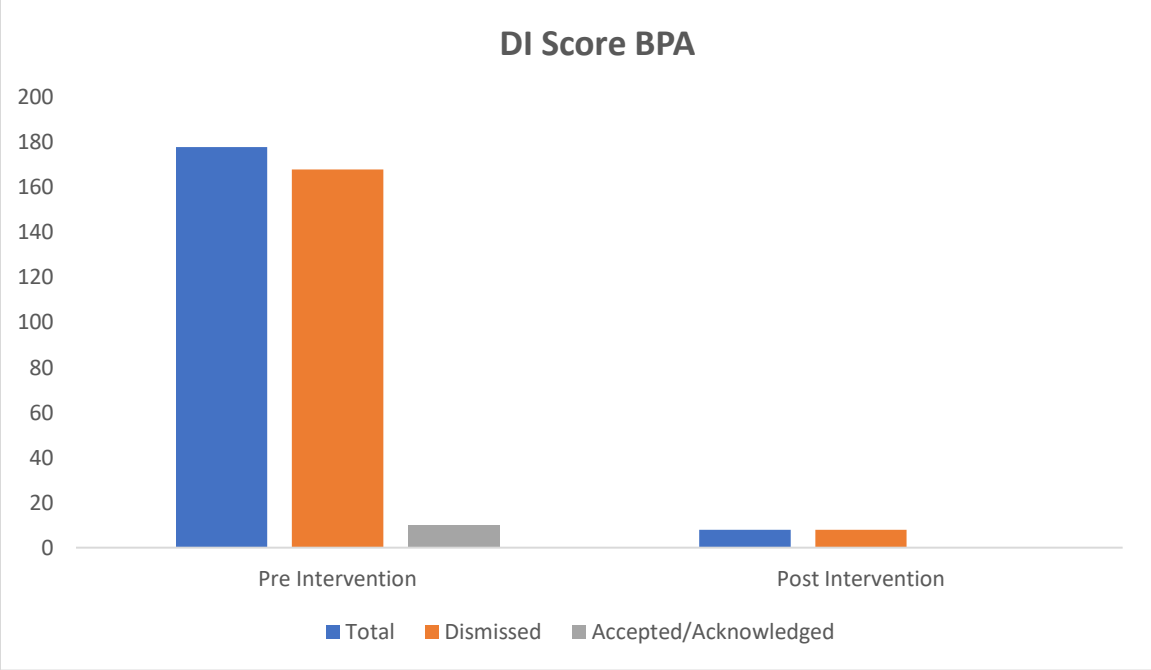
Pre-educational intervention there were 27 RRT calls to the project unit. In December 2021, the project unit had 12 calls and in January 2022 there were 15 calls. Reasons for RRT notification varied from changes in vital signs such as heart rate, oxygen level, and blood pressure to general concerns with heart and respiratory status. Of the 27 RRT calls, 29% (N=8) of patients were transferred to a higher level of care. Post educational intervention there were 33 RRT calls between February 11, 2022, and April 8, 2022. Reasons for RRT notification included vital signs such as heart rate and oxygen level changes, complaints of chest pain, and neurological changes requiring stroke assessment and evaluation. Of the 33 RRT calls, 23% (N=7) of patients required transfer to a higher level of care. RRT calls post intervention increased as compared to pre intervention data. Patients requiring transfer to a higher level of care were comparable except for the slightly lower rate of patient transfers post educational intervention.

## DI Score BPA Evaluation

The DI score BPA was evaluated two months prior to the educational intervention (December 2021 and January 2022) and two months following the educational intervention (February 11-April 8, 2022). Pre-educational intervention there were 178 BPAs that fired on the project unit. Of the 178 BPAs, 168 were canceled. Only six percent (N=10) of BPAs were accepted or acknowledged by nurses. Post educational intervention eight DI score BPAs fired with zero percent of BPAs accepted or acknowledged by nurses. There was no improvement in acknowledgment or acceptance of the DI score BPA post-educational intervention (Figure 4).

**Figure 4**

*DI Score BPA Results*



# Discussion

## Nurse Confidence

Following their participation in the educational intervention on recognizing and responding to clinical deterioration, nurses answering the post-survey reported improved confidence in the areas of recognizing signs and symptoms and assessing an individual experiencing an event. Nurses responding to the post-survey did not report improved confidence in intervening and evaluating the effectiveness of the intervention. Nurses answering the survey were knowledgeable of signs and symptoms of clinical deterioration and how to assess for those changes. An “ABCDE” pneumonic was provided in the educational intervention to give nurses a quick assessment technique. The discussion and use of the pneumonic may have contributed to the improvement in nurse confidence in these areas. Nurses voiced awareness and comfort with alerting RRT but were not confident with their skills to intervene and evaluate interventions. This project was implemented during a pandemic surge and could have been affected by staff turnover and less experienced nursing staff, resulting in nurses’ decreased ability to recognize and respond to clinical deterioration quickly as compared to a non-crisis situation. This may have contributed to nurses’ confidence in intervening and evaluating those interventions.

## RRT Calls Post-Intervention

The number of RRT calls post intervention were slightly higher than pre intervention calls. This did meet the project outcome of improving RRT calls by 10%. The project unit had one less patient requiring transfer to a higher level of care post-intervention than pre-intervention. RRT is often notified when patients show late signs

and symptoms of clinical deterioration, which can increase patient mortality (Clayton, 2019).

Nurses are recognizing change and alerting RRT for assistance with intervention and evaluation. This may negatively impact nurses' confidence in the areas of intervention and evaluation of interventions due to the difference in roles and frequency performed. As mentioned previously, nurses were comfortable with alerting RRT, perhaps because they were not confident with their skills to intervene and evaluate interventions.

**DI Score BPA**

The educational intervention covered recognition and assessment of patients, including how to incorporate the DI score with the patient's assessment to determine true deterioration. During the educational intervention nurses still seemed hesitant to trust the DI score and incorporate it with their assessment findings. Nurses voiced awareness of the DI score and BPA but were not familiar with the data that contributed to the score or how to track trends. Despite the educational intervention nurses continued to dismiss the BPA post-intervention.

The goal or outcome of this project was to improve nurse acknowledgment of DI score BPA alerts by 50% and decrease dismissal by 50%. This outcome was not met as all DI score BPAs post-intervention were dismissed. Most nurses that attended the educational intervention openly shared they often dismiss the DI score BPA for reasons such as time and accuracy of the score related to patient assessment. Nightshift nurses voiced more appreciation of the education and opportunities to identify patient deterioration as access to resources on night shift is often less than for those that work on

dayshift. Under-utilization of the DI score could be contributed to the lack of formal nursing education. Nurses do receive education on identifying signs and symptoms of cardiac, respiratory, and neurological changes and how to notify RRT. Beyond that, there is no formal education or simulation on the application of the process, interventions, and evaluation of those interventions.

This project was impacted by the COVID-19 pandemic. Pre-intervention data was collected amid a COVID surge. This surge also contributed to the high numbers of DI score BPAs. Post-intervention the COVID surge was declining which aligns with a lower number of DI score BPAs as compared to the pre-intervention surge. The pandemic also created staffing challenges and patient populations the project unit was not used to caring for. The project unit had multiple travel nurses and nurses were often floated to other units to assist with staffing coverage. Nurse full participation during the educational intervention was also a challenge as patient needs took priority.

**Relevance to Literature and Theoretical Framework**

Literature findings supported early recognition of clinical deterioration and notification of RRT in the prevention of patient deaths and outcomes using an EWS. Findings from this project were consistent with the literature regarding nurse confidence in recognizing signs and symptoms of change and alerting RRT. However, nurses dismissed the DI score (EWS) when alerted. Findings from post-intervention RRT data revealed a slight decrease in patient transfers to a higher level of care. Utilization of the DI score BPA may have prevented additional transfers to a higher level of care if acknowledged. Global pandemic and staffing shortages also influenced the results of this project which were consistent with the literature.

Staffing shortages during the pandemic impacted the nurse's ability to foster a caring relationship. The quality-of-care nurses were able to provide impacted patient outcomes by requiring a transfer to a higher level of care. Nurses offered caring reassurance through their confidence in recognizing, assessing, signs and symptoms of change, and notification of RRT. The caring behavior of assisting with basic human needs through fostering safety and security was met through nurses' identification of change, however, the DI score was dismissed, and patients required transfer to a higher level of care slightly less often than pre-intervention. Duffy's QCM is a relevant theory to guide this work and outcomes.

**Future Improvement Projects**

There is a need to develop a course on recognizing and responding to clinical deterioration with the incorporation of the DI score. Currently, there is not a course available for nursing to complete during orientation. The course used for the educational intervention could be transitioned into a learning module for new nurses to complete during orientation and current nurse education. The module should have a greater emphasis on mental status changes, and interventions and evaluation of interventions for patients experiencing cardiac, stroke, and neurological events. To sustain confidence, it would be beneficial to coordinate simulations annually that focus on patient deterioration and allow nurses to work through the process of recognizing, assessing, intervening, and evaluating care. Coordination and collaboration with the organization's simulation coordinators to develop and deliver content would be essential.

There is also a need to continue monitoring DI score data for unit compliance. Despite the education, nurses on the project unit dismissed all DI score BPAs. Unit

leadership involvement to review the importance and monitor for compliance is essential. A review of monthly DI score BPAs would assist unit leaders in this process. Unit leadership has also voiced an interest in expanding this project further to compare the patient's DI score at the time of RRT notification, interventions provided and evaluation of those interventions, for example, the number of times patients were transferred to a higher level of care.

This project unveiled many opportunities to improve nurse utilization of the DI score and confidence in intervening and evaluating interventions when clinical deterioration is recognized. Developing courses during orientation and defining a process for nurse leaders to monitor DI score BPA data would improve nurse use of the DI score. The timeline for this project was well executed and staff nurse participation during the educational intervention was phenomenal despite the pandemic. This success is contributed to having the appropriate key stakeholders and engaged nursing leaders involved in the project. Perhaps shortening the time frame between the educational intervention and post-survey, from four weeks to two weeks, would have resulted in more staff nurses completing the survey and higher confidence levels in intervening and evaluating interventions. Implementing and sustaining the education offered by this project once the pandemic was over and when staffing numbers were more stable and the patient population was more consistent, might result in improved nurse confidence and patient outcomes.

## Conclusion

Early recognition and response to clinical deterioration are imperative in reducing patient morbidity and mortality. Without proper training and support nurses' confidence

in recognizing and responding to deterioration may be delayed, resulting in unwanted patient outcomes. Artificial intelligence programs that alert nurses of significant changes in condition are beneficial if used appropriately. Although this project did not produce the intended outcomes, it did identify an opportunity to improve internal training and enhance the current process.

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