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Implementation and Evaluation of a Post-op Coronary Artery Bypass Graft Extubation Checklist to Reduce Prolonged Intubation in the Intensive Care Unit

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Implementation and Evaluation of a Post-op Coronary Artery Bypass Graft Extubation Checklist to Reduce Prolonged Intubation in the Intensive Care Unit

A DNP Project Submitted to the
Graduate Faculty
of Jacksonville State University
in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Nursing Practice

By

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Abstract

Background: Total intubation time of post-op coronary artery bypass graft (CABG) patients is set by the Society of Thoracic Surgeons (STS) guidelines. STS states that post-op CABG patients need to be extubated within twelve hours of end anesthesia time with a recommendation of fewer than six hours. The project site had a total intubation time of greater than seventeen hours before removing the outliers. The current process does not result in a total intubation time of fewer than six hours. Implementation of an extubation checklist was chosen as the intervention for this DNP project.

Purpose: This DNP project aims to reduce the total intubation time of post-op CABG surgeries closer to the recommended STS guidelines of less than six hours at the project site.

Methods: This quality improvement project implemented the use of a post-op CABG extubation checklist. The checklist was designed to follow and simplify the project site's current post-op CABG extubation protocol.

Results: Key results included statistical average total intubation time of appropriate patients (Average=4.37 hours). Two Likert scale surveys produced positive results for education and communication. The final result utilized various statistical data and showed improved outcomes in total intubation times.

Conclusion: This DNP project found that a post-op CABG extubation checklist with proper nursing education promises to reduce total intubation times. The project found that the checklist was well-received, and 100 percent compliance by nurses on the unit was achieved.

Keywords: CABG, extubation, checklist

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Finally, I need to acknowledge the staff at the facility used in this DNP project. Without the cooperation of this helpful team, I would not have completed this goal. Your time and assistance helped ease my achievements in this project.

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Implementation and Evaluation of a Post-op Coronary Artery Bypass Graft Extubation Checklist to Reduce Prolonged Intubation in the Intensive Care Unit

Coronary artery bypass graft (CABG) surgeries fall under strict guidelines laid out by the Society of Thoracic Surgeons (STS). STS guidelines are the primary framework for cardiothoracic surgery patients' preoperative, intraoperative, and post-op recovery goals (Society of Thoracic Surgeons [STS], 2021). Meeting these guidelines is crucial to maintaining a cardiothoracic heart program, obtaining maximum service reimbursement, and more successful patient outcomes (STS, 2021). Among the constraints of the STS guidelines are recommendations for the extubation of patients following CABG surgery. STS states that the standard for extubation in these patients is less than twelve hours after the patient arrives in the intensive care unit (ICU) (STS, 2021). The guidelines further recommend that extubation times should be less than six hours after the end anesthesia time for the best patient outcomes (STS, 2021).

This project addresses prolonged extubation times that failed to meet the current STS guideline recommendations within a 10-bed cardiovascular intensive care unit (CVICU). During the first quarter of 2021, the selected CVICU reported average post-op extubation times greater than 17 hours for post-op CABG surgeries. This result far exceeds the STS recommendation of fewer than six hours after arrival in the unit. This project will introduce a post-op extubation checklist (See Appendix A) to be completed by heart-trained nurses on this 10-bed CVICU. The checklist will serve as a visual representation of the unit's current CABG extubation protocol, allowing the heart nurses to check through the extubation process under the guidance of the cardiothoracic surgeon and his team. By simplifying the current extubation process, the planned result is to reduce the average extubation times while meeting the STS guidelines.

Background

The hospital in question is multi-partnered with two more prominent hospital affiliations in the Southeastern United States (U.S.). The facility prides itself on providing the best quality care in the Southeastern U.S. community it serves. The facility offers 376-beds on two campuses with more than 2500 associates and 300 physicians, providing a full range of inpatient, outpatient, and emergency medicine to the patients within the community. These services include the only open-heart surgery program within the small Southeastern U.S. community.

The STS was founded in 1964 with the goal of delivering the highest quality patient care through collaboration, education, research, and advocacy (STS, 2021). The STS sets specific guidelines for thoracic surgery to ensure the best outcomes for patients undergoing thoracic and cardiothoracic surgeries (STS, 2021). Extubation guidelines for post-op CABG surgeries are among the many patient-positive goal sets established by STS programs. Prolonged intubation of patients after CABG surgery can lead to ventilator-acquired pneumonia, increased ICU stays, increased hospital stays, and increased need for extended rehabilitation after leaving the hospital (Ghiani et al., 2020). These occurrences may lead to millions of dollars in additional hospital expenses, poor patient outcomes, and increasing patient mortality rates (Ghiani et al., 2020). This background sets the need for successful, appropriate, and timely extubation on post-op CABG patients.

Needs Analysis

The project site supports a 10-bed CVICU where post-op CABG patients advance to recover from their surgeries. CABG patients bypass the post-anesthesia care unit (PACU) environment that typically recovers patients and proceeds directly into the CVICU for post-operative recovery in the unit. Heart-trained nurses receive patients by a direct handoff from the

cardiothoracic (CT) surgeon, anesthesiologist, and operating room (OR) nurse. The heart nurses begin the process of extubation after they receive handoff and assume care of the patient. This process is referred to as "end anesthesia time." The recorded time from end anesthesia time to the time the endotracheal (ET) tube is removed defines the total intubation time for each patient.

The CT surgery office manager keeps records of STS scoring and individual STS goals achieved by every CABG surgery. This data was reviewed to establish a need for intervention. In the first quarter of 2021, the unit handled one hundred twenty cases. Any intubation lasting longer than 48 hours would be considered an outlier for comparison purposes. In these instances, a patient would have been considered too unstable for rapid extubation and, therefore, would not have benefited from the Post-Op CABG Extubation Checklist. Outliers are noted in summary statistics when included (See table 1). One-hundred nine cases met the criteria for not being considered an Outlier. The average time to extubation in these cases was 11.05 hours. This average roughly equates to 11 hours and 12 minutes. Only 41 of these cases (37.6%) exhibited the recommended six or fewer hours to extubation (See table 2). Reducing the sample size once more by only including those cases lasting less than 24 hours reproduces evidence that an intervention is necessary (See table 3). The average and median for the sub-sample, which falls beneath the artificial threshold, are still substantially above the recommended six-hour limit. Therefore, comparisons of the categories were conducted over the concentrically reducing samples (All Cases, Non-Outliers, and <24 Hours). The average extubation time was 17.05 hours for all sample cases, 11.05 hours for non-outliers, and 76.52 hours for outliers. Each sample had the same null hypothesis: "the population mean is less than or equal to six hours." More precisely: H_0: $\mu \leq 6\ Hours$ H_1: $\mu > 6\ Hours$. Basic assumptions for the categories were met (all categories resulted in intubation times greater than 6 hours). A T-test was utilized to account for

population variances. The results are as follows: (See table 4). In each case, we rejected the null that the average time to extubation was less than the recommended threshold. Therefore, based on available data, the typical time to extubation is greater than recommended. This knowledge provided evidence that an intervention is necessary. Records further revealed that patients who were intubated longer than twelve hours had an ICU stay that averaged three days longer than patients extubated in less than six hours. Extended ICU stays increase the risk of poor patient outcomes, including increased risk of ICU delirium, generalized weakness due to limitations in mobility, and adverse psychological effects on the patient (Brooks, 2017). This evidence demonstrates a need for the reduction of post-op CABG extubation times.

Problem Statement

Among cardiovascular intensive care nurses, does the use of an extubation checklist, compared to the current practice of not using an extubation checklist, reduce post-operative coronary artery bypass graft intubation times in accordance with the Society of Thoracic Surgeons guidelines during a 4-week trial?

Aims and Objectives

The overreaching aims and objectives of this project are to:

1. Reduce total intubation times among post-op CABG patients.
    a. Add implementation of a checklist for extubation.
2. Educate nurses on the implementation of a checklist for extubation.
    a. Improve nursing awareness of extubation guidelines.
    b. Improve communication between nurses and the cardiothoracic surgical team using an extubation checklist.

If such conclusions cannot be reached, the aim provides evidence that these *could* plausibly occur.

Review of Literature

A literature review was performed with the following considerations: (a) Evidence-based practice for extubation of post-op CABG patients; (b) Nurse-driven checklist for extubation of patients. The findings are presented here.

The databases utilized were CINAHL, PubMed, Google Scholar, and OVID, using master and mesh headings through a scholarly search parameter. The following terms were utilized in CINAHL: nurse-driven extubation, extubation checklist, and CABG extubation, with 115 usable examples after attempting multiple combinations of the terms. The results were narrowed further by selecting peer-reviewed and modifying results to fall within the last five years, reducing the suggestions to 6 scholarly findings. The six findings were reduced by eliminating non-specific data and alternate nurse-driven suggestions.

The following key terms were used in PubMed: nurse-driven extubation, extubation checklist, and post-op CABG extubation, with 205 results. The results were narrowed by peer-reviewed while modifying results to fall within the last five years, reducing the findings to 12 relevant results. Again, the findings were reduced by eliminating non-related material.

Google Scholar was accessed using the search ques of nurse-driven extubation, nursing extubation checklist, and post-op CABG extubation checklist yielding 318 hits. The findings were reduced by applying the article's relevance to the projected question. The results were then applied to the same criteria of peer-reviewed articles and modified to fall within the last five years, reducing the results to 32.

The OVID database was searched using the terms nurse-driven extubation, extubation checklist, and CABG extubation checklist, giving 97 results. Results were narrowed by peer-review and fell within the last five-year criteria resulting in 11 articles for review. The articles were further reduced according to the application of the primary search question.

The database searches included print, guidelines and protocols, standards of practice, observations, interviews, and surveys. Some of the titles found were used to form this project and are outlined in the following paragraphs.

Implementation of a Nurse-driven Ventilation Weaning Protocol in Critically Ill Children: Can it Improve Patient Outcomes?

Duyndam et al. (2019) reviewed a process where nurses were the focus of an extubation protocol implemented for children ages 2-17 in a pediatric intensive care unit (PICU). The review outlines the use of nursing staffing driving the extubation of children with the supervision of the medical team (Duyndam et al., 2019). The study did not significantly reduce extubation times, concluding that more is needed to reduce extubation times than nursing staff and a protocol (Duyndam et al., 2019).

Weaning from Mechanical Ventilation Driven by Non-physician Professionals Versus Physicians

Arici et al. (2017) is a research paper reviewed due to its in-depth research on non-physician-based protocols during ventilator weaning and extubation trials. This paper looked at several documented cases where non-traditional staff (e.g., nurses and respiratory therapists) were allowed to take the primary seat in decisions for ventilator management and extubation without practicing outside their scope of practice (Arici et al., 2017). This objective is done by having orders in place and meeting the process step-by-step (Arici et al., 2017). The paper

showed promise in reducing intubation times, while it alarms some officials that this is too close to practice at the physician's level (Arici et al., 2017).

Implementation and Evaluation of a Pediatric Nurse-driven Sedation Protocol in a Pediatric Intensive Care Unit

Dreyfus et al. (2017) produced a nurse-driven extubation and sedation weaning protocol trial. This study followed nurses in a PICU setting as they implemented the protocol mentioned above under the supervision of the medical staff (Dreyfus et al., 2017). This study did not have the same age group as the proposed study but promised to reduce extubation times and withdrawal symptoms from sedation (Dreyfus et al., 2017).

Early Extubation after Cardiac Surgery: an Evidence-based, Nurse-driven Protocol

Brooks (2019) detailed an evidence-based practice study on the use of nursing-driven extubation measures after cardiac surgery. This study utilized the same demographic with a slightly different approach from the proposed project. The study showed that by placing a protocol followed by nursing for extubation of patients after cardiac surgery, intubation times were reduced, and patient outcomes were improved (Brooks, 2019).

Nurse-initiated Spontaneous Breathing Trials in Adult Intensive Care Unit Patients: a Scoping Review

Starnes et al. (2019) explored multiple works of literature on the usefulness of nurse-initiated breathing trials. The cumulative results of this review showed how making nurses aware of every part of an extubation protocol is key to extubation success (Starnes et al., 2019). This information added to the project's complete scope and helped substantiate the implementation's backing with an already founded and established protocol.

Decreasing Failed Extubations with the Implementation of an Extubation Checklist

Bobbs et al. (2019) was a study implementing an extubation checklist to decrease failed extubation attempts. This study suggested adding a visual aid to an existing protocol. In this case, a checklist helped reduce failed extubation attempts within an ICU setting (Bobbs et al., 2019). This article linked the preceding articles in their affirmation that protocols show promise in extubation with the idea of adding a checklist to promote understanding and compliance with the nursing staff (Bobbs et al., 2019).

Association of Checklist Use in Endotracheal Intubation with Clinically Essential Outcomes

Turner et al. (2020) presented a systematic review and analysis of using a checklist during intubations of patients. While this research followed intubations rather than extubation, it spoke of the effectiveness of checklists within the clinical setting (Turner et al., 2020). The research showed that the clinical outcomes for intubation were improved with fewer errors when a standardized checklist was used (Turner et al., 2020).

The review of literature above produced two key findings about extubating patients in a critical care setting: (a) protocols show promising results for successful extubation and reduction in intubation times; (b) the use of a visual, such as an extubation checklist, along with an established protocol made with evidence-based practice may help reduce failed extubations and prolonged intubation times. These findings have been reviewed and used to develop this DNP project.

Theoretical Model

Lewin's Theory of Planned Change was chosen to guide this project. This theory relayed that individuals are influenced by obstacles that counter-drive forces aimed at keeping the status quo (Bradshaw & Vitale, 2021). Driving forces or positive changes push forward improvement

(Bradshaw & Vitale, 2021). The planned change for this project was induced by implementing a checklist for extubation (restraining force). Hypothetically, this implementation will push forward the positive change of decreased intubation times.

Lewin's theory supports the proposed implementation of a checklist (change) by interrupting the current extubation process (obstacle) and inserting a planned change (Bradshaw & Vitale, 2021). The checklist serves as a positive breach of the current process while offering a path around the current obstacles in extubation (Bobbs et al., 2019). Current obstacles to extubation include a four-page protocol that is not easy to follow, a protocol that includes priorities for multiple levels of practice, and hard stops when dealing with expected values. The checklist simplifies the current protocol by pulling out the nursing responsibilities, allowing a flow-through process when dealing with expected values, and reducing the four-page protocol to one page with six checkboxes. Inserting the checklist as a driving force for earlier extubation utilizes Lewin's theory to decrease extubation times (Bradshaw & Vitale, 2021).

Methodology

The Plan Do Study Act (PDSA) model outlines: (a) what needed to be accomplished, (b) how to know the change provided an improvement, and (c) how to evaluate improvement (Bradshaw & Vitale, 2021). PDSA guided the project through the chosen evidence-based practice (EBP) and determined if the outcomes were achieved and desired (See Appendix B). This model challenged the accomplishment of three goals.

- reduction of intubation times
- education of heart-trained-nurses on the use of the checklist
- improved communication between heart-trained nurses and the CT surgery team

The reduction of intubation times was the main focus of this project. The time was tracked from end anesthesia to extubation before and after the project's implementation to define improvement knowledge. This goal was evaluated for improvement by comparing the average total intubation time during implementation to the average total intubation time before implementation, then comparing the results to the recommendation. Education of heart-trained nurses on using the extubation checklist was a needed goal for the project's implementation. Formal verbal and visual education was provided with a teach-back of material and a survey to assess the nurses' perspective of understanding to define improvement knowledge. The goal was assessed for improvement with successful, completed checklists during implementation. A potential goal was improved communication between the heart-trained nurses and the CT surgery team. Knowledge of improvement for this goal was the development of the extubation checklist laying out clear expectations with the guidance of the CT surgical team. A successful test for improvement was the presentation of successful, completed checklists by the heart-trained nurses collaborating with the CT surgery team and a post-intervention survey.

Setting

The unit chosen for this project was a 10-bed CVICU located in the Southeastern U.S. This CVICU supports an open-heart program with a two-star STS score. The unit averages five CABG cases per week that require CVICU placement for recovery. The focal point of this project was on post-op CABG recovery cases after they are handed off to the heart nurses up to the point extubation occurs.

Population

The population of focus was open-heart trained nurses on both day and night shifts within the unit. The unit had eight day shift heart nurses and seven night shift heart nurses. All heart

nurses were encouraged to participate in the education and implementation of this project while given the opportunity to decline without prejudice (See Appendix C). The complete team of heart nurses accepted participation, making the sample size fifteen. There is no pattern in how the nursing staff receives cases. Some nurses may take multiple CABG cases during the study, whereas others may not receive any. The nurses were not tracked individually on total extubation times; rather, the team was tracked. Each participating nurse received a post-education (See Appendix D) and post-implementation (See Appendix E) survey.

Inclusion/Exclusion Criteria for Nurses

Inclusion criteria for the study were as follows:

- day and night shift open-heart trained nurses
- full-time, Part-time, and PRN status

Exclusion criteria were:

- all unit nurses who are not open-heart trained
- travel nurses

Recruitment

The small population size of fifteen heart nurses allowed for an invitation by the primary investigator (PI) of this project. Each heart nurse received a personal verbal acknowledgment of their eligibility to participate in this project. Potential participants were also allowed to opt out at the time of their invitation. The PI answered all questions of the participants before each consent was signed. The result was an agreement by all fifteen heart nurses to consent to education and implementation of the extubation checklist.

Consent

Consent was obtained from each participant before the education and implementation of the extubation checklist. Each participant was informed that this is a student-run project with the objective of standardizing a post-op CABG extubation checklist to reduce total intubation times. The PI informed potential participants that participation in this project was voluntary and would not affect their job, income, review, or future advancement.

Design

The design of this quality improvement project utilized the skilled training of open-heart trained nurses to implement a standardized checklist for extubation after CABG surgery. The PI completed the Jacksonville State University (JSU) required modules from the Collaborative Institutional Training Innovation (CITI training) before submitting the project for IRB review (See Appendix F). Approval was obtained from JSU's IRB before initiating this project's education portion and implementation (See Appendix G). Education was provided on the checklist individually to the heart nurses who participated in the DNP project before implementation. The PI was made available for 2 hours on the day shift (8:00-10:00 am) and 2 hours on the night shift (9:00-11:00 pm) Monday through Friday the week before implementation. These opportunities allowed every participant to have an opportunity to get direct education on the checklist. Each individual was shown a completed mock checklist, instructed on completing a checklist and delivered a teach-back of the completion process. The participants also completed a survey on their perception of understanding the education and checklist.

Before implementation, a letter of support was obtained for the facility's unit director to ensure the facility's knowledge and cooperation with the DNP project (See Appendix H). The

implementation spanned four weeks. The unit was provided with the PI's contact information and encouraged to call with any questions or concerns regarding the checklist. Re-education and questions were answered as needed by the PI. Completed checklists were placed in a manilla envelope, stored via a locked cabinet in the unit manager's office, and collected by the PI every Friday during the four-week implementation. The information gathered from the properly completed checklist was submitted for statistical analysis to provide validation of the project results.

Chart Review

An individual chart review was not utilized for this project. Before IRB approval, the PI met with the CT surgery team's office manager to gather information supporting the project. This meeting revealed that the average extubation time during the first quarter of 2021 was greater than 17 hours before the exemption of outliers. Through the comparison of categories, an observation of intubation times greater than 12 hours often demonstrated increased ICU stays. The non-identifiable information collected from this meeting founded the need for this quality improvement project.

After implementing this project, the completed checklists were evaluated for a total intubation time. The total intubation time was compared to the STS goal of fewer than 12 hours and the recommendation of fewer than six hours to establish the implementation results. The checklist contained only non-identifiable information. No identifiable information was used for this project.

Risks and Benefits

This project proposed minimal risk to the participating heart nurses. Consent forms were the only documentation that listed the individual names of the participants. These forms were not

released for use in the project documentation. Survey responses were not tracked with identifying information by giving and collecting one sheet from each participant while instructing them not to place any identifying information on the survey.

This project directly followed the hospital's current post-op CABG extubation protocol. There were no deviations or changes to the currently approved protocol. The project translated the current protocol into an easy-to-follow bedside checklist. Following these approved guidelines eliminated the risk of violating hospital policy by implementing the checklist in the CVICU.

This study's benefits include better outcomes for CABG cases with reduced intubation times, clearer communication through an approved document by the CT surgeon, and improved communication between the CT surgical team and the heart nurses.

Compensation

No compensation was offered for participation in this project. Nurses were under no obligation to participate and could opt out without prejudice. Nurses were willing to participate with the perception that this checklist would help streamline their responsibility in post-op CABG extubations.

Timeline

A timeline for the project was created to establish goals for the project's completion. This timeline was followed closely to ensure proper compliance with the JSU DNP program. (See Appendix H)

Budget and Resources

No budget was established for this project. There was no compensation for participants. No expenses for resources were needed. Education was approved to be provided while participants were on their regular shifts.

Resources needed for this project included copies of the original checklist, participant consent form, and surveys. The unit manager permitted using the unit copier and paper to print the copies needed.

Evaluation Plan

The evaluation plan for this project was subject to statistical considerations and data maintenance and security. Each category was completed and detailed in the following paragraphs.

Statistical Considerations

Data researched and acquired through this project was analyzed using multiple statistical approaches. The pre-implementation, historical data reviewed was labeled through percentages, averages, and variances and displayed through a labeled chart. After charting the pre-implementation data, a T-test was performed on the charted results to produce a population variance for comparison. Post-implementation results were reviewed and labeled through percentages, averages, and variances. After implementation, a T-test was performed on the post-implementation charts to determine a population variance. A comparison of the pre-implementation and post-implementation results produced a reduction in variance (See Tables 6 & 7). The Likert scale was utilized to establish results in the pre and post-implementation nursing surveys. The results were displayed as percentages and averages through statistical charts. All the data obtained and reviewed was utilized to produce the outcomes to this DNP project's aims.

Data Maintenance and Security

Data obtained to support the need for intervention came from the CT surgery office and only contained non-identifiable information based on trends and averages from the first quarter of 2021. This data did not require special handling or security considerations.

The consent forms were completed by the heart nurses were the only paperwork that contained identifying information. These consents were not published within the project information. They are secured in a locked file box in the unit manager's office. These consents remain at the current location and will be destroyed via hospital-approved document disposal measures one year after implementation.

The checklists did not contain any identifiable information. Completed checklists were placed in a manilla envelope and stored via a locked cabinet in the unit manager's office until retrieved by the PI. This precaution was taken to ensure that the information was not altered after completing the checklists.

Results

Results from the project were comprised of the data analysis from the extubation checklist, post-education survey, and post-intervention survey. All data collected was placed into tables and subjected to rigorous statistical analysis. The results have been thoroughly reviewed, and the pertinent information has been highlighted for presentation.

Results of Chart Review

Beginning on February 28th, 2022, the Post-Op CABG Extubation Checklist was used. However, the comparison sample lasted a full quarter, and the trial period only lasted four weeks. This led to a need for additional statistical testing. Additionally, the unit did only 12 cases during the trial period. However, the physician deemed four of those cases to be too unstable to extubate

per the implementation. As previously stated, outliers are noted in summary statistics when included (See table 5).

In the "Needs Analysis" section, a discussion about a standard case in the unit being analyzed experienced longer extubation times than recommended. Therefore, using the post-implementation sample data, the analysis looked at the following:

1. Does the trial use of a checklist provide evidence of a reduction in variance?
2. Does the trial use of a checklist provide evidence that extubation times were within the recommended range?
3. If extubation times were not within the recommended range, have they improved over prior samples?

In the comparison sample, variances ranged wildly depending on the status of the case and whether extubation could be done according to the physician's orders. Only the sample of cases "<24 Hours" were used. A simple look at the data appears to provide evidence of a reduction in variance (See table 6). Using an ANOVA F-test of sample variances, the following was tested: $H_0: \sigma_1^2 \leq \sigma_2^2; H_1: \sigma_1^2 > \sigma_2^2$. Where, σ_1^2 is the variance from the pre-implementation sample, and σ_2^2 is the variance from the post-implementation sample (See table 7). A rejection of the null was applied so that the pre-implementation variance was lower or equal to the post-implementation variance (significance level 0.025). Though sample size issues persist again (See table 6), there is evidence of diminished fluctuations.

The checklists were evaluated regarding their effects on recommended total intubation times. After reducing the sample size to the eight cases that produced extubation in less than 24 hours, a t-test was conducted on the data shown (See table 8). Not knowing the population variance played into this decision again. However, the sample size limitations also played a

distinct role. The calculated average was still below the threshold. The test was then set up to see whether this provided evidence that the sample was collected from a population having an average greater than six hours. Therefore, the hypotheses are stated as follows: H_0: μ $\geq$ 6 $Hours$; H_1: μ $<$ 6 $Hours$ (See table 9). The ability was established to reject the null at the 10% significance level. The results were not sufficient to reject the null at 1% or 5% significance levels. Due to this lack of significance, it can only be concluded that there is evidence of improvement, but this test was not classified as statistically significant.

Since we cannot make conclusions about the trial at the desired significance level of less than or equal to .05, we would like to investigate whether the checklist *improved* times over prior samples. A reduction in variance has already provided some evidence towards this conclusion. However, we will test data shown on whether there has been a reduction in the sample means (See table 10). Because of these statistics' nature and unknown population variances, it was decided to use Welch's t-test. This test is practical when dealing with samples of differing size and population variances. Therefore, we wanted to test whether the pre-implementation mean would be greater than the post-implementation mean (H_0: $\mu_{Pre-Implentation} \leq \mu_{Post-Implementation}$; H_1: $\mu_{Pre-Implentation} > \mu_{Post-Implementation}$). The test statistic is calculated as follows:

$$Welch's\ t = \frac{(\overline{x_a} - \overline{x_b}) - (\mu_a - \mu_b)}{\sqrt{\frac{s_a^2}{n_a} + \frac{s_b^2}{n_b}}}$$

Where the difference in population means is assumed to be zero. Due to the complexity, Alteryx software was chosen to calculate the degrees of freedom over further handwritten tests (See table

11). The result is the statistical conclusion to the significance level of .01 that improvements in extubation times during the use of this project's extubation checklist appear to have occurred.

Results of Survey Responses

Nurses were surveyed for their confidence in the education provided and the use of the extubation checklist. Three of the five questions used a simple Likert scale that asked nurses to rank their confidence level from one (unsure) to five (confident). The remaining two questions were simple "Yes or No" questions indicating feelings towards their level of preparedness in using the checklist (See table 12). Fifteen nurses responded to this survey, with 100% identical responses (See table 13). Therefore, it is reasonable to assume that the nurses felt comfortable and prepared due to their training. However, additional objective testing could help provide further confirmation.

Following the implementation of the checklist, Nurses were surveyed concerning associated outcomes. A four-question survey using a simple Likert scale asked nurses to rank their level of confidence from one (unsure) to five (confident) (See table 14). Fifteen nurses responded to this survey. Unlike the post-education data, there is *some* variance in this data. Twelve of the 15 respondents gave identical responses to all five questions (See table 15). Though limitations exist (sample size, outcome measurement specificity, etc.), there is evidence that the checklist positively affected communication and the entire process. We cannot determine the nature of this positive effect, as this only measures the nurses' perception of communication. The post-implementation checklist contains some non-pertinent information while offering a perspective on improved communication from the RN's point of view. The addition of handwritten information in the bottom columns of the checklists is also considered a positive

sign of communication. These notes are taken at the bedside directly from the CT surgery team. Additional research could incorporate objective measurement types or larger sample gathering.

Discussion

This DNP project intended to address prolonged post-op CABG intubation times on a ten-bed CVICU. The first aim of this project was to reduce the total intubation times of post-op CABG patients by implementing an extubation checklist. The second aim was the successful education of heart-trained nurses on using the extubation checklist. The final aim of this project was to improve communication between the heart-trained nurses and the CT surgery team. Qualitative and quantitative data were utilized in the implementation and conclusion of this project.

This project utilized statistical findings to support using a post-op extubation checklist on post-op CABG cases. The findings of this project support the existing data previously reviewed to support the implementation. The statistical data show that implementing an extubation checklist decreased total intubation times. A comparison of the 2021 average total intubation time in acceptable cases to the average total intubation time of acceptable cases during implementation shows a significant decrease in the significance level of .01. Limitations in sample size and trial length question the comparison of data. After an extensive statistical review considering all limitations and variations, the result was reduced intubation times.

A survey was given to the participating nurses to establish their perception of the education and understanding of implementing the extubation checklist. Five questions were asked utilizing the Likert scale and yes/no format. A statistical review of these surveys found that 100 percent of the nurses perceived they understood the checklist and received sufficient education. Additionally, the proper completion of checklists during the implementation trial suggests that the RNs

understood the education provided. Twelve cases occurred during the trial period, and twelve extubation checklists were completed, further suggesting proper education was received.

After implementation, a survey was given to the participating nurses to establish their perception of how the extubation checklist improved communication with the CT surgery team. Four questions were asked in a Likert scale format, and the results were recorded. This survey did not receive a 100 percent consensus. By averaging the scores for each survey question, the totals show that the majority of nurses perceived the checklist to improve communication (See table 15).

Implications for Clinical Practice

This DNP project achieved the proposed aims by implementing a standardized checklist for extubation of CABG cases after arrival in the CVICU. The project aims to lower extubation times of post-op CABG cases to achieve the goal set by the STS of total intubation times less than or equal to six hours (STS, 2021).

The project shows that the current protocols need not be altered to improve extubation times. Simplifying the current protocol into an easy-to-follow checklist allows for compliance and understanding at the bedside level of CABG recovery. Similar studies have linked checklists to improving extubation outcomes (Bobbs et al., 2019; Turner et al., 2020). The combined outcomes promote the belief that checklists can help improve extubation outcomes after CABG surgery.

Implications for Healthcare Policy

Extubation after CABG surgery already has strict guidelines promoted by the STS. One of these guidelines is the requirement of CABG cases to have extubation times less than twelve hours after end anesthesia time and a further recommendation of fewer than six hours for the best patient outcomes (STS,2021). Adherence to these guidelines is essential to keep an STS-rated

open-heart program within the operation facility. Providing a way to promote safe, timely CABG extubations ensures that the community will retain its resource for these surgeries in the future.

Implications for Quality and Safety

The study shows that implementing the extubation checklist improved post-op CABG extubation times. Improvement in these times directly correlates with safer patient outcomes and improved quality of care (Brooks, 2019). Patient safety is of utmost importance within the healthcare community, while the quality of care reflects in reimbursement and community perception. Future use of the extubation checklist can help improve safety concerns while reflecting the positive quality of care.

Limitations

The project faced a few noticeable limitations during implementation and data review. The first barrier to this study was the PI becoming Covid-19 positive before the implementation process was due to start. This complication produced time constraints by reducing the trial from eight weeks to four weeks per the original plan. Another limitation was the small sample size of CABG cases completed during the four weeks of implementation. The trial produced a week where the CT surgery team completed zero cases. A small sample of twelve completed cases during the four-week implementation placed a notable limitation on the study. Patients deemed unstable by the CT surgeon were labeled as outliers. Outliers became an issue when establishing an acceptable sample size during the project's implementation process. Due to hemodynamic instability, these CABG cases were unsuitable for implementing the checklist upon arrival at the CVICU and void in the study results. Statistical variances and limitations are included in the results section of this manuscript.

Dissemination

Dissemination of this project occurred on July 15, 2022. The project was presented through a poster board and a small verbal presentation. The manuscript will be uploaded to Jacksonville State University's Digital Commons repository. All results and conclusions were presented at this time.

Sustainability

The sustainability of this intervention has been discussed with the unit manager, unit director, the CT surgery team, and the nursing informatics director. The unit manager, director, and the CT surgeon have taken further action to continue using the paper extubation checklist indefinitely. The unit manager is working with the nursing informatics team to convert the paper checklist into a power plan within the hospital's electronic medical record (EMR). The future hope is for the checklist to be initiated on the EMR with each post-op CABG case. Once the checklist is satisfied, an order for extubation will automatically generate within the EMR. The team believes that converting the checklist into the EMR will improve compliance and tracking capabilities during and after the extubation process.

Plans for Future Scholarship

The study adds evidence to supporting education and research that already exists on the implementation of a checklist for post-op CABG extubation (Bobbs et al., 2019; Turner et al., 2020). Due to the limitations discussed in this project, further research and information would be helpful to improve the findings of this implementation. A follow-up project may provide a larger sample size or a more extended period of use. These additions can further express the implementation outcomes and benefits of a post-op CABG extubation checklist.

Research can be collected and compared to assess for an increase in compliance with an electronic versus a paper checklist. This comparison could also answer whether the change in compliance affects extubation outcomes. The future conversion of the checklist into the EMR allows for future studies.

Conclusion

Recovery from CABG surgery is a team effort that requires the right tools and knowledge for the best patient outcomes. The program used in this DNP project is working to improve its post-op CABG extubation times. Post-op CABG extubation times directly affect the patients' outcomes during and after recovery. Extubation times less than six hours are recommended for optimal recovery after CABG surgery (STS, 2021). Researching tools that can help improve these times shed light on the benefits of a post-op CABG extubation checklist. When used in extubation trials, checklists have improved outcomes (Turner et al., 2020). Implementing a checklist for post-op CABG extubation standardizes the extubation process.

This DNP project created an extubation checklist based on the hospital's current extubation protocol. The one-page checklist reduced the protocol into an easy-to-follow, six-box bedside tool. This checklist proved its ease of use by producing a one-hundred percent compliance of every case during the four-week trial. Careful statistical considerations provided a positive result on the improvement of extubation times. A Welch's T-test confirmed an improvement in extubation times from 12.4182 hours to 4.59 hours to a significance level of .01 when comparing the 2021 sample to the trial period. This result was achieved with the reasonable assumption that the population variance was zero. Therefore, the statistical conclusion is that improvements appear to have occurred.

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Table 1

Pre-implementation summary of intubation times

	OBS	AVERAGE	MEDIAN	MODE	MAX	MIN	RANGE	VAR.	ST. DEV.
ALL CASES	120	17.05	9.35	5.50	109.80	2.00	107.80	465.45	21.57
NON-OUTLIERS	109	11.05	8.40	5.50	42.90	2.00	40.90	71.87	8.48
OUTLIERS	11	76.52	73.50	*	109.80	47.10	62.70	480.34	21.92
*MODE DOES NOT EXIST									

Table 2

Pre-implementation summary of intubation times continued

Time to Extubation	Count	%
≥ 6 Hours	41	37.6%
> 6 Hours	68	62.4%

Table 3

Pre-implementation summary of intubation times less than 24 hours

	OBS	AVERAGE	MEDIAN	MODE	MAX	MIN	RANGE	VAR.	ST. DEV.
< 24 Hours	103	9.55	7.6	3.5	23.2	2	21.2	33.04	5.75

Table 4

Pre-implementation summary of population variance

	Test Statistic	Result
ALL CASES	5.61*	Reject the null
NON-OUTLIERS	6.22*	Reject the null
< 24 Hours	6.26*	Reject the null

*Statistically significant at the .01 level

Table 5

Implementation Analysis of cases and intubation times

	OBS	AVERAGE	MEDIAN	MODE	MAX	MIN	RANGE	VAR.	ST. DEV.
ALL	12	*	*	*	*	*	*	*	*
NON-OUTLIERS	8	4.37	3.79	**	9.33	1.20	8.13	7.64	2.76
OUTLIERS	4	*	*	*	*	*	*	*	*
*CANNOT CALCULATE DUE TO OUTLIERS LACKING DATA									
**MODE DOES NOT EXIST									

Table 6

Reduction in population variance

	OBS	VAR.
Pre-Implementation	103	33.04
Post-Implementation	8	7.64

Table 7

Reduction in population variance continued

F-Stat	Numerator DF	Denominator DF
4.34*	103	7
*Significant at the .025 level		

Table 8

Effects on total intubation times post-implementation

	OBS	AVERAGE	ST. DEV.
Post-Implementation	8	4.37	2.76

Table 9

Effects on total intubation times post-implementation

	Test Statistic	Result
Post-Implementation	-1.67*	Reject the null

*Statistically significant at the .10 level

Table 10

Improvement in intubation times pre- and post-implementation

	OBS	AVERAGE	ST. DEV.
Pre-implementation	103	9.55	5.75
Post-Implementation	8	4.37	2.76

Table 11

Post-implementation improvement over pre-implementation samples

	Test Statistic	DF	Result
Welch's t	4.59*	12.4182	Reject the null

*Statistically significant at the .01 level

Table 12

Nursing education survey format

Question #	Question Text	Response Type
Q1	Do you understand the expectations of this project?	Likert Scale
Q2	Do you feel that you can complete the checklist as instructed?	Likert Scale
Q3	Do you feel that the education on the extubation checklist and this project is clear?	Yes/No
Q4	Do you feel this education course prepared you to participate in the project as you understand it?	Likert
Q5	Do you feel all of your questions about this project have been answered?	Yes/No

Table 13

Nursing education survey results/perception

Response Type	Q1 = 5	Q2 = 5	Q3 = YES	Q4 = 5	Q5 = YES
Response Count	15	15	15	15	15
Response %	100%	100%	100%	100%	100%

Table 14

Post-implementation nursing survey style

Question #	Question Text
Q1	Do you feel that this checklist improved communication with the CV surgery team?
Q2	Do you feel that the checklist helped to extubate patients with more efficiency?
Q3	Do you feel that the checklist improved nursing autonomy with CABG cases?
Q4	Do you feel that the checklist improved the extubation process?

Table 15

Post-implementation nursing survey results

	Q1	Q2	Q3	Q4
AVERAGE SCORE	4.73	4.93	5.00	4.93

Appendix A

Extubation Checklist

Date:_____ **Arrival Time:**_____ **Extubation Time:**_____

Post-op CABG Extubation checklist

Start implementation of extubation process upon arrival to CVICU unless otherwise instructed by CT surgery

	Ventilator weaning to 40% FIO2 and 5 of PEEP while maintaining SPO2 ≥ 90% (Respiratory will follow current protocol. Nursing to verify correct settings before moving to next step.)
	Assess level of Consciousness *Patient is able to follow commands *Patient hand grips are equal and strong *Patient can lift and hold head off of bed
	CPAP Trial for 20 minutes (Respiratory will follow current protocol. Nursing to observe patient during trial)
	Respiratory Rate > 8 and <30, BP Systolic 100-130, MAP ≥ 65, HR 60-100 bpm (Monitor heart rate, BP, PA pressures, Cardiac index, and cardiac rhythm and report abnormal fluctuations. Parameter exceptions must be approved by CT surgery team. Do not proceed if patient becomes unstable.)
	ABG Complete. Results are within normal limits as defined by hospital documentation. (Exceptions to results are determined by pre-surgical ABG and must be approved by CT surgery before continuing.)
	Negative Inspiratory Force -20 or better RSBI ≤ 80 (Exceptions to results must be approved by CT surgery before continuing.)

*Checklist must be complete before proceeding with extubation. If a box cannot be checked re-evaluate patient in 20 minutes and restart checklist. Call CT surgery if patient results are not within the defined limits or have not already been addressed by the CT surgery team. *

If checklist is complete patient meets requirements for extubation. Proceed with extubation to 4 L nasal cannula or 50% venti-mask for SPO2 ≥ 90%.

Dr. Hakob Davtyan

Pre-Surgical ABG Results:

Bedside Notes for Additional CT Surgery Instruction:

Appendix B

Methodology: PDSA Framework

Needs Accomplished: Reduce intubation times Knowledge of improvement: Track time from intubation to extubation before and after implementation Test for improvement: Compare post-implementation times to pre-implementation, then compare to recommendation	Needs Accomplished: Educate RNs on the implementation of the checklist Knowledge of improvement: Complete education and teach-back of material Test for improvement: Successful, completed checklists	Needs Accomplished: Improved communication between RNS and Surgical team Knowledge of improvement: Checklists developed for extubation with expectations Test for improvement: Successful completion of checklist and extubation through the collaboration of RNs and surgical team

Plan: Team plans action for aim, what is expected in findings, when to take place, who will complete, and where will be completed

DO: Carry out plan, document observations and problems, begin review of results

Study: Complete data review, compare to the expected outcome, Summarize what is learned

Act: Do further changes need to be made, when to carry out the next PDSA cycle, What is the next cycle

REPEAT FOR THE NEXT AIM

Appendix C

Agreement to Participate

1. Subject consent:

I have read this entire project expectation, or it has been read to me, and I understand what is being asked of me as a participant in this project. This project is expected to start in February of 2022 and be implemented for a 4-week trial. The checklist will take 20 minutes to complete per qualified case. I understand I will be asked to complete an extubation checklist on post-op coronary artery bypass graft cases that meet the current extubation protocol requirements. The cardiac surgeon will directly notate cases that are exempt from implementing this checklist. I understand that there is no risk to myself or my position on this unit indicated in this project. I understand that no identifying patient information will be included with the extubation checklist to ensure privacy. This checklist outlines arrival time, extubation time, and extubation parameters eliminating the need to access the patient's chart to complete this checklist. It is clear to me that this project will not change the current patient care or current protocol already in place by my hospital, therefore posing no risk. All of my questions about this form or this project have been answered. I understand that my participation is not mandatory and that I will not be negatively impacted if I choose not to participate. I agree to participate in this DNP project.

Participant Name:_____

Participant Signature:_____ Date:_____

2. Signature of Investigator/Individual Obtaining Consent:

To the best of my ability, I have explained and discussed the project in its entirety, including the information on this consent form. All questions of the participant have been answered completely.

Investigator/Person Obtaining Consent (printed name):_____

Signature:_____ Date: _____

Appendix D

Participant Post-Education Survey

On a scale of 1-5, with 1 being unsure and 5 being confident, please answer the following questions:

1. **Do you understand the expectations of this project? 1 2 3 4 5**
2. **Do you feel that you can complete the checklist as instructed? 1 2 3 4 5**
3. **Yes or No. Do you feel that the education on the extubation checklist and this project is clear?**
4. **Do you feel this education course prepared you to participate in the project as you understand it? 1 2 3 4 5**
5. **Yes or No. Do you feel all of your questions about this project have been answered?**

Appendix E

Participant Post-Implementation Survey

On a scale of 1-5, with 1 being unsure and 5 being confident, please answer the following questions:

1. **Do you feel that this checklist improved communication with the CV surgery team?**

   1 2 3 4 5

2. **Do you feel that the checklist helped extubate the patients with more efficiency? 1**

   2 3 4 5

3. **Do you feel that the checklist improved nursing autonomy with CABG cases?**

   1 2 3 4 5

4. **Overall, do you feel that the checklist improved the extubation process?**

   1 2 3 4 5

Appendix F

CITI Training Certificate

CITI PROGRAM

Completion Date 23-Sep-2021
Expiration Date 22-Sep-2024
Record ID 44790200

This is to certify that:

Melissa Bailey

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Social and Behavioral Responsible Conduct of Research
(Curriculum Group)
Social and Behavioral Responsible Conduct of Research
(Course Learner Group)
1 - RCR
(Stage)

Under requirements set by:

Jacksonville State University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wa6074ae8-8c45-4be2-9151-73aaf4616e8b-44790200

Appendix G

University IRB Approval

JSU | INSTITUTIONAL REVIEW BOARD
JACKSONVILLE STATE UNIVERSITY

Institutional Review Board for the Protection of Human Subjects in Research
203 Angle Hall
700 Pelham Road North
Jacksonville, AL 36265-1602

December 9, 2021

Melissa Bailey
Jacksonville State University
Jacksonville, AL 36265

Dear Melissa:

Your protocol for the project titled "Implementation and Evaluation of a Post-op Coronary Artery Bypass Graft Extubation Checklist ot Reduce Prolong Intubation in the Intensive Care Unit" 120920201-01 has been granted exemption by the JSU Institutional Review Board for the Protection of Human Subjects in Research (IRB). If your research deviates from that listed in the protocol, please notify me immediately. One year from the date of this approval letter, please send me a progress report of your research project.
Best wishes for a successful research project.

Sincerely,

Lynn Garner
Associate Human Protections Administrator, Institutional Review Board

Appendix H

Timeline for DNP Project

TASK	START	DURATION
Project planning/proposal development	6/2021	Six months
Proposal Approval by PERC	10/21/2021	Four Weeks
Obtain the Agency Letter of Support	12/2021	One week
JSU IRB Submission/Approval	12/2021	One week
Implementation	2/2022	Four weeks
Data Collection	2/2022	Four weeks
Data Analysis	3/2022	Two weeks
Writing DNP Manuscript Results, Discussion, and Implications	1/2022	Twelve weeks
Final Presentation and Dissemination	7/15/2022	One Day

2021-2022