6-2023

Performance Improvement Project Implementing Rapid Cycle Deliberate Practice Simulation to Improve Team Performance During Administration of Moderate Sedation by Non-Anesthesia Providers in the Interventional Platform

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Performance Improvement Project Implementing Rapid Cycle Deliberate Practice Simulation to Improve Team Performance During Administration of Moderate Sedation by Non-Anesthesia Providers in the Interventional Platform

A Doctor of Nursing Practice Project

Presented to the Faculty of the

School of Nursing and Health Sciences

La Salle University

In Partial Fulfillment of the Requirements for the

Degree of Doctor of Nursing Practice

By

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Doctor of Nursing Practice Program

June 2023

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Title of Doctor of Nursing Practice Project:

Performance Improvement Project Implementing Rapid Cycle Deliberate Practice Simulation to Improve Team Performance During Administration of Moderate Sedation by Non-Anesthesia Providers in the Interventional Platform

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DATE: **June 6, 2023**

Submitted in partial fulfillment of the requirements for the Degree of Doctor of Nursing Practice.

DNP Project Form F 2-Team: DNP Project Proposal Defense Approval

LASALLE UNIVERSITY

School of Nursing and Health Sciences
Doctor of Nursing Practice Program

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Performance Improvement Project Implementing Rapid Cycle Deliberate Practice Simulation to Improve Team Performance During Administration of Moderate Sedation by Non-Anesthesia Providers in the Interventional Platform
Title of DNP Project

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Project Team decision ***(informed by discussion; outcome determined by consensus)***

☒ **Pass**

☐ **Pass with minor revisions**

☐ **Pass with major revisions**

Revisions:

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10/26/2021

I dedicate this accomplishment to my fiancée Jen, who supported me through every moment of this difficult journey. And also, to my parents Mike and Nancy, as this would not have been possible without all of your love and guidance along the way.

-John

To my lovely wife, Lauren, and our three amazing children, Kaelynn, James, and Sophia, thank you for supporting me throughout this journey. My success could not have been possible without your enduring love, support, and patience.

-Matt

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Abstract

A steady increase in procedures in interventional platforms has required the administration of moderate sedation and analgesia by non-anesthesia providers. Of concern is managing the delicate balance between different levels of sedation on a continuum to ensure safe and effective care. Moderate sedation achieves suppression of consciousness while maintaining a patent airway and intrinsic respiratory drive compared to deep sedation where airway patency and respiratory function can be compromised. Administration of moderate sedation by non-anesthesia providers in interventional platforms leads to a higher rate of procedural complications. Rapid Cycle Deliberate Practice (RCDP) simulation will be utilized to educate non-anesthesia providers and to develop their crisis resource management (CRM) skills. The purpose of this performance improvement project is to implement a rapid cycle deliberate practice simulation training for non-anesthesia providers administering moderate sedation in interventional platforms to improve crisis resource management skills as determined by current evidence-based practice (EBP).

Keywords: sedation management, moderate sedation, respiratory complications, non-anesthesia provider, evidence-based practice

Performance Improvement Project Implementing Rapid Cycle Deliberate Practice Simulation to Improve Team Performance During Administration of Moderate Sedation by Non-Anesthesia Providers in the Interventional Platform

Background

Administration of moderate sedation enables clinicians to perform a variety of procedures that would otherwise be intolerable to patients when considering the pain or anxiety they may experience during procedures. Nurse anesthetists and anesthesiologists most often deliver medications to achieve analgesia and anxiolysis during procedures. However, a steady increase in procedures performed in interventional platforms has required administration of moderate sedation and analgesia by non-anesthesia providers. In these instances, sedation management is the primary responsibility of the non-anesthesia provider thus giving them a high degree of influence on patient outcomes and management of complications (Werthman et al., 2021). Of concern is the delicate balance between the different levels of sedation management and the patient's intrinsic ability to maintain a patent airway.

Moderate sedation, previously known as conscious sedation, is a state in which patients are sedated but can respond purposefully to verbal or tactile stimulation, maintain spontaneous breathing on their own, and do not require any airway interventions (American Society of Anesthesiologists [ASA], 2019). Traditional approaches for moderate sedation include administration of opioids combined with benzodiazepines for analgesia and sedation (Olsen et al., 2013). Opioids produce both analgesic and sedative effects, whereas benzodiazepines cause sedation and anterograde amnesia (Olsen et al., 2013).

Fentanyl, a commonly administered opioid medication used in moderate sedation, is associated with significant side-effects such as cardiovascular and respiratory depression (Olsen et al., 2013). Fentanyl is a relatively short acting opioid with a time onset of approximately 2 to 3 minutes and a duration of about 30 to 60 minutes, but this varies from patient to patient (Olsen et al., 2013). Since fentanyl is fast acting and has a short duration of action, this medication is a great choice for moderate sedation. Midazolam is a commonly used benzodiazepine that is administered during moderate sedation to produce a sedative and anxiolytic effect, while also producing an anterograde amnesia (Olsen et al., 2013). Midazolam is a short acting benzodiazepine with a time onset of approximately 1 to 3 minutes and a duration of action of about 1 hour (Olsen et al., 2013).

When opioids and benzodiazepines are given together by inexperienced non-anesthesia providers during moderate sedation there is a greater risk of oversedation since both medications have synergistic sedative properties. Patients may enter into a state of deep sedation where they may be difficult to arouse without vigorous stimulation leading to significant respiratory depression and cardiovascular complications (Dossa et al., 2021). It is crucial that non-anesthesia providers who administer moderate sedation be proficient with moderate sedation pharmacology, including reversal agents for opioids and benzodiazepines (naloxone and flumazenil, respectively). In addition to being familiar with moderate sedation pharmacology, the non-anesthesia provider must be trained to appropriately intervene if the patient experiences respiratory depression, which can then progress into respiratory arrest and subsequent cardiac arrest.

The sedation continuum represents varying depths of sedation and requires a healthcare professional for proper management of depth. Sedation depth varies across stages: minimal sedation, moderate sedation, deep sedation, and general anesthesia, which can progress to coma and ultimately death due to inability to maintain airway patency and ventilatory function (ASA, 2019). It is noteworthy that the thresholds of levels of sedation can be very narrow (ASA, 2019). Sedation is a dynamic process that is a continuum from consciousness to sedation which can further progress to deep sedation and even general anesthesia; it is impossible to always be able to predict how an individual will respond to sedative medications (ASA, 2019). Therefore, it is imperative that healthcare providers that seek to provide a specific level of sedation, be able to rescue the patient in the event of a more robust response from sedative medications than anticipated to prevent patient harm (ASA, 2019).

When moderate sedation is administered by non-anesthesia providers, sedation-related complications increase in specific clinical settings (Urman et al., 2019). This increase in sedation-related complications creates a medical crisis that places patients in a potentially dangerous situation. It is crucial that non-anesthesia providers who administer moderate sedation are adequately trained to administer sedatives safely, to monitor patient status for potential adverse effects, and to intervene promptly to prevent safety threats and complications (ASA, 2019). Through education and simulation, the non-anesthesia providers will be prepared with crisis resource management (CRM) skills to better detect adverse complications from sedation management and be able to mitigate patient harm.

The shortage of qualified anesthesia providers and the cost containment strategies of healthcare systems have been associated with an increase in non-anesthesia personnel administering sedative medications to induce moderate sedation. Likewise, moderate sedation-related complications have increased when providers are not certified anesthesia providers with competencies in extensive airway management (Abram, 2018). Therefore, it is important that non-anesthesia providers learn appropriate airway maneuvers to prevent airway obstruction and stimulate the patient to breathe on their own to mitigate sedation related respiratory complications.

With the increase in non-anesthesia providers administering sedation to patients in interventional platforms, specific competencies need to be met to mitigate patient harm. The target depth of sedation used in these settings is moderate sedation, but with a narrow threshold it is possible to over-sedate patients and transition into deeper levels of sedation where respiratory complications are more common. There is an inherent risk for complications when administering sedative medications, but through education and simulation training the risk can be reduced (Sauter et al., 2016).

Urman et al. (2019) demonstrated that up to 4.7% of all patients that received moderate sedation in interventional radiology (IR) developed sedation related respiratory complications, which cost nearly $7,000 per adverse event along with a 27.1% increase in mortality for this patient population. An increased risk of respiratory complications was reported in patients with sleep apnea, increased age, and opioid therapy. Therefore, respiratory complications from moderate sedation are associated with negative clinical outcomes for patients and increased expenses for healthcare institutions (Urman et al., 2019).

When moderate sedation is administered by non-anesthesia providers in interventional platforms, sedation-related complications and death may occur if not promptly identified and managed appropriately (Amornyotin, 2015). This medical crisis that arises from sedation administration from non-anesthesia providers jeopardizes patient safety and needs to be mitigated to prevent sedation-related complications. Health care providers that administer moderate sedation in these platforms might benefit from crisis resource management skills.

Based on serious patient safety risks, non-anesthesia providers should meet specific competencies in pre-procedural assessment, monitoring, drug selection/administration, post-procedural recovery, and management of potential complications to deliver safe moderate sedation to patients (American Association of Nurse Anesthesiology, 2016). Through Rapid Cycle Deliberate Practice (RCDP) simulation, non-anesthesia providers will be exposed to specific simulation scenarios related to sedation management, where the learners will receive in-the-moment feedback throughout the simulation for immediate incorporation of feedback given. At this time, there is no single standardized method of measuring outcomes of CRM training; therefore, this performance improvement project will incorporate current evidence-based practice with RCDP. The ASA Task Force created practice guidelines for moderate procedural sedation and analgesia in 2018, which correlates both literature findings and survey findings to support scientifically evidence-based recommendations for procedural moderate sedation and analgesia (ASA Task Force, 2018).

Problem Statement

Moderate sedation is regularly administered in the interventional platform as demand for minimally invasive procedures continues to grow. However, even though it is a routine intervention it is not without potential for significant complications resulting in patient harm. The clinician managing moderate sedation in this setting has an influential effect on patient outcomes and needs to be sufficiently trained in rescue interventions such as airway management, usage of supplemental oxygen, and potential administration of pharmacologic reversal agents (Werthman et al., 2021).

Due to a shortage of licensed anesthesia providers and the cost containment strategies of healthcare systems, there has been an increase in administration of moderate sedation by non-anesthesia providers in the interventional platform. Administration of moderate sedation by inadequately trained non-anesthesia providers can result in a spectrum of complications such as cardiopulmonary compromise, agitation, long recovery times, and incomplete procedures (Werthman et al., 2021). Consequently, there is concern for a medical crisis as administration of moderate sedation by untrained non-anesthesia providers in the interventional platform results in a higher incidence of procedural complications seen by poor clinical outcomes for patients and increased costs for healthcare institutions (Urman et al., 2019).

Needs Assessment

As part of an ongoing mock code Quality Improvement (QI) initiative at a small community hospital in the northeastern United States, a consult was placed by the interventional platform nurse manager to the hospital's simulation team. The goal was to conduct a simulation scenario based on non-anesthesia provider administration of

moderate sedation in the Interventional Radiology (IR) setting. For the simulation, two Certified Healthcare Simulation Educators (CHSE) were sent to the facility with the necessary simulation equipment and a Gaumard HAL S-1000 high-fidelity simulation mannequin in the fall of 2019. The simulation mannequin was placed on the interventional procedure table connected via Bluetooth to the simulation monitor with initial vital sign data. Initial vital signs were heart rate 90 bpm, blood pressure 101/64, and oxygen saturation 99% on room air.

Although the simulation was unannounced to the IR staff, a comprehensive pre-brief was performed prior to initiation. The simulation scenario consisted of a routine cardiac catheterization procedure with Registered Nurse (RN) administered moderate sedation. During the procedure, the attending physician ordered a cumulative total of 2.5 mg of midazolam and 100 micrograms of fentanyl to be administered incrementally throughout the procedure for patient pain and agitation. At approximately 8 minutes into the procedure, the patient became unresponsive, apneic, and hypoxic with an oxygen saturation of 72% on room air. This was evidenced by changes in the high-fidelity simulation mannequin's behavior and vital signs displayed on the monitor.

The scenario progressed noting the following inadequate actions and patient deterioration over a three-minute period of time. Level of consciousness was not addressed by the staff while oxygen saturations trended downwards from 98% to 72% over a 90-second period during the simulation with no concurrent attempts to check the airway, evaluate respiratory effort, apply supplemental oxygen, or ventilate the patient with a bag valve mask during resuscitative efforts. A lack of situational awareness during the simulated oversedation event resulted in poor closed-loop communication

between both the attending physician and the nursing staff with no attempts to pharmacologically reverse the effects of the midazolam or fentanyl with the corresponding agent. After the scenario, a comprehensive team debriefing session was conducted. Recommendations were made by the simulation team for repeat simulation scenarios to be conducted and additional education to be provided to the staff based on sedation management and sedation-related procedural complications. These recommendations were based on a lack of delegation of tasks during an airway emergency that resulted in an airway obstruction, inability to reestablish a patent airway, and a prolonged period of apnea.

Purpose Statement

The purpose of this Doctor of Nursing Practice project was to develop a performance improvement project to implement RCDP simulation training for non-anesthesia providers administering moderate sedation in interventional platforms to improve CRM skills through current evidence-based practice. The project will consist of educational video modules focusing on moderate sedation pharmacology, airway management techniques, and application of evidence-based interventions through RCDP training in a recorded over-sedation video simulation scenario. Content validity index scores will be evaluated by two groups of content experts: group 1 will evaluate the anesthesia content such as moderate sedation pharmacology and airway management, while group 2 will evaluate the simulation content that will incorporate RCDP simulation training.

Project Question

The project question is: Will an educational program consisting of sedation pharmacology, airway management techniques, and a RCDP over-sedation simulation improve CRM skills for the non-anesthesia providers who administer moderate sedation in the interventional platform?

Conceptual Definitions

The following definitions structure this performance improvement project:

Non-anesthesia providers: Licensed registered nurse and physician healthcare providers that have no formal education in the field of anesthesiology, which encompasses sedation management and airway management techniques to prevent safety threats and complications in patients receiving sedative medications.

Interventional platforms: non-surgical areas in which procedures are performed by various licensed healthcare professionals that require the use of moderate sedation by non-anesthesia providers.

Procedural complications: adverse effects that occur to patients that are directly related to sedative medications given during medical procedures. Examples of procedural complications related to sedation could include hypoventilation, hypoxia, hypotension, and ultimately death.

Rapid Cycle Deliberate Practice (RCDP): simulation-based technique in which learners who participate within specific simulated experiences receive continuous, in-the-moment feedback while participating in the simulation as compared to receiving post-simulation feedback (Peng & Schertzer, 2021). By using RCDP,

the learner is equipped to incorporate immediate feedback to improve throughout the simulation in a dynamic learning process.

Evidence-Based Practice (EBP): a problem-solving approach that utilizes the best scientific evidence available with clinical expertise to guide clinical decision-making to improve quality of care and patient outcomes (LoBiondo-Wood & Haber, 2021).

Crisis Resource Management (CRM): a team-based approach to detect potential medical adverse effects and to mitigate medical crises through following predefined teamwork principles (Lei & Palm, 2021).

Sedation: a drug-induced suppression of consciousness that is measured on a continuum related to patient responsiveness and ability to maintain airway reflexes, spontaneous ventilation, and cardiovascular function (ASA, 2019). It is imperative to understand that the effect of sedation is individualized to each patient and that the intended level of sedation can become deeper, continuing down the continuum of sedation causing potential procedural complications. Four levels of sedation are defined by the ASA (2019).

Minimal sedation: the first level of sedation on the sedation continuum. Minimal sedation is a drug-induced suppression of consciousness in which a patient can respond to verbal commands with no impairment to airway reflexes, spontaneous ventilation, or cardiovascular function (ASA, 2019).

Moderate sedation: the second level of sedation on the continuum is often referred to a previously used term known as conscious sedation. Moderate sedation is conceptually defined as a drug-induced suppression of consciousness

in which the patient can respond purposefully to verbal commands or tactile stimulation, while having no impairment to airway reflexes, spontaneous ventilation, or cardiovascular function (ASA, 2019).

Deep sedation: the third level of sedation on the sedation continuum. Deep sedation is defined as a drug-induced suppression of consciousness in which the patient can respond purposefully to painful stimulation, but airway reflexes and spontaneous ventilation may be diminished and may require clinician assistance (ASA, 2019). Cardiovascular function is generally maintained with deep sedation.

General anesthesia: the fourth level of sedation on the sedation continuum. General anesthesia is conceptually defined as a drug-induced loss of consciousness in which patients are not arousable even with painful stimulation. Additionally, airway reflexes and spontaneous ventilation are often inadequate and require clinician assistance, cardiovascular function may be diminished also (ASA, 2019).

Review of the Literature

Search Process Methods

The preliminary search results yielded a total of 2,218 articles from the following 8 databases: La Salle University's Summon, Cochrane Library, Joanna Briggs Institute, Google Scholar, CINAHL, Medline, PubMed and ProQuest Dissertations & Theses Global. The keyword search terms used in this literature search included: moderate sedation and interventional with the Boolean operator "AND", and non-anesthesia with the Boolean operator "OR" which allowed for a narrowed down pool of relevant articles based on title, abstract and inclusion criteria. Inclusion criteria for selected research

articles included peer reviewed full-text articles in English that were published between 2016 and 2022. After title review, 5 articles were noted to be duplicates and were omitted from the search process review matrix (See Table 1). The omitted articles were from CINAHL and Google Scholar databases; CINAHL yielded 2 duplicate articles and Google Scholar yielded 3 duplicate articles. After review of titles, there were a total of 116 articles left in the search query. Upon review of the 116 abstracts, 108 articles were eliminated from the following databases for not meeting inclusion criteria: La Salle Summons (n=2), Google Scholar (n=22), CINAHL (n=8), PubMed (n=54), and ProQuest Dissertations & Theses Global (n=22), leaving a total of 8 articles that met inclusion criteria. The remaining 8 articles were analyzed both in a narrative format as well as a matrix format (See Table 2). All articles were analyzed and appraised on a hierarchy of evidence and quality through utilization of the Johns Hopkins Nursing Evidence Level (I-V) and Quality (A-B-C) Guide.

Appraised Studies

Dossa et al. (2021) conducted a systematic review of sedation practices in gastrointestinal (GI) endoscopy settings to formulate recommendations for best practice due to significant variability across international hospital settings. A PubMed search was conducted between 2005 and 2019 identifying 32 articles that met inclusion criteria; ultimately, 19 clinical practice guidelines and seven position statements were included. Protocol for this systematic review was developed according to the PRISMA-P checklist and included guidelines and position statements for adult patients aged greater than 18 years old who were undergoing elective gastroscopy and/or colonoscopy procedures. Within the selected clinical practice guidelines and position statements the following

were evaluated to determine best practice; choice of sedatives, sedation administration practices, personnel responsible for monitoring sedated patients, skills and training of individuals involved in sedation, and equipment required for monitoring sedated patients. No framework was identified for this systematic review.

Findings from this systematic review indicated that there was no general consensus on choice of sedative used, optimal depth of sedation, or use of capnography. Recommendations were consistent for routine use of pulse oximetry and non-invasive blood pressure monitoring. It was consistently recommended that non-anesthesia providers have adequate knowledge of pharmacology for sedatives used, training for how to respond to sedation-related complications, and at least Basic Life Support (BLS) certification. Two limitations of this review were that most articles scored poorly on the AGREE II assessment tool and that some of the articles evaluated were vague in clarity of content (whether they were practice guidelines or simply a review of literature) so they may have been misclassified. In regards to implications for clinical practice, this review indicated that current guidelines largely agree that a non-anesthesia provider may administer moderate sedation for routine interventional procedures under the supervision of an attending physician given that the non-anesthesia provider is adequately trained, and their main focus is only on sedation administration and monitoring of the patient.

Werthman et al. (2021) conducted a prospective observational study to evaluate the differences in hospital-mandated education and training for non-anesthesia providers administering moderate sedation in the IR platform. Data collection was performed via a quantitative, cross-sectional, descriptive 26-question survey conducted in 2018. Of 510 surveys sent to IR administrators throughout the country, a response rate of 16% (n=82)

was achieved. The survey was focused on hospital-mandated moderate sedation training for non-anesthesia providers prior to receiving sedation administration privileges, use of specific resources for moderate sedation training, training requirements after initial moderate sedation administration privileges were obtained, certification and clinical experience requirements of the provider, and highest nursing degree obtained. The framework used was the Minnick and Roberts Outcomes Production Model.

Study statistics were analyzed using IBM SPSS Statistics. Statistics for the data obtained included frequency distributions, means, standard deviations, medians, interquartile ranges, chi-square, and Mann-Whitney tests with a statistical significance value of $p<0.05$. Ninety-four point nine percent of respondents reported training was required for RNs prior to receiving moderate sedation administration privileges and 79.7% reported requirements for annual moderate sedation training. The most common training methods used included hospital-developed written material (86.3%), online training modules (82.7%), and verbal instruction (79.1%). Over 97% of training programs addressed specific needs such as pre-sedation evaluation, administration of moderate sedation, and rescuing patients from oversedation. One hundred percent of hospitals required at least Basic Life Support (BLS) training for RNs administering moderate sedation, while 97.4% required Advanced Cardiac Life Support (ACLS) training and 17.9% required critical care nursing certification (CCRN). Previous clinical experience as an RN was reported in 90% of respondents with a median length of 2 years (IQR 2.0, 3.0) with 51.4% reporting previous experience as a critical care RN. Registered nurses had primarily obtained a bachelor's degree in nursing (BSN) (median 60.0%, IQR 45.8, 86.1) followed by an associate degree in nursing (ADN) (median

14.3%, IQR 0.0, 44.0). Limitations of the study include low response rates limiting the overall generalization of findings, a potential for selection bias, and accuracy of questionnaire responses could not be verified. As rates of moderate sedation administered by non-anesthesia providers in non-operating room settings continues to rise, this study demonstrates the continued need for adequate education and training for RNs pertaining to the safe administration of moderate sedation.

Keegan et al. (2020) conducted a study to compare outcomes of patients that underwent minimally invasive transcatheter aortic valve replacement (TAVR) in interventional cardiology with moderate sedation by catheterization laboratory nurses versus a dedicated anesthesia team. The researchers conducted a retrospective observational study by extracting information from an institutional medical database for patients that underwent a TAVR procedure from 2012 to 2017. All patients were screened using the American Society of Anesthesiologists (ASA) Score > 4 and Mallamapati score > 2 were referred to the anesthesia department for evaluation to determine if the patient was a candidate for general anesthesia. Exclusion criteria were patients that underwent a TAVR procedure with general anesthesia. The remaining sample of patients that received minimally invasive TAVR procedure were divided into two groups: nurse-led sedation (NLS) or anesthesiology-led sedation (ALS) based on which provider administered the sedation. A total of 1092 patients met the inclusion criteria, 807 in the NLS group and 285 in the ALS group. The researchers matched patient characteristics using a 2:1 propensity score, which yielded 407 patients in the NLS group and 243 patients in the ALS group.

Statistical analysis was performed utilizing a propensity score for each patient. This was created using a logistic regression model and two groups with similar propensity scores were matched in a 2:1 fashion. The two groups were compared with two sample t tests for continuous outcomes and the chi square test for dichotomous outcomes. Clinical outcomes demonstrated that in the NLS group patients that converted to general anesthesia was 2.2% compared to the ALS group which was 0.8% ($p = 0.22$), which was not statistically significant. Both sedation groups had similar results of patients that required conversion to open surgery 1.0% for the NLS group and 0.8% for the ALS group ($p = 0.99$) also demonstrating no statistical significance. Survival to discharge was very similar between the two groups at 98.3% in the NLS group compared to 100% in the ALS group, $p = 0.05$, it is important to note that the deaths in the NLS group was not related to moderate sedation but complications of the TAVR procedure itself. The NLS group had statistically significant results in reduction of procedure time (NLS: 138 minutes vs ALS: 160 minutes) $p < 0.01$, contrast volume (NLS: 115mL vs ALS: 150mL) $p < 0.01$, and length of ICU stay $p = 0.003$. Keegan et al. (2020) demonstrated that nurse-led moderate sedation can be performed safely where patient outcomes are similar to anesthesia-led moderate sedation, there was no difference in 1 year readmission or death between NLS and ALS groups, and that NLS is associated with less ICU length of stay and procedural time. Keegan et al. (2020) explained that training nurses was a high priority and the reason for NLS success which was demonstrated in this study. Although the study was 2:1 propensity matched, the study's limitation is that the study is a single-center, non-randomized, retrospective study within an experienced TAVR institution which decreases generalizability of the study. Another limitation of the

study, which the author did not mention, is the potential for bias. There is no discussion of potential selection bias regarding the nurses being assigned to certain cases and, similarly, the anesthesia providers being assigned to certain cases. In fact, case selection was not discussed at all as the data was obtained through a search feature. The implications of this study demonstrate that with adequate knowledge and training, nurses are able to provide safe and effective moderate sedation in many platforms.

Judd and Warner (2019) evaluated the use of specialized registered nurse sedation teams (RNST) for procedures that require moderate sedation. The Mayo Clinic developed a moderate sedation team composed of registered nurses to administer moderate sedation on general care units. Since moderate sedation is associated with inherent risks that could lead to increased morbidity and mortality rates, it is important for nurses who administer moderate sedation to maintain competency in sedation education and in airway assessment and management techniques. Through collaboration of anesthesiology and nursing leadership, nurses (n =10) were selected to gain additional knowledge of moderate sedation through didactic and clinical experiences. Didactic classes were composed of sedation competency requirements, airway assessment and management techniques, obstructive sleep apnea screening assessment, end tidal carbon dioxide (ETCO2) capnography monitoring, and documentation of moderate sedation. Clinical experience was obtained when the selected nurses were paired with nurse anesthetists in high volume operating rooms to learn and master airway assessment, management, and rescue techniques. After obtaining didactic education and hands-on airway management skills, the RNST nurses participated in sedation simulation scenarios where airway rescue skills could be employed. Data was collected from the patients'

electronic medical record through a retrospective chart assessment and recorded 18 required fields. Notably, six quality indicators were analyzed; use of any reversal agents, any sedation complications, any admission to a higher level of care, oxygenation saturation < 90%, cardiac arrest, and patient death. A quasi-experimental post-test design was used with nonequivalent comparison groups (Judd & Warner, 2019). No framework was identified for this study.

In the 3-month retrospective chart review, a total of 180 data items from 10 patient charts were extracted from the chart assessment which demonstrated pre- and post-RNST percentage agreement of 95.6% and 99.4% respectively. All data was analyzed by SAS Version 9.2. Mean and standard deviation were analyzed for continuous data and a paired t-test was used to compare mean calculated documented items for each patient. Fisher's exact test was used to compare between the two groups (pre- and post-RNST implementation) and p-values ≤ 0.001 were considered statistically significant due to the number of comparisons made in this study. A total of 103 patient records met the inclusion criteria for the 3-month pre-implementation and 96 met inclusion criteria for the 3-month post-implementation RNST review. After completion of the pilot study, the RNST was implemented throughout the entire hospital on all general care units and during a seven plus year period from 2010 to 2018, 45 out of 4,009 patients (1.1%) with the RNST model experienced at least one complication as compared to six out of 103 patients (5.8%) in the pre-implementation group, which demonstrates a statistically significant ($p < 0.001$) improvement in frequency of adverse complications. Several limitations were noted by the researchers in this study such as technical difficulty during the beginning of the study and manual entering of vital sign documentation

opposed to automatic linking of vital signs to electronic medical records. This study supports the use of a team of sedation nurses to be utilized in hospitals where there are low volume sedation practices to improve patient safety. Lastly, this study demonstrates the need for adequate sedation education, airway management techniques and simulation exercises to improve patient outcomes.

Urman et al. (2019) conducted a retrospective study to quantify the economic and clinical burden involving respiratory compromise for inpatient interventional radiology procedures while also identifying associated risk factors. Data was obtained from 853 hospitals and the sample consisted of 525,151 patients who had a primary interventional radiology procedure utilizing moderate sedation between October 2012 and September 2015. Data was collected using a Premier Discharge Database. Inclusion criteria specified that the patient required inpatient interventional radiology procedure, was 18 years of age or older, did not have a pre-existing diagnosis, and did not have same-day anesthesia or sedative use. Exclusion criteria include individuals under the age of 18 years, pre-existing respiratory or cardiac arrest, pre-existing chronic or acute respiratory failure, interventional radiology procedural reports that were missing data, and same day use of sedatives or anesthesia cases. There was no conceptual framework identified. Data was analyzed with four defined cohorts. These predefined cohorts included all patients, relative value unit (RVU) <2, RVU 2-6, and RVU >6. The RVU indicated the complexity of the procedure. Statistical analysis was performed by utilizing SAS version 9.4 for Unix.

The study analysis of the predictors associated with respiratory compromise, the all-patients group demonstrated that there were several predictors: age (65 years of age

and older) (OR: 1.4; $P < 0.001$; 95% CI: 1.3, 1.5), sleep apnea diagnosis (OR: 1.3; $P < 0.001$; 95% CI: 1.1, 1.4), and history of long-term therapy for opioids as well as active issues surrounding substance abuse (OR: 2.7; $P < 0.001$; 95% CI:2.4, 3.0). Analysis of the various outcome measures revealed that patients exhibiting respiratory compromise were associated with higher costs, length of hospital stay, ICU admission rates, invasive mechanical ventilation, and death compared to patients without respiratory compromise. The mean associated with the cost for admission was $6,904 more for patients associated with respiratory compromise ($P < 0.001$); patients with respiratory compromise had longer mean hospital stays (an extra 1.1 days in the all-patients group ($P < 0.001$), patients demonstrating respiratory compromise were more likely to be admitted to the ICU (69.7% in the all-patients group vs. 25.5%, respectively ($P < 0.001$), patients with respiratory compromise were more likely more likely to have invasive interventions of mechanical ventilation 33.6% in the all-patients group vs. 1.6% respectively ($P < 0.001$), and an overall death rate was also evaluated to be 27.1% vs. 3.2%, respectively ($P < 0.001$). Several limitations were noted by the study authors including the timing and amount of sedatives that were administered, intraprocedural monitoring, under-coding errors, coding errors, physical status classification by the American Society of Anesthesiologists, driving forces influencing costs, operator experience, causality of events, timing of events, and respiratory events that were not captured on the database. Using a keyword search to distinguish between anesthesia and moderate sedation could have affected the identification of patients. Cause-and-effect relationships were not able to be established and only observational associations were identified. Urman et al. (2019) demonstrates the need for pre-assessment of risk factors and the need for

procedural monitoring to reduce the economic and clinical burden as well as improve the health outcomes of patients.

Jones et al. (2018) conducted a retrospective review from 2005 to 2017 at Brigham and Women's Hospital, a single tertiary care center, to evaluate clinical factors that led to adverse events during moderate sedation during interventional procedures. Patient and procedural data were collected, along with the nature of adverse events during moderate sedation. Patient data included age, sex, body mass index (BMI), comorbidities, and ASA classification. Procedural data included medical specialty, location of procedure, and if the procedure was emergent. The nature of adverse events included classifications based on severity of patient harm, most common procedural complications, and most common necessary interventions. In this review, 106 adverse events were identified and 83 met inclusion criteria. No framework was identified for this study.

Study statistics were analyzed using Strata 13.0 software. Univariate descriptive statistics were calculated; percentages were used for categorical variables and mean/standard deviation for continuous variables. Bivariate relationships between adverse events and patient/procedural data were analyzed by Fisher's exact test (for all categorical variables) and two-tailed t-tests for differences in means of continuous variables (BMI and age). The most common adverse events related to moderate sedation included oversedation (60.2%), hypoxemia (42.2%), aspiration (24.1%), and patient pain or discomfort (9.6%). The most common interventions required were use of pharmacological reversal agents (55.4%), apnea requiring prolonged bag-mask ventilation (25.3%), inability to complete the procedure (16.9%), unplanned hospital

admission (12.2%), and intubation to secure the airway (6.0%). The most common healthcare provider related factors associated with adverse events were miscommunication within the care team (28.9%) and no moderate sedation certification attained by the provider (9.6%). Patients with a higher BMI had a statistically significant increase in rate of adverse events with a p value of 0.016. Patients who required the use of pharmacologic reversal of sedation were older, on average, compared to those who did not (62.8 years compared to 55.7 years, p=0.08). Female patients and those with more comorbidities had higher overall rates of adverse events during moderate sedation. A limitation of this study is a small sample size, although the authors suggest that the sample is large enough to allow for generalization to similar tertiary care centers. Other study limitations include a potential underreporting of adverse events and a change in mandatory patient monitoring modalities during the study time frame. This study demonstrates both the deficiencies within a healthcare system as well as specific patient characteristics that can lead to adverse events during moderate sedation administered in interventional platforms.

Tuck et al. (2018) conducted a quality improvement project to evaluate educational interventions that would assist IR nurses administering moderate sedation in their perceived importance, competence, confidence, and satisfaction. The study utilized a pre/post survey intervention design to assess changes in nurses' perceived importance, competence, confidence, satisfaction, and knowledge in administering moderate sedation after completion of an online educational program by the American Association of Moderate Sedation Nurses (AAMSN) and an airway management practicum with an anesthesia provider. The anesthesia provider that worked with the IR nurse between pre-

and post-educational interventions was either an anesthesiologist or a CRNA. A convenience sample was obtained that consisted of all IR nurses (*n*=24) that perform moderate sedation during interventional procedures in a single center facility. Exclusion criteria were identified as IR nurses that did not administer moderate sedation. The subjects of the study were all given the option to withdraw if they did not want to participate, and all eligible IR nurses (*n*=24) chose to participate in the study. The researchers used Roger's Diffusion Innovation Theory as a framework to create a comprehensive educational training program in which the researchers assigned a code to each subject to maintain privacy and confidentiality. All subjects of the study completed a pre- and post-educational intervention survey, which consisted of a 49 item four-point Likert scale questionnaire (0 [strongly disagree] to 4 [strongly agree]) to assess their perceived importance, confidence, competence, satisfaction, and outcomes with administration of moderate sedation. The survey was then reviewed by five internal moderate sedation experts.

The researchers used independent-sample t tests to compare change in mean test scores of IR nurses administering moderate sedation between two groups (pre-intervention and post-intervention). Statistical results were obtained using Stata Statistical Software with statistical significance (two-tailed) determined using a p value ≤ 0.05 (Tuck et al., 2018). The study demonstrated a statically significant improvement in knowledge with mean test scores between pre-education and post-education from 69.7% to 92.7% ($p < 0.001$) respectively. Perceived confidence in all subjects revealed $p < 0.001$ in airway management after 1:1 training with anesthesia providers. Both the AAMSN online education and anesthesia airway management training interventions revealed a

statistically significant finding in confidence in moderate sedation management for patients with various comorbidities with p values ranging from 0.002 to 0.019. The only data point that was shown to not be statistically significant was competency in monitoring equipment, which demonstrated a p value of 0.069, which seems logical since the subjects use the monitoring equipment daily when administering moderate sedation. Limitations identified by the researchers include variation in clinical cases which afforded some subjects to have more hands-on experience with several airway management techniques, differences in airway management techniques taught from anesthesia providers, and not all educational modules performed by the subjects were able to be completed in one time-period. The implications from this study support the need to standardize evidence-based orientation to improve quality of care and the researchers recommend a comprehensive approach in training staff with educational modules, airway management, and utilization of monitoring equipment for the use of moderate sedation.

Sauter et al. (2016) conducted a single center QI project with a pre- and post-test design with the goal to evaluate viability of interprofessional training sessions to improve sedation practices and CRM strategies with the goal of improved patient outcomes. The intervention followed the format of an initial self-study handout given to participants, a 30-minute didactic lecture, simulation-based team training, a basic airway skills workshop, another simulation-based team training, followed by deliberate practice of newly learned skills. The QI project was implemented in 2015 and the setting was Berne University Department of Emergency Medicine in Switzerland, which typically has over 42,000 admissions per year. A total of 50 emergency medicine personnel participated in

this QI project; 26 nurses and 24 physicians, two of which had prior anesthesia training. Pre- and post-intervention questionnaires based on an 11-point Likert scale were used to measure the following; self-efficacy, awareness of emergency procedures, knowledge of sedation medications, and CRM. To assess the clinical impact of this QI project, patient satisfaction, response team satisfaction, and sedation related complications were recorded for one year post intervention. Data from this project was also compared to data from the Berne University department of anesthesiology to evaluate differences in outcomes of moderate sedation based on which care team it was administered by. Time to procedure start, duration of the procedure, and time to patient discharge were the main focus specifically for patients who required moderate sedation for shoulder dislocations. This QI project was based on Smith's Principles of Patient Safety.

Statistics from this QI project were analyzed by IBM SPSS Statistics 21 software. T-tests and Fisher's exact tests were used to evaluate participants age, years of experience, gender, and profession. Paired sample Student's t-tests were used to compare self-assessment of knowledge and confidence. Differences between emergency department and anesthesia department administered sedation were evaluated using Mann-Whitney-U tests for unrelated samples and patient characteristics (such as ASA classification) by univariate ANOVA. A p value of <0.05 was used for statistical significance. Cohen's d was calculated for effect size to determine statistically significant tests in unrelated samples and Cohen's d_z was used for related samples. Post-intervention, there was a significant increase in participant self-efficacy ($p<0.01$), situational knowledge of medications used for sedation ($p<0.01$), and an increase in self-assessment regarding knowledge of CRM skills ($p<0.01$) with a large effect size ($d_z =$

1.8). In 2015, the emergency department administered moderate sedation 43 times with an average time to procedure of 144 minutes (SD 146 minutes), an average time to discharge of 387 minutes (SD 255 minutes), and with 4 patients experiencing a sedation related complication; the most common need for sedation was a shoulder dislocation (n=19). Compared to similar data from 2014 when sedation given in the emergency department was administered by the anesthesia staff, there was no significant difference between time to discharge or time required for the procedure. There was a statistically significant difference in time to procedure ($p=0.02$, $d=0.88$). There were no major complications noted in the clinical evaluation that lasted for one year following implementation of this QI project. Limitations of this QI project is that data obtained was only via self-assessment with no objective indicators of acquisition of new knowledge and a small sample size. This study is relevant to clinical practice because it shows how interdisciplinary education and simulation-based training can improve CRM skills and knowledge of moderate sedation administration in a non-operating room environment by a non-anesthesia provider.

Related Literature

Werthman et al. (2020) described parameters surrounding moderate sedation within adult-centered interventional radiology services. Parameters included provider type present during IR cases involving moderate sedation, total volume of cases, moderate sedation privileges, and percentage of sedation administration noted by provider type. The authors performed a prospective observational study to determine administrative variables in interventional radiology. A survey was developed based upon the Minnick and Roberts Outcomes Production Model, which sought to identify a

relationship between health service-related concepts and patient outcome influences. A survey was sent out to a diverse sample of practicing radiologic administrators throughout the United States (510 administrators). Data collection was reliant upon final response rates (82 respondents out of 510 survey requests). Inclusion criteria specified radiologic administrators were to be targeted for a nationwide, cross-sectional survey between May 2018 and July 2018. Exclusion criteria included undeliverable mail, facilities with no current interventional radiology services, and those that declined participation.

Results of the survey revealed a median value of interventional radiology cases that were completed within the year prior (2,656.5), a median value of patients who received moderate sedation (1500) and a median value reporting that registered nurses were responsible for the administration of sedation to adult patients (90.0%). Other providers that were present included a procedural nurse (98.7%), a radiologic technologist (97.0%), anesthesiologists (88.9%), a certified registered nurse anesthetist (CRNAs) (78.6%), a resident (65.5%), fellow (61.3%) a nurse practitioner (58.5%) or a physician assistant (58.5%). Overall, practice variability was noted. Variation was noted regarding sedation medications that were used, differences among training between physicians or nurses involved in the sedation procedures, and the availability of the nurses to administer sedation. Provider type was also variable. Registered nurses were noted to administer a higher percentage of moderate sedation at non-Council Teaching Hospitals, while CRNAs and anesthesiologists administered a higher percentage in facilities that were members of the Council of Teaching Hospitals ($P = 0.004$). Limitations include the small response rate in addition to the assumption that radiology

administrators would be the most appropriate to answer questions regarding the operational procedures of their department. Additionally, the accuracy of the respondents' answers could not be confirmed. Future research initiatives would warrant the study of the role of certifications and education in nursing and hospital policies as they relate to privilege to administer moderate sedation.

Tran et al. (2019) discussed current medications used in intravenous sedation (both moderate and deep sedation) by non-anesthesiologists within the United States. Tran et al. (2019) also discussed training expectations for sedation since it plays an important role in pre-procedural planning and anesthetic selection. As a review, Tran et al. (2019) summarizes the current information related to the topic of sedation by non-anesthesiologists within the United States and is, therefore, a secondary source, as it discusses information from studies that have been previously published.

The review by Tran et al. (2019) discussed the use of benzodiazepines and opioids in moderate sedation and propofol and ketamine in deep sedation. It also noted dexmedetomidine's role is evolving in procedural sedation as providers explore its use in moderate sedation. It is noted that all sedation types should be mindful of adverse events such as apnea, hypotension, hypoxia, and hypoventilation. Pre-procedural preparation should be performed including physical examination and patient history, anesthetic consultations, and adherence to NPO (nil per os) guidelines. Documentation and monitoring should be performed to avoid adverse complications and maintain a depth that is appropriate. Monitoring should continuously assess oxygen saturation, heart rate, and ventilation. Cardiovascular performance should be monitored with an electrocardiogram to note any arrhythmia and blood pressure monitoring should be performed.

Additionally, resources for sedation-training should be available. The ASA's Safe Sedation Training: Moderate and Deep Program was developed for non-anesthesiologist physicians and other healthcare workers. The author did not discuss any limitations of the review. This review demonstrates implications for pre-procedural planning and training as playing an integral role in minimizing patient adverse events and risks.

Summary

The reviewed literature has demonstrated the incidence of moderate sedation training, and, in some cases, lack thereof, prior to receiving sedation administration privileges and, subsequently, the adverse events associated with non-anesthesia providers with inadequate training. It can be inferred from Werthman et al. (2021) that 5.1% of respondents did not report training requirements for RNs prior to receiving moderate sedation administration privileges and 20.3% of respondents did not report annual moderate sedation training requirements. This study demonstrates the continued need for adequate education and training for RNs pertaining to the safe administration of moderate sedation. Much like the Werthman et al. (2021), Tuck et al. (2018) also investigated nurses administering moderate sedation within the interventional setting. However, while the Werthman et al. (2021) focused on identifying the incidence of inadequacies in training, Tuck et al. (2018) compared inadequate training with a more standardized training initiative.

In fact, Tuck et al. (2018) used a tailored pre and post survey intervention design to assess gaps in knowledge and competence in an attempt to demonstrate the value of further training for non-anesthesia providers. The implementation of the online educational program by the AAMSN and an airway management practicum with an

anesthesia provider showed a statistically significant improvement in knowledge from 69.7% to a significant 92.7% ($p < 0.001$). These non-anesthesia providers also reported increased confidence in working with populations with comorbidities. These results have implications for a standardized evidence-based approach to improve quality care and enhance training initiatives for moderate sedation privileges.

While Tuck et al. (2018) successfully demonstrated the effect that enhanced training has on non-anesthesia providers and their competency administering moderate sedation in the interventional setting, Keegan et al. (2020) demonstrated improved clinical outcomes of non-anesthesia moderate sedation providers in an interventional setting. This study divided providers into two distinct groups (nurse-led sedation and anesthesiology-led sedation) within an experienced TAVR institution. Clinical outcomes demonstrated that nurse-led moderate sedation can be performed safely. In fact, patient outcomes associated with nurse-led sedation are similar to anesthesia-led moderate sedation. There was no difference in 1 year readmission or death between NLS and ALS groups, and, interestingly, the NLS was associated with less ICU length of stay and procedural time. Keegan et al. (2020) credits these results to the prioritization of training for non-anesthesia providers administering moderate sedation in interventional settings. Additionally, the team followed strict orders outlining dosages of drugs, parameters for monitoring and continuous reassessment to ensure patient safety. Not only do the nurses partake in yearly verifications of their skill set, but they also participate in other educational sessions to ensure proper training. This study highlights that, with adequate knowledge and training, nurses are able to provide safe and effective moderate sedation in many platforms.

Overall, the findings consistently point to the enhancement of training initiatives leading to competency and better patient outcomes under moderate sedation in the interventional setting. However, training is not only inconsistent within singular institutions, but the training methods were inconsistent on a larger scale among various institutions. Further gaps in the literature are noted. While training initiatives have been successful, it does not account for the variation in learning styles. Some non-anesthesia providers would benefit from real-time feedback and more interactive learning initiatives rather than simply reading guidelines and watching video programs. Therefore, the proposed project addresses this gap by incorporating an interactive RCDP over-sedation simulation in addition to airway management techniques and sedation pharmacology education. This project proposes that the evidence-based education program become a standardized initiative to improve the skill set and knowledge of non-anesthesia providers who administer moderate sedation in interventional platforms.

Additionally, it should be noted that there are some areas of potential bias within the evaluation of these studies. This is particularly true regarding the Keegan et al. (2018) study. The study discusses the competency of the NLS and credits the success to the training. However, there is no discussion of potential selection bias regarding the nurses being assigned to certain cases and, similarly, the anesthesia providers being assigned to certain cases. This gap in knowledge is due to the nature of the study and that the data was obtained from a database search as there is no clear discussion of case selection.

This project addresses gaps in non-anesthesia providers education through the implementation of an evidence-based practice initiative such as the RCDP simulation.

This simulation provides real time feedback and coaching to help educate non-anesthesia providers as well as develop their crisis resource management skills. Specifically, the project contains educational video modules that are tailored to the pharmacology of moderate sedation and airway management techniques. It provides specific scenarios meant to educate the non-anesthesia provider regarding known complications and appropriate interventions. Overall, the educational program proposed in this project would improve the competence of non-anesthesia providers administering moderate sedation in the interventional setting through an increased understanding of sedation pharmacology (and, subsequently, reversal agent usage as necessary), airway management strategies, and the RCDP over-sedation simulation modules.

Theoretical Framework

The theoretical framework used for this project is the cognitive load theory (CLT), which was first outlined by a psychologist named John Sweller in 1988. CLT focuses on human cognitive architecture for the formulation of instructional procedures through relationships between working and long-term memory (Sweller, 2011). Sweller (2010) identifies three categories of cognitive load:

1. Intrinsic cognitive load which focuses on the innate complexity of information that has element interactivity of information that is being taught and the learner's ability to learn new information which is fixed intrinsically.
2. Extraneous cognitive load that is under the control of the instructor or instructions being taught and can be reduced or eliminated to remove unnecessary processes and improve learning.

3. Germane cognitive load which is when learning is maximized through organized working memory resources or schemas to assist in learning new information.

To maximize the effectiveness of learning, instructional strategies should be matched to the way humans process information. Applying the CLT framework, human cognition is biologically divided into two categories; primary and secondary knowledge. Primary knowledge consists of information and skills that are passively acquired through life experience and do not need to be explicitly taught (Sweller et al., 2011). Alternatively, secondary knowledge consists of domain-specific skills that are developed via education and are not instinctively acquired so conditions of learning must be optimized for effective learning to occur (Sweller et al., 2011). An increased level of cognitive load present during educational sessions causes a negative impact on retained knowledge, an increased frequency of errors, and decreased acquisition of skills (Sweller et al., 2011).

Administration of moderate sedation by non-anesthesia providers in the interventional platform is associated with increased adverse events, specifically the development of respiratory complications. Therefore, it is imperative to mitigate these patient safety concerns through education and training. The purpose of this performance improvement project is to utilize RCDP during simulation-based training and didactic education so non-anesthesia providers in the interventional platforms will develop increased germane knowledge to improve CRM skills and mitigate patient safety concerns related to moderate sedation.

CLT fits well into the framework of this performance improvement project because through RCDP the non-anesthesia provider will alternate between deliberate practice and directed feedback, which consists of both primary and secondary knowledge gained during simulations until mastery is achieved. CLT may afford non-anesthesia providers a greater understanding of sedation management in the interventional platform by minimizing extraneous cognitive load, such as removing unnecessarily complicated information. Immediate feedback will be provided on an individual basis to improve techniques and ensure that conditions of learning are optimized. The minimization of extraneous cognitive load can encourage the development of germane cognitive load for long-term knowledge and skill acquisition. It is expected that the germane cognitive load developed in the non-anesthesia provider improves CRM skills thus ultimately leading to improvement in patient safety through the mitigation of procedural complications.

Methods

Design

This DNP project was developed as a performance improvement project for a community hospital's interventional platform located in the northeastern United States. Through use of evidence-based education modules, this DNP scholarly project is designed to improve CRM skills for non-anesthesia providers who administer moderate sedation in interventional platforms. These educational modules will consist of evidence-based best practice guidelines for pharmacology of moderate sedation agents and airway management strategies, including a summative video simulation scenario that incorporates RCDP. This RCDP simulation will consist of a moderate sedation scenario in the interventional platform where a procedural complication develops in which the

patient becomes over-sedated. Participants will incorporate the knowledge and skills gained from the educational modules to competently navigate through this simulation.

To ensure that the educational modules and simulation scenario are relevant and appropriate for the target audience, the content will be evaluated by two separate groups of content experts. Group one will consist of anesthesia practitioners (CRNAs or anesthesiologists) who will evaluate educational content including moderate sedation pharmacology and airway management. Group two will consist of healthcare simulation experts (Certified Healthcare Simulation Educators [CHSE]) that will evaluate RCDP implementation and simulation strategies. Content validity index (CVI) scores will be calculated for each group of experts.

Content validity is an appropriate tool to evaluate the information contained within the educational modules and simulation scenario as it ensures that the topics are in fact relevant within the constructs of the performance improvement project. This is done through the use of an expert panel who will objectively assess the information to ensure that it is appropriate and meaningful with CVI scores calculated to indicate the degree of consensus among experts (Polit & Beck, 2021). This is achieved via the use of experts in the subject who can assess the information for relevancy and inclusion.

Sample and Setting

The sample for this performance improvement project will consist of two data sources. After an extensive review of scholarly literature, all literature that met inclusion criteria were appraised on the hierarchy of evidence and quality through utilization of the Johns Hopkins Nursing Evidence Level and Quality Guide for critical appraisal of selected studies; evidence level was scored from I (highest level – experimental study,

randomized control trial, systematic review) through V (lowest level – experiential and non-research evidence) while quality was graded with either an A (high), B (good), or C (low, flawed) designation.

The literature review was critically evaluated for content analysis of non-anesthesia providers administering moderate sedation. The extrapolated codes and recurring themes focused on adverse events from non-anesthesia providers administering moderate sedation and mitigating educational activities to improve patient safety under moderate sedation. The educational modules will address these identified areas to improve patient safety and quality of care provided in the interventional platform.

The second data source is composed of two expert panels. One expert panel will evaluate the anesthesia content such as moderate sedation pharmacology and airway management, while the second expert panel will evaluate the simulation content that will incorporate RCDP training. Both expert panels will review the content and determine the content validity index (CVI) scores to ensure this performance improvement project adequately addresses both the educational content and RCDP simulation scenario.

Ethical Considerations

This DNP project is an educational program consisting of sedation pharmacology, airway management techniques, and a RCDP over-sedation simulation to improve CRM skills for non-anesthesia providers who administer moderate sedation in the interventional platform.

This DNP project proposal was approved by the Institutional Review Board (IRB) within the Albert Einstein Healthcare Network with an exempt status due to the project design which includes no involvement of human subjects. There was no identifiable risk to

participants within this DNP project and all data collected from the participants is anonymous. Furthermore, confidentiality and anonymity are assured, and data is secured on a password protected computer that only the researchers have access to. La Salle University acknowledges and accepts Einstein's IRB approval.

Instrumentation

The instruments utilized in this DNP project consisted of content validity generated from two Qualtrics surveys utilizing both the anesthesia and simulation expert panel groups assessing for their specific areas of content for this project. After the major themes were identified from the literature review, the two expert panel groups evaluated the content in each respective subject area. The first expert panel group was composed of licensed anesthesia providers (CRNAs or anesthesiologists) who validated the accuracy of moderate sedation pharmacology and airway management techniques. The second expert panel group was composed of certified healthcare simulation educators who validated the appropriate incorporation of RCDP techniques in an over-sedated simulation video module. Both expert panel groups evaluated the qualitative content of the educational modules and assigned a score on the Expert Content Validity Form to determine the content validity index (CVI) scores to display a quantitative score of the content validity. Expert Content Validity Forms will rank the data being analyzed on a 5-point ordinal scale (1 = *strongly disagree;* 2 = *disagree;* 3 = neutral; 4 = *agree;* 5= *strongly agree*).

After the expert panels evaluated the qualitative content of the educational module, the content validity index of each item (I-CVIs) was quantified to determine the relevance of the content. The content experts scored each item from 1 (*lowest – strongly*

disagree), 2 (*disagree*), 3 (*neutral*), 4 (*agree*), to 5 (*strongly agree*). Secondly, an average of the item-level CVIs (S-CVI/Ave) was assessed for average responses of relevance. The sum of I-CVIs was divided by the sum of the total number of items (Zamanzadeh et al., 2015). Zamanzadeh et al. (2015) explains that 80 percent agreement or higher indicates appropriateness for relevancy. Once the content of the educational modules and RCDP simulation is validated, the modules can be employed in the performance improvement project it was designed for.

Initial Needs Assessment and Additional Data Collection

The data from the initial needs assessment that led to this DNP project was collected by a small community hospital's quality improvement committee that conducted a mock code initiative amongst non-anesthesia providers. The nurse manager from the interventional platform sought the assistance of two Certified Healthcare Simulation Educators (CHSE) to conduct a simulation scenario based on non-anesthesia provider administration of moderate sedation in the Interventional Radiology (IR) setting. A gap in knowledge and clinical performance was identified that ultimately resulted in patient deterioration and inadequate resuscitative efforts during the mock code initiative. This DNP project addresses this identified gap by developing an educational module to assist in airway management skills along with pharmacology knowledge and administration, and an EBP simulation that incorporates RCDP to improve patient outcomes, patient safety, and staff CRM skills.

Additional data was then collected through an extensive literature review from 2016 to 2022 on topics in which non-anesthesia providers administered moderate

sedation in an interventional setting. Notable findings from the literature review identified recurring themes such as adverse events associated with inadequately trained non-anesthesia providers administering moderate sedation, and that through training initiatives non-anesthesia providers can increase knowledge, competency, and skills leading to improved patient outcomes. Therefore, it was determined that implementing an evidence-based educational program consisting of moderate sedation pharmacology, airway management techniques, and an over-sedation simulation utilizing RCDP is the foundation of this performance improvement project to improve CRM skills for the non-anesthesia provider who administers moderate sedation in the interventional platform.

Data Analysis

Expert Review Data Analysis

Both quantitative and qualitative data were obtained from the content experts and analyzed in a Microsoft Excel Spreadsheet. All content areas assessed by the content review experts were ranked from 1 (*strongly disagree*) to 5 (*strongly agree*) in relevance to the validity of content material. Items ranked 4 or 5 are considered relevant to the quality improvement project and items ranked 1 or 2 are interpreted as not relevant or needing significant revision to become relevant to the quality improvement project. The item content validity index (I-CVI) was computed from all experts rating a 4 or 5 to the relevancy of each item, which was then divided by the total number of experts in that expert panel group. Polit & Beck (2021) recommends an I-CVI score of 0.78 or greater to decrease the risk of chance agreement. The scale content validity index averaging (S-CVI/Ave) will be calculated to average the summation of the I-CVIs divided by the total number of content areas.

Results

Content Analysis

The first expert panel group consisting of licensed anesthesia providers (CRNAs or anesthesiologists) yielded a total of 20 completed Expert Content Validity Forms. Of these 20 responses from licensed anesthesia providers, 4 were anesthesiologists and 16 were CRNAs. Within this group, 6 experts reported having greater than 20 years of experience, 5 experts reported having between 1-5 years of experience, and the rest of the experts fell within the 5-20 years of experience range. Of these 20 responses, only 3 licensed anesthesia providers denied that they had ever been consulted to rescue an airway or manage another sedation related complication in an IR setting; 16 experts reported they had been called for management of a restless, agitated, or difficult to sedate patient, 11 experts reported they had been called for airway management, and 10 experts reported they had been called for management of a patient that had been over-sedated by a non-anesthesia provider (Appendix C). All licensed anesthesia experts who responded either agreed or strongly agreed that a moderate sedation educational module should be a mandatory requirement for non-anesthesia providers who administer moderate sedation.

It is worth noting that one of the expert's responses were excluded from the findings due to a dissent bias with a potential misunderstanding of the survey questions, yielding a final total of 19 licensed anesthesia providers (4 anesthesiologists and 15 CRNAs). The individual I-CVIs calculated for all items on the Expert Content Validity Forms received from the group of licensed anesthesia providers were 1.00. The calculated S-CVI/Ave for the Expert Content Validity Forms received from the group of

licensed anesthesia providers was 1.00. The full results from this group of content experts can be seen in Appendix D.

The second expert panel group consisting of healthcare simulation experts yielded a total of 8 completed Expert Content Validity Forms. Of these 8 responses, 6 experts reported being anesthesia providers, 4 experts reported being licensed CHSEs, and 1 expert reported being a non-licensed healthcare simulation educator. Within this group, 2 experts reported having 1-5 years of experience, 2 experts reported having 6-10 years of experience, 2 experts reported having 11-15 years of experience, and 2 experts reported having greater than 20 years of experience. Six out of the 8 experts reported that they were previously aware of the simulation technique of RCDP, with 4 out of the 6 experts stating they previously used RCDP in "Mock Code" simulations. Four experts identified perceived barriers or obstacles to the implementation of RCDP in their healthcare simulation settings, with all 4 experts listing time constraints and 3 experts listing staff cooperation (Appendix G). I-CVIs were unable to be calculated for the Expert Content Validity Forms received from this group of healthcare simulation experts, as the data received was purely qualitative and/or open-ended to provide a better understanding of how RCDP may be implemented in different healthcare simulation environments. All the completed Expert Content Validity Forms received from both groups were anonymous and did not contain any identifying information for that individual.

Discussion

This DNP project was developed to improve CRM skills of the non-anesthesia provider administering moderate sedation in the interventional platforms using current evidence-based practice. Content validity index scores were obtained to evaluate the

information contained within the educational modules and simulation scenario to ensure that the topics are in fact relevant and within the constructs of this performance improvement project. All calculated I-CVIs were 1.00 for the expert panel group consisting of licensed anesthesia providers, therefore, no content revision was needed for the educational modules. Content validity index scores vary between 1.00 and -1.00, the higher the score indicates stronger agreement of members of the expert panel (Zamanzadeh et al., 2015).

According to Polit & Beck (2021), an I-CVI score of 0.78 or greater decreases the risk of chance agreement amongst content experts. Since all calculated I-CVIs were 1.00, all topics included in the corresponding Expert Content Validity Forms were therefore included in the educational modules which consisted of narrated Microsoft PowerPoint presentations with embedded instructional videos and a cumulative over-sedation video simulation incorporating RCDP. These final topics included recognition of an airway obstruction, non-invasive airway interventions (head tilt, chin lift, and jaw thrust), pharmacologic agents used in moderate sedation and their synergistic effects, assessment of level of consciousness, optimal level of sedation, pharmacologic reversal agents, placement of oropharyngeal and nasopharyngeal airways, and bag mask ventilation techniques.

Educational Module Development

The development of the educational modules focuses on evidence-based best practice for moderate sedation and airway management techniques that incorporate RCDP in an over-sedation simulation. The learning objectives outline the principal factors involved within each category for thorough learning. The format of the

educational module is a Microsoft PowerPoint presentation that includes instructional videos and presents an over-sedation video simulation which incorporates RCDP. Prior to dissemination of the educational modules to the expert panels, the Project Chair and the Project Reader evaluated the educational modules.

Limitations

Limitations identified during the literature review revealed that was no consensus on what is included in moderate sedation education. This is of particular concern because the literature review indicated that there is an increase in adverse events associated with non-anesthesia providers providing moderate sedation with inadequate training. This DNP project utilized current evidence-based practice and evaluation from an expert panel to calculate CVI scores to address this limitation, but this limitation still exists.

Another limitation was that CVI scores were not obtained from the simulation expert panel group. Since RCDP is a newer simulation technique, open-ended survey questions were utilized to obtain qualitative data. This qualitative data identified gaps in knowledge, benefits of RCDP and perceived barriers in implementing RCDP simulation techniques.

Implications

Although the primary focus of this DNP scholarly project was to improve CRM skills for non-anesthesia providers in the interventional platform at a specific community hospital, this project can be implemented in other hospitals. Additionally, this project can be implemented in other departments outside of the interventional platform that utilize non-anesthesia providers to administer moderate sedation. Through use of current evidence-based education and simulation, CRM skills in non-anesthesia providers who

administer moderate sedation will improve patient safety by decreasing adverse events associated with moderate sedation.

Future Project and Plans

The educational modules will be given to the specific community hospital interventional platform where the needs assessment was obtained for this performance improvement project. Through use of these evidence-based education modules, this DNP scholarly project will improve CRM skills for non-anesthesia providers who administer moderate sedation in interventional platforms. Our findings will also be disseminated to La Salle University Digital Commons and to our fellow DNP cohorts at Frank J. Tornetta School of Anesthesia.

Conclusion

Moderate sedation is important for patients to receive medical procedures that would otherwise be too uncomfortable to tolerate. Moderate sedation is a delicate balance between different levels of sedation on a continuum. Therefore, it is imperative that clinicians such as non-anesthesia providers receive additional education and training on administering and managing moderate sedation. This will improve care for patients that require moderate sedation by minimizing adverse events associated with administration of moderate sedation. Through moderate sedation education and simulation, the non-anesthesia provider will have increased knowledge of moderate sedation pharmacology, airway management interventions and improved crisis resource management skills, which will improve patient outcomes.

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Table 1

Search Process Review of Literature

N					
Database	Total Articles	Articles Remaining After Title Review	Articles Remaining After Abstract Review	Articles Retrieved and Examined	Articles that fit Inclusion Criteria
La Salle University's Summon	147	2	0	0	0
Cochrane Library	97	0	0	0	0
Joanna Briggs Institute EBP Database	2	0	0	0	0
Google Scholar	229	23	1	1	1
CINAHL	87	12	4	4	4
Medline	21	0	0	0	0
PubMed	1147	57	3	3	3
ProQuest Dissertations & Theses Global	488	22	0	0	0

Note. Number of duplicate articles removed 5

Table 2

Review of Literature Matrix Systematized Review

Database # Article First Author, Year (full citation in References)	Purpose of Study Major Variables (IV, DV) or Phenomenon	Theory or Conceptual Framework	Design	Measurement Major Variables (Instrument)	Data Analysis (Name of Statistics, descriptive, Inferential and Results)	Findings	Evidence Level of Research & Quality Johns Hopkins Nursing Evidence-Based Practice
CINAHL #1 Dossa, 2021	To review the significant variability of sedation practices used in gastrointestinal (GI) endoscopy settings and to formulate a recommendation for best practice supported by existing position statements and guidelines for basic GI procedures	None	Systematic review of clinical practice guidelines and position statements	Choice of sedatives; sedation administration; personnel responsible for monitoring sedated patients; skills and training of individuals involved in sedation; equipment required for monitoring sedated patients. Quality of all included data	Protocol for this systematic review was developed according to the PRISMA-P checklist; included guidelines and position statements for adult patients aged >18 years undergoing elective gastroscopy and/or colonoscopy procedures.	19 clinical practice guidelines and 7 position statements were included in this review. There was no general consensus on choice of sedative used or optimal depth of sedation. Recommendations were consistent for routine use of pulse oximetry and non-invasive blood pressure monitoring, however guidelines for capnography varied. It was recommended that providers administering sedation have adequate knowledge of pharmacology for	III-B

				was assessed using the AGREE II instrument.		sedatives used, training on how to respond to sedation-related complications, and basic life support certification.	
CINAHL #2 Werthman, 2021	To evaluate differences in hospital-mandated education and training for providers administering moderate sedation in the IR platform	The Minnick and Roberts Outcomes Production Model	Prospective observational study	Hospital-mandated moderate sedation training for providers prior to receiving administration privileges; use of specific resources for moderate sedation training; training requirements after moderate sedation privileges were obtained; certification and clinical experience requirements; highest nursing degree obtained. Data was obtained through a national, quantitative, cross-sectional,	Statistics were analyzed using IBM SPSS Statistics and included frequency distributions, means, standard deviations, medians, interquartile ranges, chi-square, and Mann-Whitney tests with a statistical significance value of $p<0.05$.	A response rate of 16% (n=82) from an initial sample size of 510 national survey recipients. 94.9% of respondents reported training was required for RNs prior to receiving moderate sedation administration privileges; 79.7% of respondents had a requirement for annual training. The most common method used for training included hospital-developed written material (86.3%), online modules (82.7%), and verbal instruction (79.1%). >97% of training programs addressed specific content including pre-sedation evaluation, performing moderate sedation, and rescuing patients from a deeper than intended level of sedation. 100% of hospitals required basic life support (BLS) training for RNs, 97.4% required advanced cardiac life support (ACLS) training, and	III-B

				descriptive, 26-question survey conducted in 2018.		17.9% required critical care nursing certification (CCRN). Previous clinical experience as an RN was reported in 90% of respondents and median length of required experience was 2 years (IQR 2.0, 3.0), with 51.4% reporting previous critical care experience. Most respondents reported that RNs primarily obtained a bachelor's degree (median 60.0%, IQR 45.8, 86.1), followed by an associate's degree (median 14.3%, IQR 0.0, 44.0).	
PubMed #1 Keegan, 2020	To compare outcomes of patients that underwent minimalist transcatheter aortic valve replacement (TAVR) in interventional cardiology with moderate sedation by catheterization laboratory nurses versus a dedicated anesthesia team.	None	Single-center retrospective cohort study	Data was obtained from institutional medical database search for patients that underwent a TAVR procedure from 2012 to 2017 under minimalist procedure.	Retrospective data analysis of cases that received minimalist TAVR procedure were divided into two groups: nurse-led sedation (NLS) or anesthesiology-led sedation (ALS) based off of which provider administered the sedation. A propensity score for each patient was created using	A total of 1092 patients met the inclusion criteria, 807 in the NLS group and 285 in the ALS group. The researchers matched patient characteristics using a 2:1 propensity score matching, which yielded 407 patients in the NLS group and 243 patients in the ALS group. All tests were performed with SAS Version 9.4 for the statistical analysis with two-tailed tests and level of significance of 0.05. Clinical outcomes demonstrated that in the NLS group patients that converted to	III-B

					a logistic regression model and two groups with similar propensity scores were matched in a 2:1 fashion. The two groups were compared with two sample t test for continuous outcomes and the chi square test for dichotomous outcomes.	general anesthesia was 2.2% compared to the ALS group which was 0.8% (p = 0.22), which was not statistically significant. Both sedation groups had similar results of patients that required conversion to open surgery 1.0% for the NLS group and 0.8% for the ALS group (p = 0.99) also demonstrating no statistical significance. Survival to discharge was very similar between the two groups at 98.3% in the NLS group compared to 100% in the ALS group, p = 0.05, it is important to note that the deaths in the NLS group was not related to moderate sedation but complications of the TAVR procedure itself. The NLS group had statistically significant results in reduction of procedure time (NLS: 138 minutes vs ALS: 160 minutes) p < 0.01, contrast volume (NLS: 115mL vs ALS: 150mL) p < 0.01, and length of ICU stay p = 0.003.	
Google Scholar #1 Judd, 2019	To evaluate whether the creation of a Registered Nurse Sedation Team (RNST), a team of RNs	None	Single center retrospective chart review	An 18-item retrospective chart assessment tool, developed in 2008, was used to assess	Data was analyzed using SAS Version 9.2. Mean and standard deviations were used for	10 nurses (n=10) were selected through collaboration with the department of anesthesiology and nursing leadership to become members of the RNST and receive specialized sedation training.	III-B

	given specialized training to perform moderate sedation on general care units, improved patient safety compared to the general RN staff			pre-, intra-, and post-sedation elements of care at the Mayo Clinic. Quality indicators such as age, gender, and BMI of the patient were collected, along with the presence or absence of 6 patient adverse outcomes; use of reversal agents, sedation complications, admission to next higher level of care, oxygen saturation <90%, cardiac arrest, and death. Data was collected for a 3-month period in 2010.	continuous variables. Frequency counts and percentages were used for nominal variables. Each patient chart that was reviewed was assigned a total calculated value-based on the 18-item chart assessment tool and were compared using paired t-tests. Each individual element of the tool was compared using Fisher's exact test. A p value of ≤0.001 was considered statistically significant.	103 patient records met inclusion criteria for the 3-month pre-intervention chart review. 96 patient records met inclusion criteria for the 3-month post-intervention chart review. There was an adverse outcome rate of 5.8% (n=6) prior to the implementation of the RNST. There was an adverse outcome rate of 2.0% (n=2) post-implementation of the RNST. The calculated p value was 0.28 indicating no statistical significance between groups. After the 3-month study was completed, the RNST was implemented on all 42 adult general care units in two Mayo Clinic hospitals. Additional data was collected from 4,009 patients who received sedation from 2010 to 2018; the adverse outcome rate within this group was 1.1% (n=45). Compared to the pre-intervention adverse outcome rate of 5.8%, there was a statistically significant difference between these groups (p<0.001).	
PubMed #2 Urman, 2019	To quantify the economic and clinical burden	None	Retrospective Observational Study	Involved classification of patient's	A score for the propensity of respiratory	Patients exhibiting respiratory compromise were associated with higher costs, longer	III-A

	involving respiratory compromise for inpatient interventional radiology procedures while also identifying associated risk factors			respiratory compromise which was defined by the billing record for flumazenil or naloxone or a procedural code indicating nonmechanical resuscitation, endotracheal tube insertion or cardiopulmonary resuscitation.	compromise was obtained through a multi-variable logistical regression calculation and it included the following characteristics: age, sex, type of admission, status of insurance coverages, chronic pain, obesity, sleep apnea, and evidence of long-term therapy (specifically related to opioids) or any active issues related to substance abuse. A calculation of the post-matching covariate balance was obtained to represent the standard difference among independent variables involving the groups associated	hospital stay duration (1.1 day longer), ICU admission, more likely to have invasive interventions of mechanical ventilation and death. therapy for opioids as well as active issues surrounding substance abuse. The study analysis of the predictors associated with respiratory compromise, the all-patients group demonstrated that there were several predictors: age (65 years of age and older) (OR: 1.4; $P < 0.001$; 95% CI: 1.3, 1.5), sleep apnea diagnosis (OR: 1.3; $P < 0.001$; 95% CI: 1.1, 1.4), and history of long-term therapy for opioids as well as active issues surrounding substance abuse (OR: 2.7; $P < 0.001$; 95% CI:2.4, 3.0). The mean associated with the cost for admission was $6,904 more for patients associated with respiratory compromise ($P < 0.001$); patients with respiratory compromise had longer mean hospital stays (an extra 1.1 days in the all-patients group ($P < 0.001$), patients demonstrating respiratory compromise were more likely to be admitted to the ICU (69.7% in the all-	

					with respiratory compromise. The Charlson comorbidity index was used to sum up all of the comorbidity weights noted in the hospital discharge record. Outcome analysis was performed by using categorical variables (counts and percentages) as well as descriptive statistics of continuous variables (such as standard deviation +/- mean). The statistical significance for categorical and continuous variables was obtained by "two-sample *t* tests and X^2 tests." Odds ratio significance was evaluated by X^2 tests. *P* values	patients group vs. 25.5%, respectively (P < 0.001), patients with respiratory compromise were more likely more likely to have invasive interventions of mechanical ventilation 33.6% in the all-patients group vs. 1.6% respectively (*P* < 0.001), and an overall death rate was also evaluated to be 27.1% vs. 3.2%, respectively (*P* < 0.001).	

					were used to determine statistical significance. Statistical analysis was performed with statistical software SAS 9.4 for Unix The RVU (relative value unit) group was designated as the independent variable in the analysis of the all-patients grouping.		
CINAHL #3 Jones, 2018	To evaluate clinical factors, including patient and healthcare provider data, that lead to adverse events during moderate sedation during interventional procedures. The most common adverse events during moderate	None	Retrospective review at a single tertiary care medical center	Patient characteristics (age, sex, BMI, comorbidities, ASA classification); procedural focus (medical specialty, location, and if the procedure was emergent); nature of adverse events	Univariate descriptive statistics with percentages for categorical variables and mean with standard deviation for continuous variables were calculated. Bivariate tests for relationships	Cases requiring moderate sedation over a 12-year period were evaluated; 106 adverse events were analyzed and 83 were included as they were relevant to the goals of this study. The most common adverse events related to moderate sedation were; oversedation leading to apnea (60.2%), hypoxemia (42.2%), aspiration	III-B

	sedation and resultant severity of harm were identified.			classified by severity of patient harm (no harm, minor harm, major harm).	were conducted; Fisher's exact test used for most patient/procedure characteristics (categorical values) and two-tailed t-tests for BMI and age (continuous variables). Analysis was performed using Strata 13.0.	(24.1%), and patient pain or discomfort (9.6%). The most common interventions needed were; use of pharmacological reversal agents (55.4%), apnea requiring prolonged bag-mask ventilation (25.3%), inability to complete the procedure (16.9%), unplanned hospital admission (12.2%), and intubation to secure the airway (6.0%). Patients with a higher BMI had a statistically significant higher rate of adverse events (p=0.016). Patients who required pharmacologic reversal agents had an average age of 63.1 compared to an average age of 54.8 for patients who did not (p=0.014). Rates of oversedation were higher for the elderly (62.8 years compared to 55.7 years, p=0.08). Female patients had higher rates of adverse events compared to male patients.	

						More patient comorbidities were associated with higher rates of adverse events. Healthcare provider related factors associated with adverse events; miscommunication within the care team (28.9%), no moderate sedation certification (9.6%).	
CINAHL #4 Tuck, 2018	To evaluate perceived importance, competence, confidence, and satisfaction, in implementing a moderate sedation protocol among IR nurses.	Roger's Diffusion of Innovation Theory	A quality improvement project	A pre/post survey intervention survey was developed with 49 Likert scale questions (0 [strongly disagree] to 4 [strongly agree]). The survey was used to assess change in the nurse's perceived importance, confidence, competence, and satisfaction after an educational online program by AAMSN and airway management	Data was analyzed using independent-samples t test to compare the change in mean scores of the validated IR moderate sedation survey for RNs between the two groups (preintervention and postintervention). Statistical significance (two-tailed) was determined using a p value of $\leq$ 0.05. All analyses were conducted with Stata Statistical Software: Release 12.	24 IR nurses working in IR procedure area, cardiac catheterization laboratory, lung center, interventional pain management with mean nursing experience of 20 years and mean IR experience of 15 years administering moderate sedation. The moderate sedation classes were considered the most important perceived intervention with a statistically significant finding from pre-education mean test score of 69.7% to a post-education test score of 92.7% ($p< 0.001$). Airway management with 1:1 anesthesia personnel training was perceived to be a source of confidence ($p < 0.001$). Education obtained provided nurses with confidence in using sedation drugs and reversal	V-B

				practicum by an anesthesiologist/CRNA before and after educational interventions. The surveys were administered electronically without identifiers. The survey tool was reviewed by five internal highly knowledgeable nurses: BSN (n=2), MSN with IR experience (n=1), PhD national expert consultants in moderate sedation (n=2)		agents ($p < 0.001$) and overall confidence in monitoring, managing, and administering sedation to IR patients ($p = 0.001$). The education and airway management training interventions showed statistically significant findings in confidence to care for patients having various comorbidities with p values running from 0.002 to 0.019. There was no significant change in confidence in monitoring devices. Satisfaction on educational content, airway management and pre- to post-intervention scores were statistically significant ($p < 0.001$) and policy ($p<0.001$).	
PubMed #3 Sauter, 2016	To evaluate the viability of implementing interprofessional training sessions	Smith's Principles of Patient Safety	Single center quality improvement project with	Pre- and post-intervention questionnaires based on an 11-point Likert	Statistics analyzed by IBM SPSS Statistics 21. Participants compared by age	50 participants were included in this training; 26 nurses and 24 physicians. Only 2 physicians had previous anesthesia experience.	V-B

	to improve sedation practices and CRM strategies to improve patient outcomes in an emergency department setting. Training sessions involved physicians and nurses from Berne University Department of Emergency Medicine (Switzerland) and involved simulation-based education.		pre- and post-test design	scale were used to measure self-efficacy, awareness of emergency procedures, knowledge of sedation medications, and CRM. To assess the clinical effect of training, patient satisfaction, response team satisfaction, duration, and complications were also recorded for one year post intervention.	group, years of experience, gender, and profession by t-test and Fisher's exact test. Self-assessment of knowledge and confidence compared by using paired samples Student's t-tests. ED and anesthesia teams were evaluated on time to procedure start, procedure duration, and time to discharge after sedation compared by Mann-Whitney-U test for unrelated samples and ASA classification by univariate ANOVA. A p value of <0.05 was used for statistical significance. Cohen's d calculated as effect size for statistically	There was a highly significant increase in self-efficacy post-intervention ($p<0.01$). Emergency situational knowledge of medications used for sedation increased significantly post-intervention ($p<0.01$). There was a significant increase in self-assessment regarding knowledge of CRM principles ($p<0.01$). In all subgroups, there was a statistically significant increase in self-efficacy and knowledge with a large effect size ($d_z=1.8$). Time to procedure significantly improved post-intervention for patients sedated by the ED team compared to the anesthesia team ($p=0.002$, $d=0.88$). No major complications were observed in the clinical evaluation that occurred for a year following the intervention.	

					significant tests in unrelated samples and d_z for related samples.		

Figure 1

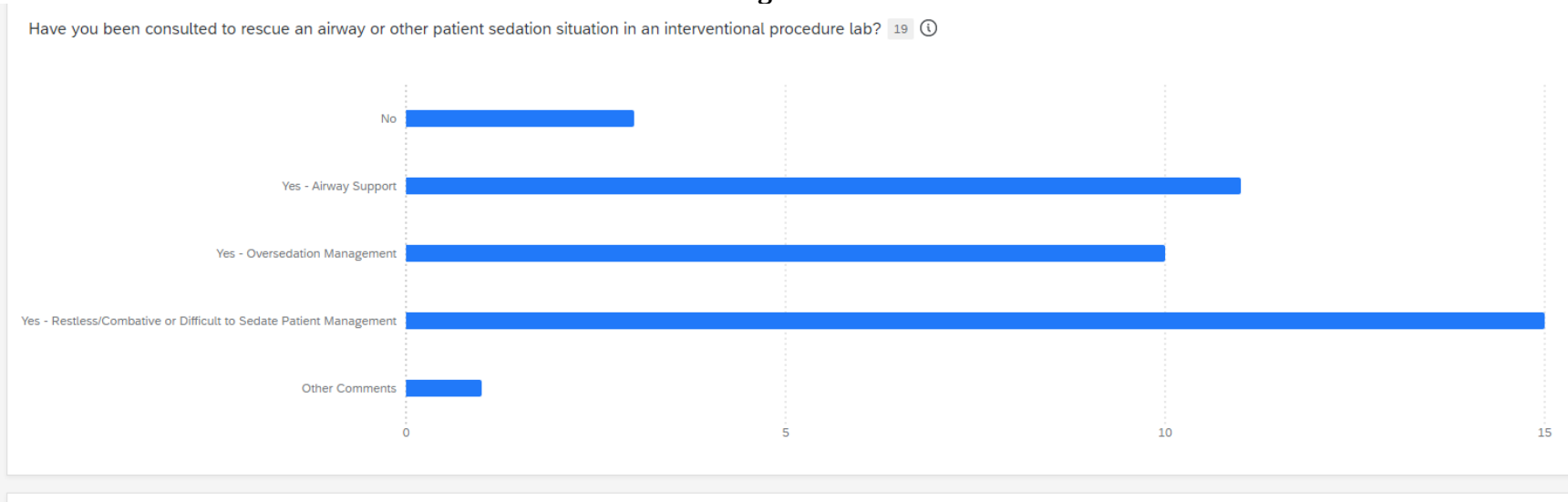

Have you been consulted to rescue an airway or other patient sedation situation in an interventional procedure lab? 19
No
Yes - Airway Support
Yes - Oversedation Management
Yes - Restless/Combative or Difficult to Sedate Patient Management
Other Comments
0
5
10
15

Figure 2

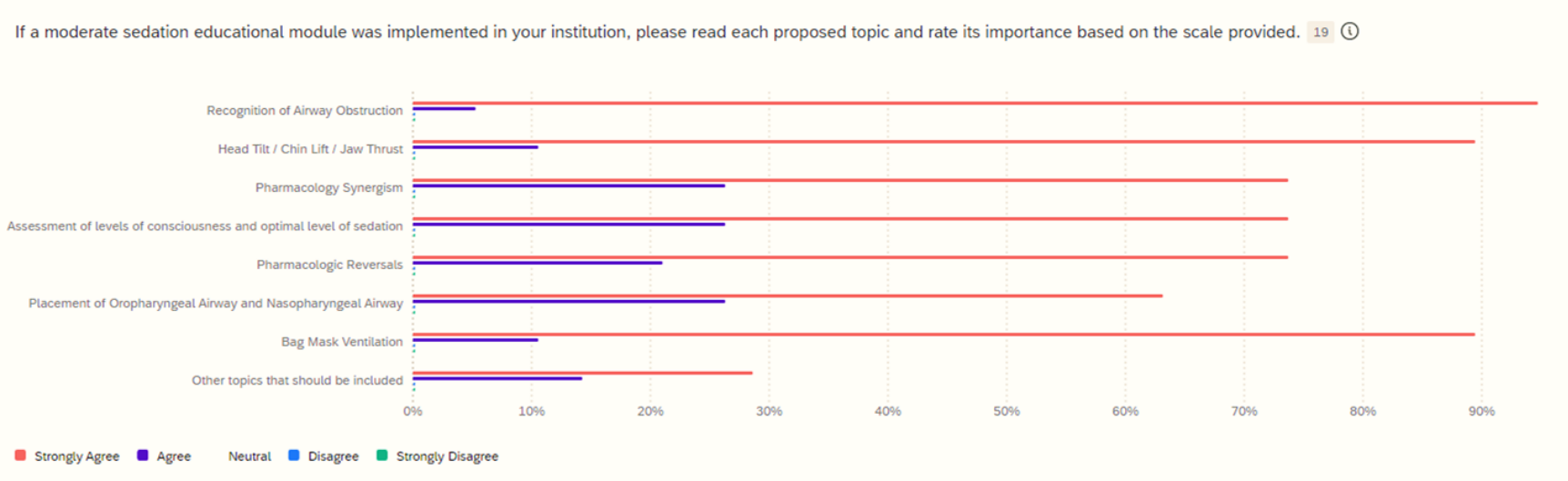

If a moderate sedation educational module was implemented in your institution, please read each proposed topic and rate its importance based on the scale provided. 19
Recognition of Airway Obstruction
Head Tilt / Chin Lift / Jaw Thrust
Pharmacology Synergism
Assessment of levels of consciousness and optimal level of sedation
Pharmacologic Reversals
Placement of Oropharyngeal Airway and Nasopharyngeal Airway
Bag Mask Ventilation
Other topics that should be included
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree

Figure 3

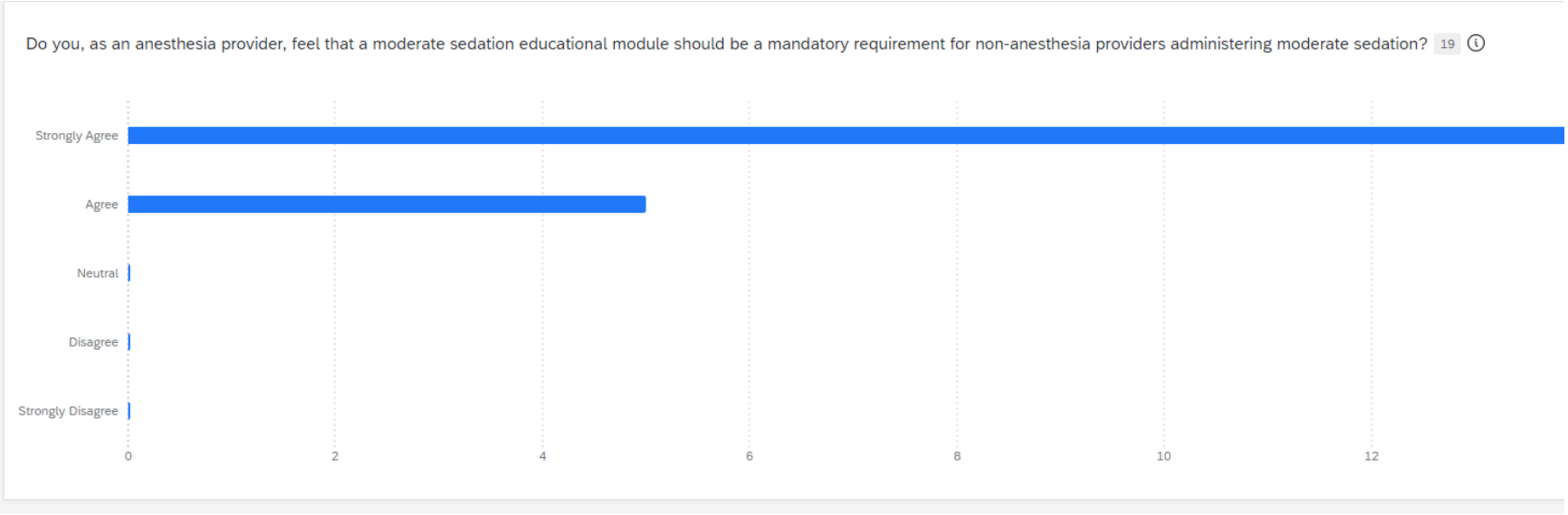

Do you, as an anesthesia provider, feel that a moderate sedation educational module should be a mandatory requirement for non-anesthesia providers administering moderate sedation? 19
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree
0
2
4
6
8
10
12

Figure 4

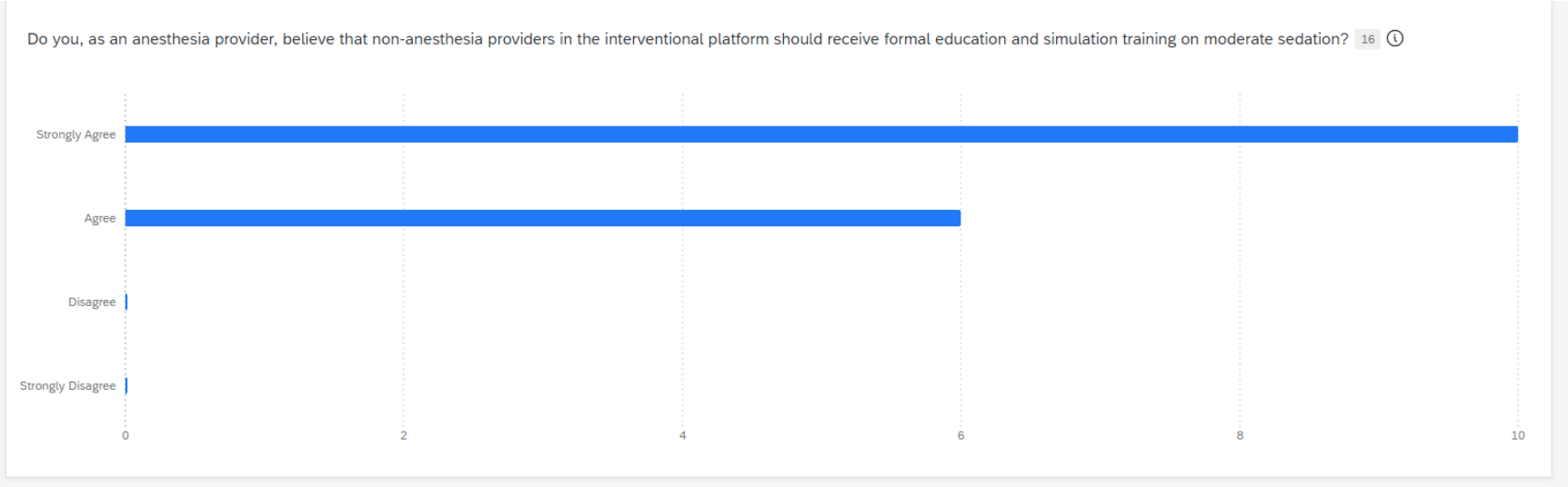
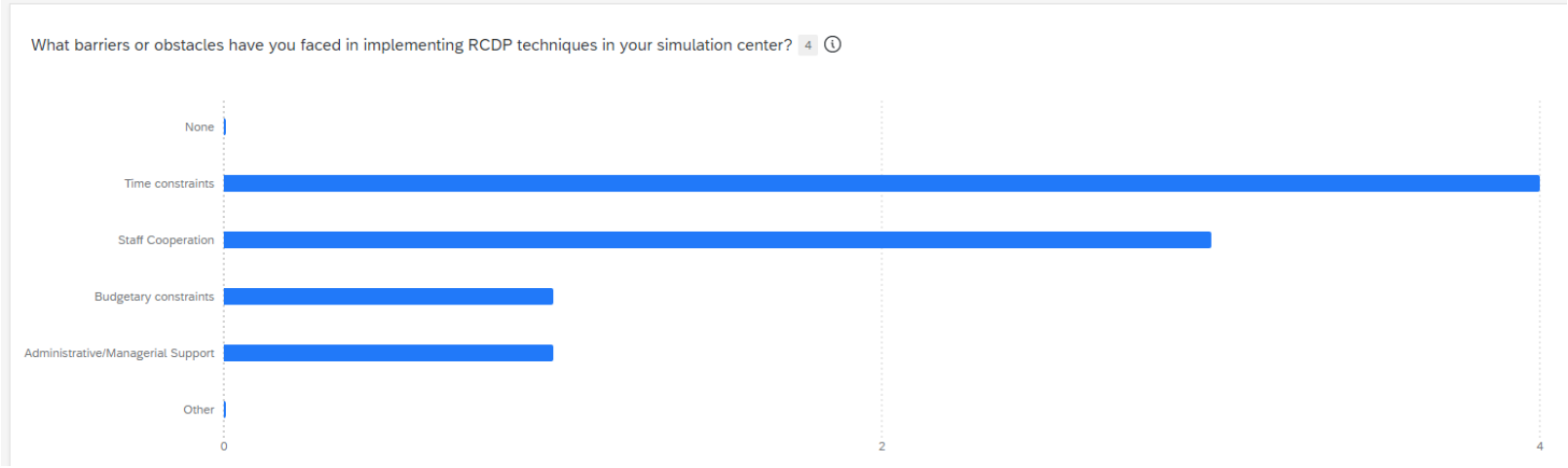

Do you, as an anesthesia provider, believe that non-anesthesia providers in the interventional platform should receive formal education and simulation training on moderate sedation? 16
Strongly Agree
Agree
Disagree
Strongly Disagree
0
2
4
6
8
10

Figure 5


What barriers or obstacles have you faced in implementing RCDP techniques in your simulation center? 4
None
Time constraints
Staff Cooperation
Budgetary constraints
Administrative/Managerial Support
Other
0
2
4

Appendix A – IRB Letter

18 February 2022

TO: Patricia Dillon, PhD, RN
Chair of Graduate, RN to BSN and RN to MSN Nursing Programs

FROM: Susan C. Borkowski, Ph.D.
Chair, Institutional Review Board

RE: Post BSN - DNP Anesthesia Students' Projects

The La Salle University Institutional Review Board [IRB] accepts Einstein Hospital's IRB assessment of the Post BSN - DNP Anesthesia Students' Projects as non-human research.

These projects focus on quality improvement and do not involve human subjects. Based on the Einstein determination, La Salle's IRB does not require the submission of a formal IRB proposal.

Appendix B

Summary of Learning Modules and Instructional Videos

Title: Performance Improvement Project Implementing Rapid Cycle Deliberate Practice Simulation to Improve Team Performance During Administration of Moderate Sedation by Non-Anesthesia Providers in the Interventional Platform

Purpose: To develop a performance improvement project to implement RCDP simulation training for non-anesthesia providers administering moderate sedation in interventional platforms to improve CRM skills through current evidence-based practice.

Learning Outcomes	Content Outline	Methods of Instruction	Estimated time in minutes to complete section

Pharmacology of Moderate Sedation: An Overview
 	
The non-anesthesia provider will…
• Recognize the levels within the sedation continuum
• Describe the most common pharmacologic agents used for the administration of moderate sedation
• Explain the appropriate reversal agents for both opioids and benzodiazepines
	• Introduction
	• Definitions
	• Overview of pharmacologic agents
	  ○ Fentanyl
	  ○ Naloxone
	  ○ Midazolam
	  ○ Flumazenil
	• Diluting naloxone
		• Narrated PowerPoint
		• Narrated PowerPoint
		• Narrated PowerPoint
		• Instructional video
			• 12:05

Basic Airway Management for Administration of Moderate Sedation
 	
The non-anesthesia provider will…
	• Introduction
	• Airway obstruction
	• Interventions
	  ○ Head tilt
	  ○ Chin lift
	  ○ Jaw thrust
		• Narrated PowerPoint
		• Narrated PowerPoint
		• Narrated PowerPoint with instructional videos
		• Narrated PowerPoint with instructional video
			• 7:57

• Recognize the signs and symptoms of an airway obstruction • Implement the most appropriate non-invasive interventions to a alleviate an airway obstruction • Utilize the proper size of oral and nasal airways • Demonstrate proper bag valve mask ventilation techniques	• Oro- and nasopharyngeal airways • Bag valve mask ventilation	• Narrated PowerPoint with instructional video	
Rapid Cycle Deliberate Practice Video Simulation: **Oversedation in the Interventional Platform** The non-anesthesia provider will… • Demonstrate the usage of Rapid Cycle Deliberate Practice (RCDP) to improve Crisis Resource Management (CRM) skills through current evidence-based practice • Assess the level of consciousness • Utilize closed-loop communication strategies • Initiate appropriate interventions to relieve an airway obstruction, bag-valve-mask ventilation, and naloxone preparation and administration	• Definitions • Patient introduction • Setting • Rapid cycle deliberate practice video simulation • Debriefing	• Narrated PowerPoint • Narrated PowerPoint • Narrated PowerPoint • Video simulation • Narrated PowerPoint	• 11:56

Appendix C – DNP Project Timeline

Objectives	Methods and Techniques	Timeline	Evaluation Methods	Responsible Personnel	Outcomes
Short-term Objectives					
Review of existing literature	Comprehensive search of scholarly databases	Summer 2021 – Summer 2022	Search process methods and project inclusion criteria	DNP project team and committee	Literature review was completed and 8 articles were deemed appropriate for inclusion
Appraisal of articles meeting inclusion criteria	Content analysis of included articles	Summer 2022	Application of the Johns Hopkins Nursing Evidence Level and Quality Guide and review by DNP project team members	DNP project team members	Creation of both narrative and matrix format review of literature
Intermediate-term Objectives					
Development of educational modules and video simulation scenario	Summarize literature and create script for video simulation using rapid cycle deliberate practice	Fall 2022 – Spring 2023	Consultation with experts in both anesthesia and healthcare simulation	DNP project team and committee	Creation of educational modules and initial script for video simulation scenario

Content validation by panel of experts	Selection of two expert panels for content validity (anesthesia practitioners and healthcare simulation experts)	Fall 2022 – Spring 2023	Collect qualitative data from expert panels and calculate content validity index scores	DNP project team and committee, content experts	Content validation of educational modules and script for video simulation scenario
Filming of rapid cycle deliberate practice over-sedation video simulation	Utilization of the Frank J. Tornetta School of Anesthesia simulation lab facilities	Spring 2023	Completion of filming video simulation with feedback from simulation experts	DNP project team, simulation techs, simulation expert	Finalized rapid cycle deliberate practice video simulation scenario
Long-term objectives					
Educate non-anesthesia providers who administer moderate sedation in interventional platforms	Disseminate educational modules and video simulation to non-anesthesia providers	Summer 2023 –	Pre-Post education survey	Interventional platform nurse manager and institutional simulation healthcare educators	Increased knowledge of moderate sedation pharmacology and basic airway management skills for non-anesthesia providers

Improve non-anesthesia provider crisis resource management skills	Disseminate educational modules and video simulation to non-anesthesia providers	Summer 2023 –	Pre-Post intervention survey	Interventional platform nurse manager and institutional simulation healthcare educators	Improved ability to manage sedation-related procedural complications for non-anesthesia providers