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## Improving Pediatric Nurses' Knowledge of Postoperative Care for the Pediatric Patient Undergoing Surgical Correction of Pectus Excavatum: A Quality Improvement Project

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Improving Pediatric Nurses' Knowledge of Postoperative Care for the Pediatric Patient  
Undergoing Surgical Correction of Pectus Excavatum: A Quality Improvement Project

A Scholarly Project Presented to the Faculty of the  
Nicole Wertheim College of Nursing and Health Sciences

Florida International University

In partial fulfillment of the requirements  
For the Degree of Doctor of Nursing Practice

By

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## Abstract

Surgical correction for the chest wall deformity known as Pectus Excavatum (PE) is often performed during adolescence for patients exhibiting cardiac, respiratory, and psychological problems. The established surgery performed to correct PE is a thoracoscopic-assisted minimally invasive repair of pectus excavatum (MIRPE) or Nuss procedure. The clinical care of patients who undergo the Nuss procedure is mainly focused on the postoperative pain management related to the constant pressure from the bar(s) on the sternum. A quality improvement project was developed with the aim to improve the nurses' knowledge of the postoperative care for the pediatric patient undergoing a Nuss procedure. The project was set in a stand-alone urban pediatric hospital. Participants included pediatric nurses who work in the surgical unit and nurse practitioners who manage pediatric surgical patients.

A comprehensive study search was conducted using CINAHL and MEDLINE (ProQuest) to identify research studies from the past five years that have evaluated the effectiveness of the nurses' knowledge of postoperative care for patients undergoing chest wall corrective surgery. The six research studies identified as relevant for review investigated nurse's knowledge and attitudes of postoperative pain management in the pediatric patient and the effectiveness of enhanced recovery pathways to improve patient outcomes. The quality improvement project demonstrated that the implementation of a targeted education program for the care of the pediatric patient who undergoes a Nuss procedure improved the clinician's knowledge and attitudes that positively impact pain management practices and improve patient outcomes.

*Keywords:* Pediatric, Enhanced Recovery, Postoperative Care, Nurses Knowledge, Pectus Excavatum

## Introduction

The most common inborn chest wall anomaly among adolescents and young adults is Pectus Excavatum (PE), or "funnel chest." This condition is characterized by a significant depression in the middle of the chest that also involves the costal cartilages (Pingwen et al., 2020). The standard of care for surgical correction of PE is a thoracoscopic-assisted minimally invasive repair of pectus excavatum (MIRPE) or Nuss procedure. The procedure's general postoperative complications are chest pain, pleural effusions, bar displacement, pneumothorax, wound infection, and scoliosis, with bar displacement being the primary reason for surgical failure (Dong-Kun Zhang et al., 2015). The patient's postoperative clinical care must be focused on effective postoperative pain management to minimize post-surgical complications. The use of an effective multimodal analgesic approach is associated with a reduced total opioid use, lower pain scores, and a decreased hospital length of stay (Litz et al., 2017).

Surgical correction of pectus excavatum was revolutionized in 1998 when Dr. Donald Nuss developed a minimally invasive surgery to repair pectus excavatum. The new technique adhered to sound orthopedic fundamentals but posed a significant learning curve for the surgeons due to the severity of asymmetry and pliability of the chest wall. As the procedure gained popularity, it was applied to more complex chest wall deformities causing numerous life-threatening complications, including deaths (Notrica, 2019). From the negative experiences reported by pioneer surgeons, the Nuss procedure has undergone many modifications that have improved its safety and effectiveness by yielding less trauma and better cosmetic outcomes (Pingwen et al., 2020).

MIRPE or Nuss procedure involves a surgical elevation of the chest when a metal pectus bar is gently pulled through the mid-chest and placed under the sternum using thoracoscopic

guidance. The bar is initially placed in the convex position and using a flipping tool, the bar is rotated 180 degrees counterclockwise into the correct position for the patient. The bar is then fixed to the thorax to prevent bar displacement (Nuss et al., 2016). Postoperatively, every effort must be made to achieve appropriate pain control. Patient-controlled analgesia (PCA) is started in the operating room, and other pain management strategies such as intravenous non-steroidal anti-inflammatory, antipyretics, and prophylactic anti-nausea management are commenced upon arrival to the surgical unit.

Enhanced recovery after surgery (ERAS) pathways have been used in the past with adults, and more recently, with the pediatric patient to help reduce complications and improve postoperative recovery (Puett & Smith, 2018). ERAS pathways have been designed to reexamine traditional practices and replace them with evidence-based guidelines to achieve early postoperative recovery. Furthermore, ERAS pathways can provide nursing with standardized surgical care guidelines detailing nursing responsibilities and goals when caring for the postoperative patients (ERAS Society, 2020).

Developing a clinical pathway for effective pain management includes the collaboration of nursing, the surgical team, and the patient and family. Implementing a Nuss postoperative practice guideline or enhanced recovery pathway will help shorten hospital stay, improve pain scores, decrease urinary catheter usage, and lessen postoperative emergency room visits and readmissions (Pingwen et al., 2020). It is known that undertreatment of pain causes undue patient suffering, risk of increased complications, morbidity, and increased length of hospital stay (Shaalán et al., 2017). Prior studies have shown that nurses lack knowledge of key areas regarding the management of children's postoperative pain. Thus, it is important that surgical

nurses have a clear understanding and availability of tools to manage postoperative pain in the pediatric patient (Smeland et al., 2018).

### **Problem Statement**

Surgical correction for pectus excavatum is usually sought out during adolescence to correct the chest wall deformity. During puberty, adolescents have rapid physical growth, which abruptly accelerates the deformity. Surgical correction is recommended to alleviate respiratory and cardiac difficulties and enhance the adolescent patient's positive psychological development (Shaalan et al., 2017). Postoperative pain is the principal cause of the increased length of stay and returns to the emergency room after surgical correction (Litz et al., 2017).

A clinical problem related to poor postoperative pain management and inadequate physical activity is the nursing knowledge deficit concerning pediatric pain management during the postoperative period (Smeland et al., 2018). Research has demonstrated that standardization of surgical pathways based on best practice guidelines has improved surgical outcomes evident by minimized hospital length of stay and increased patient satisfaction. Currently, nurses caring for patients in the postoperative period of the Nuss procedure do not have an updated evidence-based practice guideline to follow. By effectively managing pain, postoperative complications related to delayed ambulation, high pain scores, constipation, urinary retention, and prolonged opioid use were significantly improved (Litz et al., 2017).

Additionally, there has been a recent high nursing turnover in the hospital's pediatric surgical unit of interest. Many nurses caring for the postoperative pediatric surgical patient are new graduates or nurses who are inexperienced in the pediatric patient's postoperative care, leading to a generalized lack of understanding of the surgical procedure's unique aspects and specialized postoperative care needs. This lack of knowledge can directly increase post-surgical

complications, prolong hospital length of stay, increase emergency room visits post-discharge, and decrease patient and family satisfaction (Dong-Kun Zhang et al., 2015).

### **Significance**

Developing a nursing evidence-based practice guideline for pediatric post-surgical patient care in the hospital of interest requires a collaborative team effort to achieve the best patient outcomes as proposed by the organization's mission to promote lifelong health and provide the best care to every child. Therefore, the project aims to provide the pediatric nurse with the necessary tools to empower the pediatric patient through a multidisciplinary team effort, manage their postoperative pain effectively, and ultimately improve their overall surgical outcome (Rabbitts et al., 2017).

Around the country, ERAS pathways are now being utilize during the postoperative phase to care for the pediatric population to reduce complications and improve postoperative recovery (Puett & Smith, 2018). These pathways are designed to evaluate current institutional practice and replace them with an evidence-based guidelines to achieve early postoperative recovery.

It is expected that one of the strengths of the development of an enhanced recovery pathway specific to the postoperative care of adolescents undergoing chest wall reconstruction is its alignment with the organization's mission, vision, and values. For example, the organization's operating statements emphasize that all patients and their families will be provided with the most advanced method of compassionate care through collaboration, responsibility, advocacy, empowerment, transparency, and empathy.

## Summary of the Literature

The six articles chosen from the literature review represent the most recent evidence-based studies focused on developing an enhanced recovery pathway for the pediatric surgical patient who undergoes a Nuss procedure. Because a protocol's success depends heavily on nurses' compliance, it was important to analyze the nurses' pain management knowledge, attitudes, and beliefs when caring for the postoperative pediatric patient. Four of the articles reviewed focused on developing a standardized enhanced recovery pathway, while two centered on the nurse's knowledge and the impact on the postoperative pain management of children. The literature review's goal was to combine the two concepts: first, the concept of nurses' knowledge, and second, the effectiveness of an ERAS protocol to determine the feasibility of developing an enhanced recovery protocol for children who undergo surgery for correction of PE.

Findings from the literature review reported that ineffective management of pediatric postsurgical pain could be attributed to the nurses' non-compliance with pain management guidelines and other factors that include nurses' knowledge deficits, negative attitudes, and poor perceptions of pain and pain management. For instance, Smeland et al. (2018) explain that clinicians have insufficient knowledge of assessing, diagnosing, and managing pain during the perioperative period. Implementing measures to improve compliance with pain management protocols and practice guidelines was deemed necessary.

Furthermore, health education was reported to be one of the main interventions to improve pain management practices in nurses. In their systematic review, AlReshidi et al. (2018) found that educational programs significantly improved pain management in children by addressing the nurses' perceptions, knowledge, attitudes, and pain management beliefs.

Realizing that the Nuss procedure for correcting PE is associated with intense postsurgical pain and prolonged hospitalization, Wharton et al. (2020) examined whether ERAS pathways could improve these adverse surgical outcomes. The study found that ERAS pathway programs decreased hospital stay to 2.90 from 3.49 days due to a decreased use of urinary catheters and lower pain scores, leading to fewer emergency department visits post-discharge. As such, enhanced recovery pathways could serve as an effective measure to improve post-surgical pain management in the pediatric population.

Consequently, Puett and Smith (2018) sought to determine the feasibility of developing recovery protocols in children with PE who undergo a minimally invasive repair of pectus excavatum or Nuss procedure by conducting a systematic review of the literature. Their research reached similar conclusions to prior studies and further highlighted the importance of nurses having a fundamental understanding of the ERAS pathways, their importance, and the nurses' role in executing these protocols. Because nurses are the facilitators of the patient's transition through all the surgical phases, they are perceived as vital members of the ERAS team (Puett & Smith, 2018).

Through the review of the literature, it was evident that standardization of clinical care pathways and protocols increases compliance rates for both the patient and the nurse. In their study, Litz et al. (2017) analyzed the implementation of an ERAS protocol on the effectiveness of reducing utilization resources and decreasing length of stay (LOS). They reported significantly shorter times to start enteral narcotics with fewer resources allocated to radiological studies and blood draws. One of the challenges in this study is the probability of accepting a higher rate of readmissions, thus supporting the need for proper patient and family education during preoperative visits and effective postoperative education by the nurse (Litz et al., 2017).

Lastly, Gurria et al. (2020) found that compliance with standardized clinical care pathways – SCCPs- decreased hospital LOS from 4.5 to 3.4 days due to improved pain management and patient satisfaction. These findings help support that quality improvement frameworks should be utilized in standardizing clinical care pathways to achieve optimal outcomes. Analysis of individual studies is summarized in Table 1.

Table 1

*Analysis of Individual Studies*

Author(s)	Purpose	Methodology/ Research Design	Intervention(s)/ Measures	Sampling/Setting	Primary Results	Relevant Conclusions
<b>Puett and Smith (2018)</b>	To investigate existing literature on the knowledge of feasibility of developing an enhanced recovery pathway in the care of children, to explore the patient and provider experience with enhanced recovery pathways and discuss implications for nursing.	Systematic Literature Review Level 1	Literature review conducted using CINAHL, PubMed/Medline, and EMBASE. First search aimed at finding studies that identified ERAS in the pediatric population. Second search was conducted to identify studies that discussed nursing and patient experiences with ERAS.	Only articles published in academic journals, full text, and in the English language were utilized. On the first search pediatric was defined as 18 years or less. On the second search that identified the nurses or patient experience, the search was not limited to pediatrics.  Sample sizes among prospective and retrospective results were small (n= 46 to 203)	Search on ERAS studies yielded 7 studies. Five of the 7 studies found a decreased hospital LOS, among ERAS cohorts. Two studies reported reduced time to mobilization. One study reported oral nutrition and bowel activity on POD 1. All 7 studies reported readmission but not associated with the ERAS intervention. Four studies reported patient positive patient satisfaction.  The ERAS experience studies yielded 4 studies. On patient experiences patient reported high levels of anxiety with discussing early discharge and home recovery. Provider experience reported negative feelings toward	All 7 ERAS studies found the implementation of ERAS as feasible and safe for pediatric surgical patients.  The success of ERAS programs relies on protocol compliance; thus, nursing leadership must identify ways to engage nursing staff and foster an environment that supports change and the advancement of evidence-based practice.

					ERAS if the protocol deviated from past practice or conflicted with prior experience	
<b>Litz et al., (2017)</b>	To analyze resource utilization after implementation of an enhanced recovery pathway to standardize practice for patients who undergo MIRPE for pectus excavatum.	Retrospective review. Level III	<p>A retrospective review was performed on patients who underwent MIRPE between 2012 through 2015 to evaluate trends in utilization of resources before and after a standardized practice plan was implemented in 2013.</p> <p>On year one a second review was performed on patients from 2010-2015 after the implementation of a pain management protocol to assess for opioid utilization, urinary retention, and LOS.</p>	<p>For the review of resource utilization 71 patients were included. Patient's age was 0-35 years. There were 25 patients in Y1, 24 in Y2, and 22 in Y3.</p> <p>For the standardized pain management protocol was comprised of 64 patients- 27 patients before and 37 patients after implementation of protocol.</p>	<p>Review of resource utilizations reported a significant reduction in the following key items over time: ICU LOS (<math>1.0 \pm 1.5</math> vs <math>0</math> days); decreased radiological studies (<math>2.3 \pm 1.5</math> vs <math>1.8 \pm 0.7</math>); and decrease in laboratory tests (<math>3.1 \pm 3.0</math> vs <math>1.1 \pm 1.2</math>).</p> <p>Postoperative outcomes after the implementation of pain management protocol reported earlier initiation of oral narcotics (<math>2.4 \pm 0.7</math> days before vs <math>0.9 \pm 0.6</math> days after); lower postoperative morphine equivalents after implementation (<math>3.3 \pm 1.4</math>mg/kg before vs <math>1.2 \pm 0.5</math> mg/kg after); and LOS decrease (<math>4 \pm 1</math> days before to <math>2.8 \pm 0.8</math> days after).</p>	<p>The study concluded that it is feasible and effective to implement an enhanced recovery pathway for patients undergoing MIRPE.</p> <p>The implementation of a standardized perioperative practice plan that includes a postoperative pain management protocol can lead to a decrease in resource utilization, use of narcotics, length of hospital stay, and postoperative complications.</p>
<b>Smeland et al., (2018)</b>	To investigate the nurses' knowledge, attitudes, and	Descriptive cross-sectional study including a	Study conducted in 6 university hospital PACUs in Norway.	Paper version of the PNKAS-N questionnaire was given to nurses ( $n =$	Mean PNKAS-Score was 28.8 (72% correct answers). Most items answered incorrectly	Findings concluded that nurses have knowledge deficit in effective pain

	clinical practice when caring for the post-surgical pediatric patient and determine the relationship between the nurses' knowledge and clinical practice.	questionnaire and observation. Level IV	Questionnaire utilized was derived from best practice standards set forth by the WHO, APS, and AHCPR. Items included in the questionnaire covered general pediatric pain management, pain assessment, pharmacologic and nonpharmacological pain management questions.	259) with a return envelope. Total of 193 nurses completed the questionnaire and 138 were observed giving care to 266 children (416 hours in total).  Observational data was collected using a structured observational tool and field notes.  Data from PNKAS-N was described using descriptive and correlative statistics using IBM SPSS Statistics for Windows, version 24.0.	included questions related to pharmacologic management. Nurses with higher degrees and years of experience scored significantly higher.  Nurses reported knowledge of pain assessment tools (84%), written guidelines for pain assessment (55%) and pediatric pain management (59%). However, on observation only 22% of nurses utilized pain assessment tools with 19% of the patients.  Nurses (98%) correctly answered questions regarding nonpharmacologic pain management.	assessment, pain assessment tools, and rely heavily on physical indicator of pain. Based on observation data 81% of pediatric patients did not have pain assessed using a pain assessment tool.  This study emphasizes a need to improve nurses knowledge of pediatric pain management. It also recommends the development of evidence-based guidelines to strengthen the nurses management of pediatric pain.
<b>Wharton et al., (2020)</b>	Investigate if the implementation of a standardized enhanced recovery after surgery (ERAS)	Retrospective review. Level III	ERAS program was instituted to standardize perioperative exercise, pharmacologic regimens, pre- and postoperative education, and early return to activity.	Pectus excavatum ERAS was implemented in a high-volume academic center between Jan. 1, 2015 and Dec. 3, 2018).	Primary outcome of LOS in the 2015-2016 group was $3.49 \pm 0.12$ vs $2.897 \text{ days} \pm 0.1197$ in 2017 reaching statistical significance. Moreover, 38% of patients were discharged on POD 2 for the pos-ERAS group vs	Pectus excavatum ERAS protocol reduces hospital LOS, decreases the need for urinary catheter use, and improves pain scores on POD 0.

	<p>pathway would decrease LOS and reduce level of postoperative pain without increasing the readmission rate for patients who undergo Nuss procedure for pectus excavatum.</p>		<p>A retrospective review of all patients undergoing the Nuss procedure from 2015 to 2018 was performed. ERAS was implemented midpoint of the study period and pre- and post-protocol analysis of patients were compared</p>	<p>109 patients under the age of 21 were included. Pre-ERAS (<math>n = 51</math>) and post-ERAS (<math>n = 58</math>).</p> <p>Patients with combined surgeries were excluded.</p> <p>Primary outcome focused on hospital LOS. Secondary outcomes included pain scores, urinary retention requiring catheterization, hospital readmissions, and ED hospital visits.</p>	<p>5.9% for the pre-ERAS group.</p> <p>Secondary outcomes reported a reduction of urinary catheter use from 47% to 21%, lowered postoperative pain scores on POD 0 (4.488 vs 5.527), and reported a trend toward fewer readmissions (19 readmission pre-ERAS to 8 readmissions post ERAS)</p>	<p>Significant number of patients were safely discharged earlier therefore decreasing hospital cost.</p>
<p><b>Alreshidi et al., 2017</b></p>	<p>Systematic review to explore current literature pertaining to the impact of the education programs on factors that may affect the practice of</p>	<p>Systematic Review Level I</p>	<p>Literature review conducted using CINAHL, MEDLINE&lt; Ovid SP, The Cochrane Library, ProQuest, and Google Scholar databases. and EMBASE.</p> <p>Studies focused on educational programs and the impact they</p>	<p>Review was limited to studies with only randomized control trials and quasi-experimental designs. Excluded were any studies that focused on chronic pain or studies that included adults.</p>	<p>13 studies tested the impact of an educational program and the nurses' knowledge of the management of pharmacologic and nonpharmacologic interventions.</p> <p>11 of the 13 studies strongly supported implementation of educational program.</p>	<p>Education of pediatric nurses is vital to improving practice for pain management in the post-surgical patient.</p> <p>Improved nurses' knowledge supports positive attitudes in managing pain in the pediatric population.</p>

	pediatric nurses' pain management.		have on enhancing pediatric nurses' knowledge of postoperative pain management.	15 of 499 studies met inclusion criteria and were included in the review.  Conducted from July and August 2014 and updated on March 2016	9 studies found significant impact of nurses' knowledge. 9 out of 15 studies reported good evidence on the impact of pain assessment and management education and the nurses' attitudes toward pain management.  Studies suggested an implied link between nurses' knowledge and attitudes toward pain management	
<b>Gurria et al., 2019</b>	Study aimed to assess patient outcomes after the implementation of a standardized clinical care pathway (SCCP) specific to pectus with the goal of achieving a 90% compliance rate within 9	Clinical research; Quality improvement (QA) project Level V	Multidisciplinary team implementation of a pectus SCCP specific to pediatric patients with pectus excavatum with goal of improving early ambulation, pain control, lung recovery, and effective intake and output. Goals: compliance measurements with pectus SCCP. Primary outcome measured decreased LOS. Secondary outcomes measured patient	Study conducted in a 540-bed free standing children's hospital.  Multidisciplinary team included nursing, APRNs, pain team, holistic therapy, PT, OT, respiratory therapist, program manager, QI specialist.  Pectus SCCP included 42 components under	LOS decreased from mean of 4.4 days to 3.4 days. Median LOS decreased from 4.5 days pre- to 3 days post-protocol. Decrease LOS of 3.4 has been sustained to date.  Pectus SCCP compliance started at 74% at protocol implementation and increased to 96% post implementation and has remained at $\geq 93\%$ remainder of the study.	Evidence from the QA project demonstrated that implementation of a SCCP pectus specific protocol decreased LOS, improved postoperative pain management, eliminated readmission, or return to the ED, improved patient satisfaction, and reduced overall patient hospital cost by 30%.

	months of implementation.		satisfaction, cost, and hospital readmission	5 postoperative care fields.		
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## Quality Improvement Project

### Purpose

Pectus excavatum is the most common chest wall deformity in children (Das et al., 2019). Surgery is often recommended during the adolescent years for patients whose condition affects their cardiac, respiratory, and psychological well-being. Currently, the surgical standard of care for PE is the Nuss procedure, which is also known as a MIRPE. The Nuss procedure involves surgically placing a metal pectus bar below the sternum under thoracoscopic guidance producing an immediate elevation of the mid-chest (Nuss et al., 2016).

Postoperative complications of the Nuss or MIRPE procedure include intense pain, pleural effusions, bar displacement, pneumothorax, and wound infections (Dong-Kun Zhang et al., 2015). It is also known that undertreatment of pain causes undue patient suffering, risk of increased complications, morbidity, and increased hospital LOS (Shalan et al., 2017). Therefore, if the postoperative course is effectively managed, patients will exhibit fewer postoperative complications (Litz et al., 2017). One way of optimizing the postoperative recovery for the patient who undergoes chest wall corrective surgery is to implement a clinical nursing pathway or enhanced recovery pathway that will improve the nurses' skills in postoperative care. Because prior studies have shown that nurses lack knowledge of key areas on the management of children's postoperative pain, surgical nurses must have all available tools and a clear understanding to proficiently care for the postoperative patient (Smeland et al., 2018).

The current process in the postoperative care of patients who undergo the Nuss procedure is admission to the pediatric surgical unit, where they are cared for by pediatric surgical nurses competent in the postoperative management of patients who have undergone PE correction.

However, the pediatric surgical unit has been challenged with a significant loss of experienced nurses combined with a considerable increase of complex surgical patients. In turn, patients are now cared for by inexperienced nurses or nurses from other hospital units unfamiliar with the Nuss procedure and its postoperative management. The primary goal of developing an ERAS protocol for patients who undergo the Nuss procedure is to provide all pediatric nurses with a standardized, structured, evidence-based post-surgical care protocol specific to nursing responsibilities and goals that improve traditional practice and achieve early postoperative recovery (ERAS Society, 2020).

### **Aim**

The aim of the QI project is to:

1. Assess the nurse's knowledge of clinical practice when caring for the postoperative pediatric patient who has undergone a Nuss procedure.
2. To develop a standardized postoperative guideline or enhanced recovery pathway specific to the care of the pediatric patient post-Nuss procedure.
3. To provide nurses with an evidence-based guideline for managing postoperative pain, intravenous fluid administration, early ambulation, use of incentive spirometer, and activity restrictions for the pediatric patient post-Nuss procedure.
4. To improve the overall nurse, patient, and family satisfaction and patient outcomes.

### **PICO Question**

Does providing pediatric nurses with an educational intervention on the postoperative care of the pediatric patient undergoing surgical correction of pectus excavatum surgery improve their knowledge of postoperative care?

- **Population:** Pediatric nurses
- **Intervention:** Education intervention
- **Comparison:** None
- **Outcome:** Increased postoperative care knowledge

## **Objectives**

Available research supports the safety and efficacy of the Nuss procedure; however, it also explicates that those major surgical complications go underreported. Although severe complications are rare, pediatric nurses must realize the risk and mortality of the life-threatening complications associated with the procedure to ensure optimal patient safety (Hebra et al., 2018).

The primary surgical outcomes expected to improve with an evidenced-based standardized discharge practice guideline include a decreased use of opioids, shorter length of hospital stay, fewer postoperative office phone calls, visits to the emergency room, reduced incision site infections, avoidance of injury to the chest (bar displacement) and minimized anxiety. It is also expected that patients will have earlier ambulation, improved compliance with incentive spirometer, foster better coping mechanisms, improve awareness of discharge activity restrictions, and increase overall patient and family satisfaction. In their study, Gurria et al., (2020) describe that developing standardized clinical care pathways (SCCPs) at the Nuss postoperative stage facilitated the patient's discharge with a clear reduction in patient's LOS while maintaining appropriate postoperative pain management and positive patient satisfaction.

Moreover, in developing a standardized postoperative guideline or enhanced recovery pathway specific to MIRPE, nurses will have a well-defined guideline for managing postoperative pain, intravenous fluid administration, early ambulation, use of incentive

spirometer, and management of urinary retention. Furthermore, it will provide nurses with a delineated process of preventing infection, respiratory complications, improve drug compliance, psychological care, and ultimately improve patient outcomes and satisfaction (Okpara, 2018).

### **Definition of Terms**

#### **Pectus Excavatum**

Pectus excavatum is the most common congenital chest wall deformity characterized by a depression of the anterior chest wall, usually described as mild, moderate, or severe. The physiologic effect of PE is determined by the degree of cardiac and pulmonary compression caused by the severity and depth of the mid-chest depression. Pectus excavatum may also be associated with other genetic conditions, including Marfan, Noonan, Poland Syndromes, and scoliosis. No genetic causative factors have been identified, although there may be a positive family history. (Hebra et al., 2016).

#### **MIRPE**

Thoracoscopic-assisted minimally invasive repair of pectus excavatum (MIRPE), also known as the Nuss procedure. MIRPE procedure involves a surgical elevation of the chest produced when a metal pectus bar is gently pulled through the mid-chest and placed under the sternum using thoracoscopic guidance. The bar is initially placed in the convex position, and using a flipping tool, it is rotated 180 degrees counterclockwise into the correct position for the patient. The bar is then fixed to the thorax to prevent bar displacement (Nuss et al., 2016).

#### **Haller Index**

The Haller index (HI) is an objective measure of the anatomical severity of pectus excavatum deformity calculated using computed tomography (CT). It is defined as the maximum latero-lateral per shortest anteroposterior distance at the point of maximum pectus

deformity (Funabashi et al., 2019). HI measurement greater than 3.25 is an objective criterion for pectus excavatum repair (Dong-Kun Zhang et al., 2015).

## **ERAS**

Enhanced recovery after surgery (ERAS). ERAS pathways are designed to reexamine traditional practices and replace them with standardized, evidence-based practice guidelines to achieve early postoperative recovery. (ERAS Society, 2020).

## **Postoperative Pain**

Acute pain caused by post-surgical trauma involving an onslaught initiation of sensory signals through afferent neurons to the central nervous system (Sng et al., 2017).

## **Evidence-Based Practice**

Evidence-based practice (EBP) is a problem-solving paradigm that is scholarly and systematic and results in the delivery of high-quality health care (ANA, 2015).

## **Pediatric Surgical Nurse**

A pediatric nurse utilizes evidence-based practice guidelines in a multitude of settings to provide care for the pediatric patient (and family) who require surgical intervention. They function as clinicians, educators, mentors, and researchers to restore health and prevent illness for the child who requires surgical intervention (American Pediatric Surgical Nurses Association, Inc., 2020).

## **Pediatric Patient**

Persons aged 21 or younger at the time of diagnosis (Hardin & Hackell, 2017).

## **Conceptual Framework**

The Donabedian conceptual framework will be used to identify the various components and help connect all the project's essential features. This model focuses on three main

categories: structure, process, and outcome (Moran et al., 2020). Furthermore, to help guide and inform the process, Katherine Kolcaba's Comfort theory will be utilized. The Nursing Department at the children's hospital of interest has embedded Dr. Kolcaba's comfort model to assist nurses in providing comforting measures for patients to produce positive outcomes that focus on preventing postoperative pain and increasing the patient's well-being. This theory also reinforces the need to comfort nurses' own physical, psycho-spiritual, sociocultural, and environmental well-being.

## **Methodology**

### **Settings and Participants**

The setting was a stand-alone level I pediatric hospital in South Florida. The focus was the pediatric surgical unit, where most surgical patients are admitted pre- and postoperatively. Of note, other unit nurses where patients may overflow post-surgically were also included. The project centered on the pediatric surgical nurse, including full-time, part-time, and float nurses, who care for the pediatric post-surgical patients, as well as the nurse practitioners who were new to the pediatric surgical team.

### **Project Approach**

The aim of the project was to assess the nurse's knowledge of clinical practice when caring for the postoperative pediatric patient who has undergone a Nuss procedure. A pre- and post-test were developed from the findings of the literature review along with an educational intervention. Because there was no available tool or survey that measures the nurse's knowledge when caring for the postoperative pediatric patient post-Nuss procedure, a pre- and post-test survey (see Appendix A) was developed from the literature review and in part from the "Knowledge and Attitudes Survey Regarding Pain" tool developed by Ferrell and McCaffery

(2014), (see Appendix B). The educational intervention consisted of a voice-over PowerPoint presentation available through the institution's educational platform.

Nurses were recruited to voluntarily complete a pre-test to assess baseline knowledge. Nurses were then linked to an educational intervention that lasted approximately 20 minutes. Lastly, participants were provided with a link to complete a post-test. Qualtrics® software was used to create the pre- and post-test surveys and to generate a report of the nurses' knowledge.

### **Protection of Human Subjects**

The basis of this project qualified as a quality improvement (QI) project. For this reason, Institutional Review Board (IRB) approval was obtained from the children's hospital and the university (see Appendix D & E). Data collected was de-identified using Qualtrics programming with untraceable links and quick response (QR) codes. Results of the surveys were stored on a password-protected computer equipped with internet antivirus and antimalware detection capabilities, which ensured the safety of the data. All participation was voluntary; subjects did not have any obligation to participate and were able to terminate participation at any time.

### **Data Collection**

Participants were recruited from a convenience sample mainly of full-time, part-time, and float nurses who work in the pediatric surgical unit and care for postoperative Nuss patients. Nurses from other units where patients may also be assigned post-surgically were invited to participate. Furthermore, nurse practitioners new to the pediatric surgical team were also included in the project.

Invitation to participate was distributed via email by the pediatric surgical clinical specialist. The email included an introduction to the project with a statement assuring complete anonymity and confidentiality. The email provided participants with a link and QR code to the

pre-test. The pre-test needed approximately 5-10 minutes to complete. Once the pre-test was completed, participants were linked to a 20-minute educational voice-over PowerPoint presentation. The educational presentation was developed based on the literature review results and evidence-based practice guidelines that focused on the postoperative care of the pediatric patient who undergoes a Nuss procedure. After viewing the PowerPoint presentation, participants were immediately linked to a post-test questionnaire. The post-test was identical to the pre-test to compare findings and determine the outcome of the educational intervention.

### **Data Management and Analysis**

Response to the pre- and post-test questionnaire was the source of data processing. All participant information was de-identified. The whole process, including recruitment, data collection, and data analysis, was performed remotely. The pre-test, educational course, and post-test were all accessible via electronic devices, including computers, cell phones, tablets, and laptops by scanning the QR code or clicking on the link provided by Qualtrics. The final analysis was descriptive in the form of ranges and percentages, eliminating any intrinsic analysis. Qualtrics software program was used to filter, classify, merge, and analyze responses. Reported data were exported from Qualtrics to Microsoft Excel for inferential analysis.

## **Results**

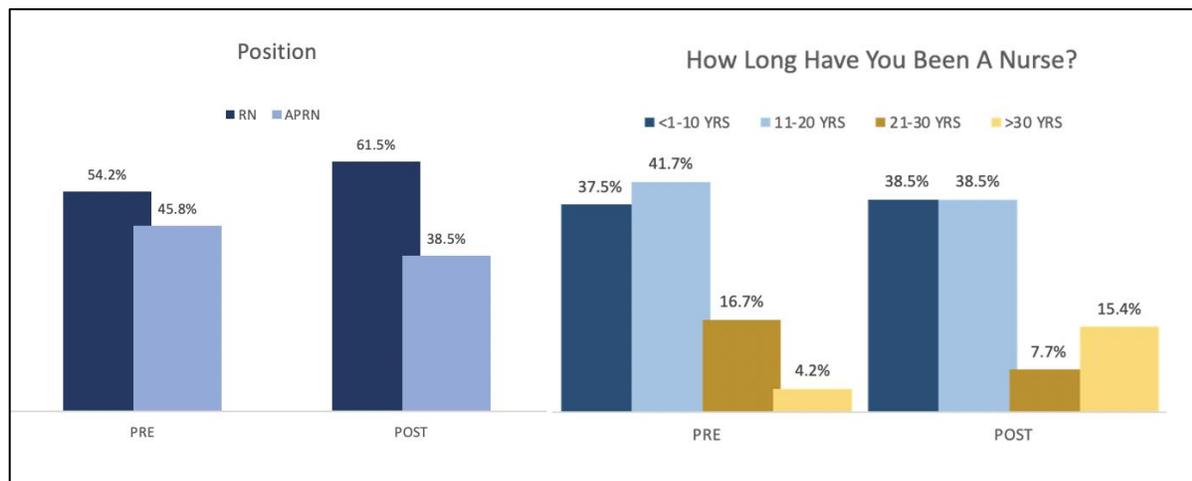
### **Pre-Intervention Sample**

A total of 24 nurses participated in the pre-intervention questionnaire. Participant were mostly females ( $n = 23, 95.8\%$ ), over half were between the ages of 31-40 ( $n = 13/24, 54.2\%$ ), and Hispanic ( $n = 13/24, 54.2\%$ ). Additionally, most of the responders were registered nurses ( $n = 13/24, 54.2\%$ ) with, the remainder of the responders being nurse practitioners ( $n = 11, 48.8\%$ ).

The average of years in practice was 12.2 years for the group. Figure 1 references the nursing demographics based on position and years of practice.

**Figure 1**

*Nursing Demographics*



**Post-Intervention Sample**

Thirteen of the initial responders participated in the post-test survey. Like the pre-intervention group, the majority were females ( $n = 12/13$ , 92%), Hispanic ( $n = 8/13$ , 62%), and registered nurses ( $n = 8/13$ , 62%). The complete pre- and post-intervention demographic data is referenced in Table 2. Possible reasons for failure to complete both surveys is unknown but are considered when assessing the limitations of the project.

**Table 2***Pre-Intervention and Post-Intervention Participants Demographic Data*

Respondent Demographics		
	Pre-Test	Post-Test
<b>Gender</b>		
Female	95.8%	84.6%
Male	4.2%	15.4%
<b>Age</b>		
20-30	25.0%	30.8%
31-40	20.8%	30.8%
41-50	33.3%	23.1%
>50	20.8%	15.4%
<b>Race/Ethnicity</b>		
Hispanic	54.2%	61.5%
Black or AA	16.7%	7.7%
White	16.7%	23.1%
Asian	8.3%	-
Other	4.2%	7.7%

**Training**

Before answering the survey questions, responders were asked if they had previously received educational training regarding PE, Nuss procedure, or the use of an ERAS pathway. Sixty-two percent (62.5%) of the participants had received some form of education related to PE; however, 54.2% did not recall how long ago they received the training. Fifty-four percent (54%) had received education on the post-surgical management of the pediatric patient who has undergone a Nuss procedure, and 12.5% reported ever having received training on post-surgical ERAS pathways.

**Pre-test and post-test analysis**

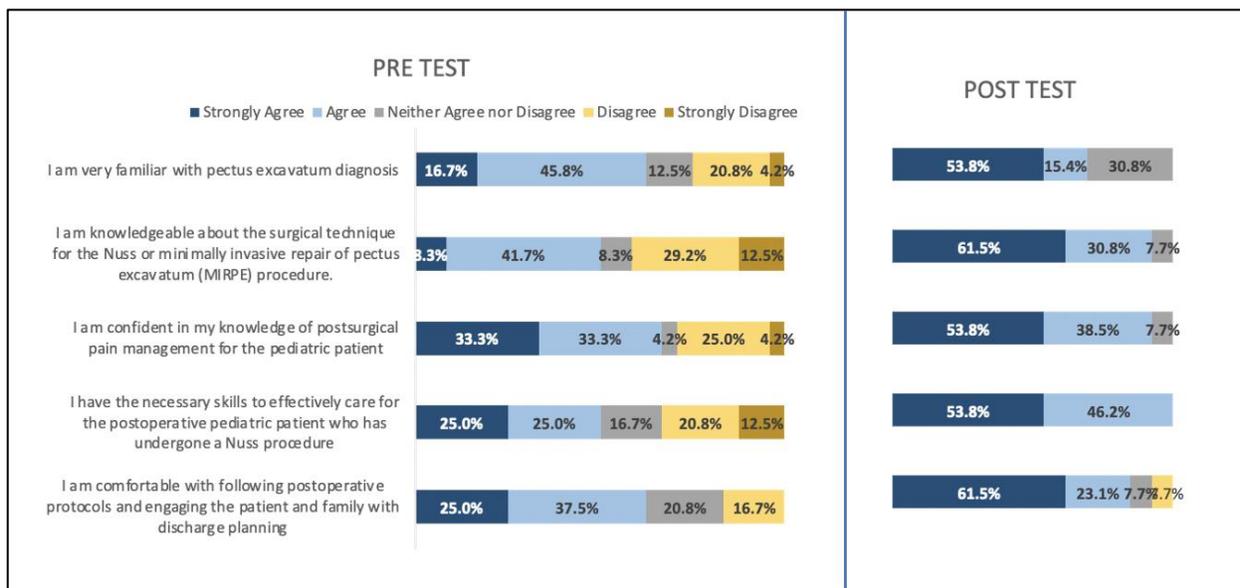
In the pre-test, survey participants were first asked to rank their knowledge related to PE, surgical procedure for chest wall deformity correction or Nuss procedure, post-surgical management, and post-Nuss discharge planning by ranking their level of agreement. Overall,

16.7% strongly agreed, and 45.8% agreed to be familiar with the diagnosis of PE, while 20.8% disagreed. A total of 50% of participants strongly agreed or agreed to have the necessary skills to effectively care for the postoperative pediatric patient who undergoes a Nuss procedure. Only 25% strongly agreed to feel comfortable following post-operative protocols that engage the family and patient in their discharge planning.

Participants increased their knowledge after participating in the educational course in all questions, with the most significant knowledge increase noted in their knowledge of the surgical technique for chest wall anomaly (61.5% from 8.3% strongly agreed). There was also an increase to 61.5% from 25% of participants who strongly agreed to feeling comfortable following post-operative protocols and engaging the patient and family with discharge planning. Figure 2 illustrates the participants' knowledge assessment related to PE pre- and post-survey.

**Figure 2**

*General Knowledge Assessment*

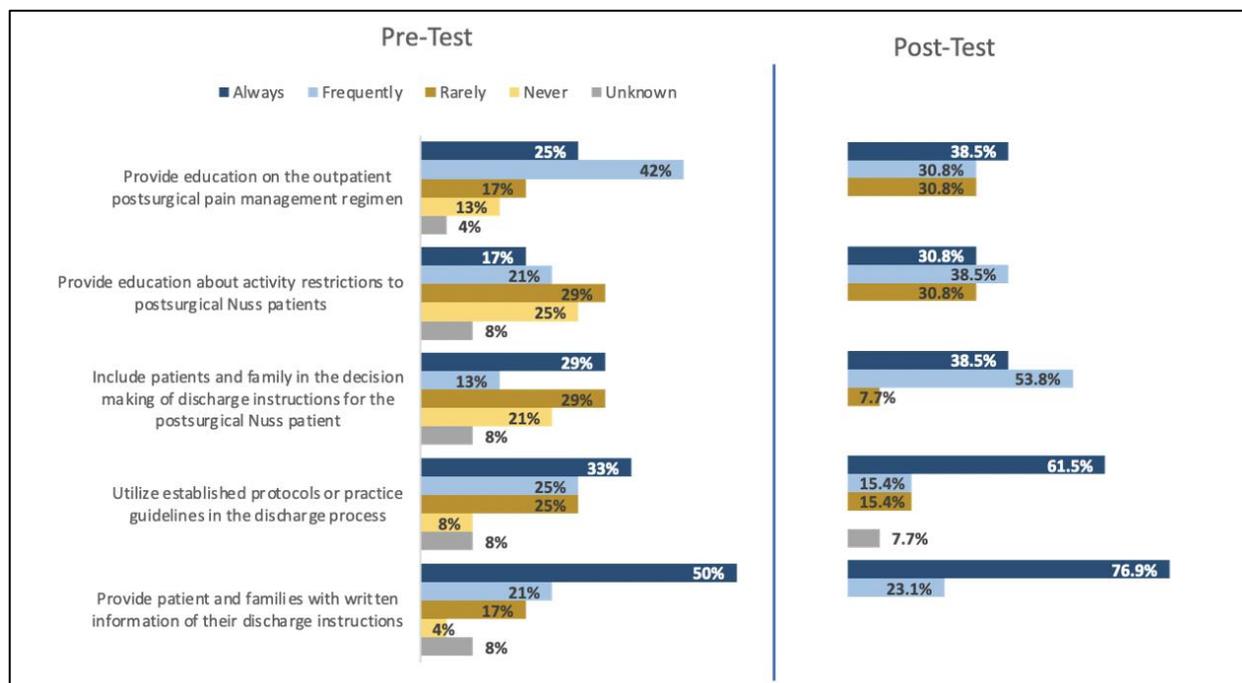


Additionally, participants answered several statements that measured how often they provided outpatient education for the patients and families who have undergone the Nuss

procedure. Regarding activity restrictions, an average of 62% of the pre-survey respondents rarely or never provided instructions, with only 38% always or frequently providing activity restrictions instructions. Post-survey respondents reported an increase to 69.3% who provided activity restrictions discharge information. Additionally, 42% of pre-survey participants included the family in the decision-making process upon discharge compared to 92.3% on the post-survey group. Participants reported an increase of knowledge of 18.9% (pre-survey 58% to post-survey 76.9%) concerning the participant's use of an established protocol in the discharge process. Lastly, participants provided written discharge instructions 71% of the time pre-survey compared to 100% of the time post-survey. A graph representation of discharge knowledge assessment post-Nuss procedure is illustrated in Figure 3.

**Figure 3**

*Status Post Nuss Discharge Instructions Knowledge Assessment*



## PE knowledge assessment

In the pre-test survey, participants knowledge was assessed utilizing multiple questions related to PE and its associated treatment. The pre-test group had an overall score of 85.1% correct responses, while the post-survey group had a 97.8% correct response rate for a total increase of knowledge of 12.7%. Table 3 references the knowledge assessment questions.

**Table 3**

### *Pectus Excavatum Knowledge Assessment*

<b>PE Knowledge Assessment</b>			
	<b>Pre</b>	<b>Post</b>	<b>% Change</b>
Pectus excavatum is the most common chest wall anomaly in children characterized by a deep depression in the mid-chest	83.3%	100.0%	16.7%
Surgical correction is sought out during infancy to correct cardiorespiratory and psychological difficulties cause by the deformity	75.0%	92.3%	17.3%
The standard care for the correction of pectus excavatum is a thoracoscopic assisted minimally invasive repair of pectus excavatum (MIRPE) which is also known as the Nuss procedure	91.7%	91.7%	0.0%
Postoperative pain is the principal cause of increased length of stay and return visits to the emergency room.	87.5%	100.0%	12.5%
Which of these patients are the best candidates for surgical repair of pectus excavatum?	75.0%	92.3%	17.3%
Pectus excavatum is most commonly present in	87.5%	100.0%	12.5%
The MIRPE or Nuss procedure involves:	91.7%	92.3%	0.6%

## ERAS knowledge assessment

Respondents answered three questions related to their knowledge of the ERAS pathways. Pre-survey, 79.2% answered the questions accurately, while the post-survey respondents answered 84.6% correctly. The slight change in knowledge was attributed to the question's

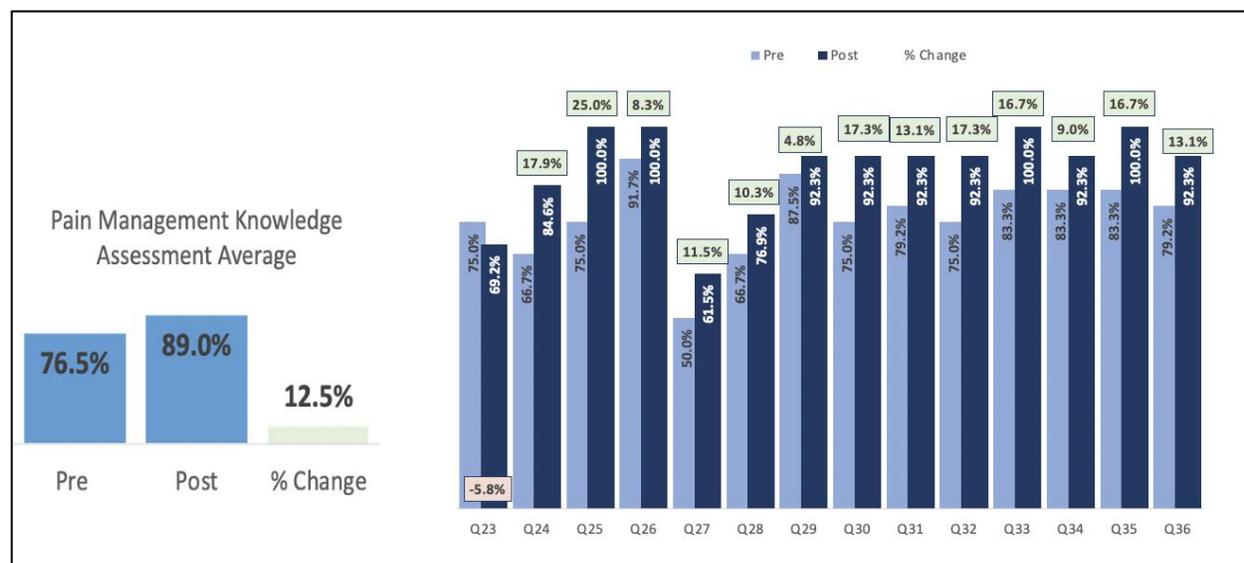
design, as the questions had multiple correct answers, which could have been confusing to the participant.

### Pain management knowledge assessment

Overall, participants averaged an increase in postoperative pain assessment knowledge by 12.5%. Meaning, before the educational intervention, respondents answered 76.5% of the assessment questions correctly, while the post-survey group answered 89% of the questions right. Except for one question there was an increase in knowledge in all the questions with four questions showing an increase in knowledge to 100%. Figure 4 illustrates the findings.

**Figure 4**

#### *Pain Management Knowledge Assessment*



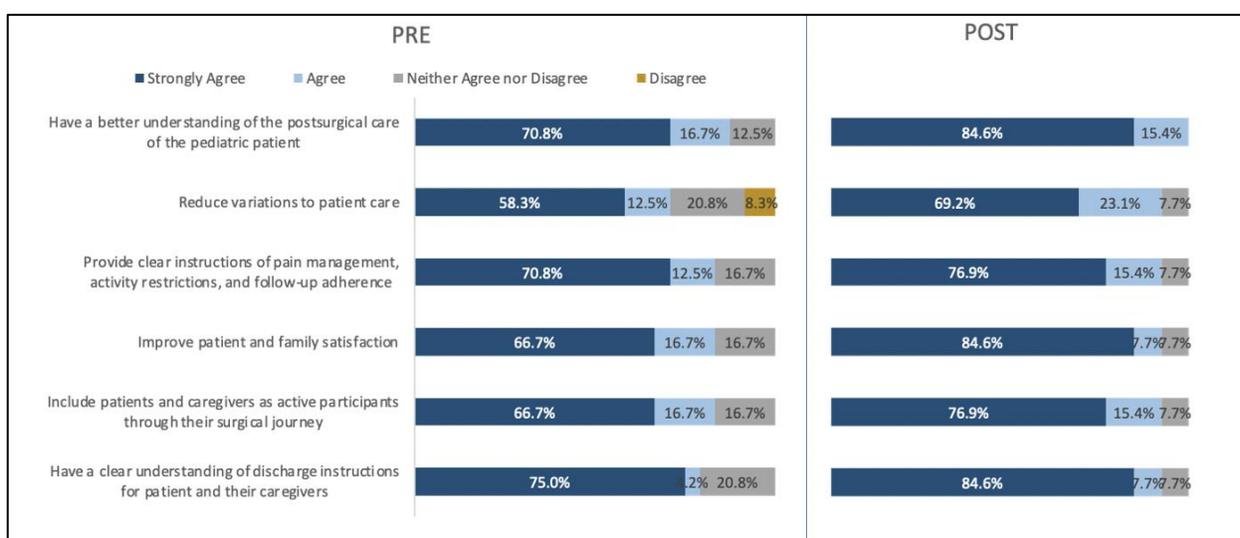
### Discharge knowledge assessment

Participants were asked to respond in agreement or disagreement regarding their postoperative Nuss discharge instructions knowledge utilizing an ERAS pathway. Overall, 81.2% of the pre-survey group strongly agreed or agreed that an ERAS pathway would help them to understand the post-surgical care of the pediatric surgical patient, provide them with

clear discharge instructions, allow them to include the patient, and the family as active participants in the surgical journey. After the educational intervention, 93.6% strongly agreed and agreed to understand better the discharge process, an increase in knowledge of 12.4%. Pre- and post-survey results for post-Nuss discharge patient knowledge assessment using an ERAS pathway are presented in Figure 5.

**Figure 5**

*Post Nuss Discharge Patient Education Knowledge Assessment with use of an ERAS Pathway*



## Discussion

The American Nurses Association (ANA) strongly advocates for nurses to be competent in their field with the goal to help people attain, maintain, and restore health (American Nurses Association [ANA], 2015). Inefficient post-surgical management of pediatric pain is attributed to non-compliance with pain management guidelines and interventions due to many factors, including nurses' knowledge deficits, negative attitudes, and pain and pain management perceptions. Findings from the QI project demonstrated that implementing a targeted educational program for the care of the pediatric patient who undergoes a Nuss procedure improved the

nurses' knowledge and attitudes that positively impacted the pain management practices. Moreover, a collaborative multidisciplinary approach accompanied by an education and awareness campaign showed to be a successful way to integrate surgical enhanced recovery pathways into practice.

Health education is one of the primary interventions to improve pain management practices in nurses. In their systematic review, AlReshidi et al. (2018) found that educational programs significantly improved factors related to pain management in children, such as the nurses' perceptions, knowledge, attitudes, and beliefs on pain and pain management. Realizing that the Nuss procedure for correcting pectus excavatum is associated with intense post-surgical pain and prolonged hospitalization, Wharton et al. (2020) examined whether enhanced recovery after surgery (ERAS) pathway could improve these adverse surgical outcomes. The study reported that enhanced recovery pathway programs decreased hospital stay to 2.90 from 3.49 days due to decreased pain scores and the use of urinary catheters leading to the subsequent decrease in emergency department visits. As such, ERAS pathways could serve as an effective measure to improve post-surgical pain management in pediatrics.

Subsequently, Puett and Smith (2018) sought to determine the feasibility of developing recovery protocols in children with pectus excavatum who undergo MIRPE procedure by conducting a systematic review of the literature. Their research reached similar conclusions to the prior studies and further highlighted the importance of nurses having a fundamental understanding of the ERAS programs, why the programs are important, and the nurses' expectations in executing these protocols. Thus, Puett and Smith recognized that nurses are key members of the ERAS team for their role as facilitators of the patient's transition through all the surgical phases.

Through the literature review, it was evident that standardization of clinical care pathways and protocols increases compliance rates for both the patient and the nurse. In their study, Litz et al. (2017) analyzed the implementation of ERAS protocol and further expanded on the effectiveness of the process in reducing utilization resources and decreasing length of stay. They reported significantly shorter times to start enteral narcotics with fewer resources allocated to radiological studies and blood draws. One of the challenges described in this study is the probability of accepting a higher rate of readmissions, thus supporting the need for proper patient and family education during preoperative visits and effective postoperative education by the nurse (Litz et al., 2017).

Lastly, in their study, Gurria et al. (2020) found that compliance with SCCPs decreased hospital LOS from 4.5 to 3.4 days due to improved pain management and patient satisfaction. These findings help support that quality improvement frameworks should be utilized in standardizing clinical care pathways to achieve optimal outcomes.

### **Implications for Advanced Nursing Practice**

In 2001 the ERAS Study Group first introduced an ERAS protocol for patients undergoing major abdominal surgery. The ERAS protocol was developed with an academic surgeon's collaboration to improve the postoperative recovery and reduce postoperative complications. Findings led to the standardization of evidence-based enhanced recovery protocols for the entire surgical process spectrum, including the preadmission, preoperative, operative, postoperative, and follow-up phase (Puett & Smith, 2018).

As vital stakeholders in pediatric surgical patient care, APRNs are expected to understand and utilize standardized, evidence-based pathways to improve surgical outcomes by reducing variations in provider and institutional care. As ERAS programs become more popular among

the pediatric surgical specialties, APRNs are in the ideal position to facilitate evidence-based protocols for multiple surgical interventions to standardize care and improve patient outcomes.

Furthermore, the nurse practitioners' scope and standards of practice encourage nurses to utilize guidelines to determine patient-care management that can improve care quality and decision-making practices. Thus, practice guidelines developed using systematic scientific evidence, and clinical expertise can effectively address a specific patient population and provide a practical framework for practice (ANA, 2015).

### **Dissemination and Sustainability**

To further serve the public and nursing profession, nurse practitioners must be active contributors in developing evidence-based guidelines and standards of practice. Such guidelines and practice standards should be evaluated and revised on an ongoing basis to promote the quality of practice and support its dissemination effectively. As the body of nursing research continues to grow within a dynamic health care environment, nurses must strive to maintain and develop competent clinical practices that heighten the quality of pediatric nursing care (ANA, 2015).

As part of the QI project, an ERAS pathway was developed for the pediatric patient post-Nuss procedure. The ERAS pathway was developed with a collaboration with team a of stakeholders, including the pediatric surgeon, pain team nurse practitioner, child life, physical therapist, clinical specialist, nurses, and surgical nurse practitioners. The hospital has approved this pathway and will now be implemented for all the patients undergoing a Nuss procedure. The postoperative surgical care and the discharge instructions provided in the ERAS pathway are now available in the electronic record and can be downloaded into the patient's chart and printed for families and patients to have available as reference.

Additionally, the educational intervention has been developed into an interactive learning module that will be required onboarding learning for all new pediatric surgical nurses and pediatric surgical nurse practitioners. The module is housed in the Myles educational platform, where all the hospital's educational material is contained.

Lastly, project findings will be presented at the American Pediatric Surgical Nurses Association, Inc (APSNA) Annual Conference in collaboration with the Chest Wall Special Interest Group (SIG). A manuscript will also be submitted to the Journal of Pediatric Surgical Nursing for publishing.

### **Limitations**

Limitations to the QI project included sample attrition due to differences in the number of responders who participated in the pre-test versus the post-test, nursing time restriction, and heavy nursing workload. It was also noted that the project survey coincided with the hospital-wide second quarter mandatory education modules making this survey a burden to the nurses to complete

### **Conclusion**

The delivery of high-quality pain management in the postoperative environment can be challenging to quantify. Commonly used tools in delivering care, such as pain intensity ratings, individual pain experience reporting, assessments of individual patients' expectations, and patient satisfaction scores, have limitations and are not always helpful when addressing quality improvement measures. Despite clinical advances in pain management, patients continue to experience inadequate pain control and inconsistent pain management practices. Nurses, who are often the first to identify when patients are experiencing pain and frequently advocate for patient's rights, lack knowledge in managing the pediatric patient's postoperative pain.

Health education was found to be one of the primary interventions to improve pain management practices in nurses. Therefore, nurses and their organizations should design and implement programs to improve clinicians' knowledge and attitudes to impact positively pain management practices in pediatrics. More measures, such as SCCPs and ERAS pathways, should be executed to promote compliance with pain management interventions. This effort can result in better pain management, lower pain scores, reduced patient stress, fewer complications, quick recovery, and significant improvements in patient satisfaction, outcomes, and reduction in the cost of care. As demonstrated by the findings of the QI project, ERAS pathways can successfully be placed into practice by employing a structured, collaborative, multidisciplinary approach in addition to an education and awareness campaign.

This project may encourage other initiatives for developing new approaches and policies for improving processes and outcomes on the quality of surgical care by the nursing profession to benefit the pediatric patient. Nurse practitioners can continue to contribute to nursing knowledge through creative approaches that improve healthcare practice, including conducting research that evaluates knowledge further to promote clinical analysis (ANA, 2015).

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## Appendix A:

### Participant Questionnaire



### Improving pediatric nurses' knowledge of postoperative care for the pediatric patient undergoing surgical correction of pectus excavatum

#### Introduction:

This questionnaire is an essential part of a quality improvement project aiming to increase the pediatric surgical nurses' postoperative knowledge of pediatric patients who undergo a Nuss procedure for the correction of pectus excavatum chest wall deformity. Please, answer to the best of your knowledge. Your response will help to understand gaps in knowledge and room for improvement. The questions are structured to assess your understanding of pectus excavatum, Nuss procedure, postoperative enhanced recovery guidelines, pain management, patient education, and post-surgical management.

- *Please do not write your name of other personal information on this questionnaire*
- *Your answers are anonymous and will be kept confidential*
- *Your participation is voluntary and will not have any bearing on your position*

#### Demographic:

Gender: Female \_\_\_\_\_ Male \_\_\_\_\_ Non-binary/third gender \_\_\_\_\_ Prefer not to say \_\_\_\_\_

Age: 20 – 30 yrs. \_\_\_\_\_ 31 – 40 yrs. \_\_\_\_\_ 41 -50 yrs. \_\_\_\_\_ > 50yrs \_\_\_\_\_

How long have you been a nurse (in years)? \_\_\_\_\_

Ethnicity: White \_\_\_\_\_ Black or African American \_\_\_\_\_ Hispanic \_\_\_\_\_ Asian \_\_\_\_\_ Other \_\_\_\_\_

Position: RN \_\_\_\_\_ APRN \_\_\_\_\_ Other \_\_\_\_\_

#### Questionnaire:

1. Have you received any type of training on the care of patients who have pectus excavatum?  
  
\_\_\_\_\_ No \_\_\_\_\_ Yes  
If yes, how long ago? \_\_\_\_\_
2. Have you ever received education on the postsurgical management of the pediatric who has undergone Nuss procedure for pectus excavatum?

\_\_\_\_\_ No                      \_\_\_\_\_ Yes  
 3. Have you received any training on postsurgical enhanced recovery pathways (ERAS)?

\_\_\_\_\_ No                      \_\_\_\_\_ Yes  
 4. *Please respond to the following statements:*

Statement	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
I am very familiar with pectus excavatum diagnosis					
I am knowledgeable about the surgical technique for the Nuss procedure					
I am confident in my knowledge of postsurgical pain management for the pediatric patient					
I have the necessary skills to effectively care for the postoperative pediatric patient who has undergone a Nuss procedure					
I am comfortable with following postoperative protocols and engaging the patient and family with discharge planning					

5. *Please answer the following statement:*

How often do you:

Statement	Always	Frequently	Rarely	Never
Provide education on the outpatient postsurgical pain management regimen				
Provide education about activity restrictions to postsurgical Nuss patients				
Include patients and family in the decision making of discharge instructions for the postsurgical Nuss patient				

Utilize established protocols or practice guidelines in the discharge process				
Provide patient and families with written information of their discharge instructions				

### Assessment of knowledge

#### *True or False*

6. Pectus excavatum is the most common chest wall anomaly in children characterized by a deep depression in the mid-chest.

\_\_\_\_\_ True                      \_\_\_\_\_ False

7. Surgical correction is sought out during infancy to correct cardiorespiratory and psychological difficulties cause by the deformity.

8. \_\_\_\_\_ True                      \_\_\_\_\_ False

9. The standard care for the correction of pectus excavatum is a thoracoscopic assisted minimally invasive repair of pectus excavatum (MIRPE) which is also known as the Nuss procedure.

\_\_\_\_\_ True                      \_\_\_\_\_ False

10. Postoperative pain is the principal cause of increased length of stay and return visits to the emergency room.

\_\_\_\_\_ True                      \_\_\_\_\_ False

11. Which of these patients are the best candidates for surgical repair of pectus excavatum?

- \_\_\_\_\_ Children between the ages of 4-10 years of age with a depression of the chest wall  
 \_\_\_\_\_ Adolescents between the ages of 10-17 year of age who have a deep mid-chest wall depression causing cardiac and respiratory compromise  
 \_\_\_\_\_ Young adults between the ages of 18-25 years of age with asymptomatic pectus excavatum  
 \_\_\_\_\_ Infants who are born with a chest wall depression

12. Pectus excavatum is present most common in:

\_\_\_\_\_ Males                      \_\_\_\_\_ Females

13. The MIRPE or Nuss procedure involves:

- Incision across the chest and the removal of the cartilage that causes the defect
- Surgical elevation of the chest produced when a metal pectus bar is slowly pulled through the mid-chest and placed under the sternum under thoracoscopic guidance
- Placement of a chest brace that produces gentle pressure to gradually correct the area of protrusion

14. Enhanced recovery after surgery (ERAS) protocols are designed to: *Select all that apply*

- Reexamine traditional practices and replaced them with standardized evidence-based practice guidelines
- Provide a multimodal perioperative care pathway to achieve early recovery for patients undergoing major surgery.
- Cover all the areas of the patient's surgical journey – preoperative, operative, and postoperative course
- Provide a strict guideline without need for individualization

15. Enhanced recovery pathways (ERAS) have proven to: *Select all that apply*

- Minimize length of stay
- Decrease postsurgical complications
- Encourage emergency room visits post discharge
- Increase patient and family satisfaction

16. The MOST common complication for the postsurgical Nuss patient is:

- Pneumonia
- Pneumothorax
- Postsurgical pain
- Bar displacement

### **Pain Management Knowledge Assessment**

17. Vital signs are always reliable indicators of the intensity of a patient's pain.

- True  False

18. Patients who can be distracted from pain usually do not have severe pain.

- True  False
19. Patients may sleep despite of severe pain.

True  False

20. Combining analgesics that work by different mechanisms (e.g., combining an NSAID with an opioid) may result in better pain control with fewer side effects than using a single analgesic agent.

True  False  
 21. The usual duration of analgesia of 1-2 mg morphine IV is 4-5 hours.

True  False  
 22. Opioids should be used in patients with a history of substance abuse only when other forms of pain relief have been ineffective.

True  False  
 23. Patients should be encouraged to endure as much pain as possible before using an opioid.

True  False  
 24. Patients' spiritual beliefs may lead them to think pain and suffering are necessary.

True  False  
 25. After an initial dose of opioid analgesic is given, subsequent doses should be adjusted in accordance with the individual patient's response.

True  False  
 26. The recommended route administration of opioid analgesics for patient with brief, severe pain of sudden onset such as trauma or postoperative pain is:

- Intravenous
- Intramuscular
- Subcutaneous
- Oral
- Rectal

27. Analgesics for post-operative pain should initially be given:

- Around the clock on a fixed schedule
- Only when the patient asks for the medication
- Only when the nurse determines that the patient has moderate or greater discomfort

28. The most likely reason a patient with pain would request increased doses of pain medication is:

- The patient is experiencing increased pain
- The patient is experiencing increased anxiety or depression
- The patient is requesting more staff attention
- The patient's requests are related to addiction

29. In verbal patients, the most accurate judge of the intensity of the patient's pain is:

- The treating physician  
 The patient's primary nurse  
 The patient  
 The pharmacist  
 The patient's parent or family

30. Patients who have limited out of bed activities and do not request PRN opioid analgesics have well managed pain.

True  False

### **Nuss Discharge Patient Education Knowledge Assessment**

31. *Please answer the following statement:*

Access to an evidence-based standardized postsurgical enhanced recovery after surgery (ERAS) for Nuss procedure protocol will allow me to:

Statement	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Have a better understanding of the postsurgical care of the pediatric patient					
Reduce variations to patient care					
Provide clear instructions of pain management, activity restrictions, and follow-up adherence					
Improve patient and family satisfaction					
Include patients and caregivers as active participants through their surgical journey					
Have a clear understanding of discharge instructions for patient and their caregivers					

## Appendix B



January 2020

The “Knowledge and Attitudes Survey Regarding Pain” tool can be used to assess nurses and other professionals in your setting and as a pre and post test evaluation measure for educational programs. The tool was developed in 1987 and has been used extensively from 1987 – present. The tool has been revised over the years to reflect changes in pain management practice.

Regarding issues of reliability and validity: This tool has been developed over several years. Content validity has been established by review of pain experts. The content of the tool is derived from current standards of pain management such as the American Pain Society, the World Health Organization, and the National Comprehensive Cancer Network Pain Guidelines. Construct validity has been established by comparing scores of nurses at various levels of expertise such as students, new graduates, oncology nurses, graduate students, and senior pain experts. The tool was identified as discriminating between levels of expertise. Test-retest reliability was established ( $r > .80$ ) by repeat testing in a continuing education class of staff nurses ( $N=60$ ). Internal consistency reliability was established ( $\alpha > .70$ ) with items reflecting both knowledge and attitude domains.

Regarding analysis of data: We have found that it is most helpful to avoid distinguishing items as measuring either knowledge or attitudes. Many items such as one measuring the incidence of addiction really measures both knowledge of addiction and attitude about addiction. Therefore, we have found the most benefit to be gained from analyzing the data in terms of the percentage of complete scores as well as in analyzing individual items. For example, we have found it very helpful to isolate those items with the least number of correct responses and those items with the best scores to guide your educational needs.

Enclosed for your use is a copy of our instrument and an answer key. You may use and duplicate the tool for any purpose you desire in whole or in part. References to some of our studies which have included this tool or similar versions are included below. We have received hundreds of requests for the tool and additional use of the tool can be found in other published literature. We also acknowledge the assistance of several of our pain colleagues including Judy Paice, Chris Pasero, and Nessa Coyle in the revisions over the years. If using or publishing the tool results please cite the reference as **“Knowledge and Attitudes Survey Regarding Pain” developed by Betty Ferrell, RN, PhD, FAAN, ([www.cityofhope.org/NRE/resources](http://www.cityofhope.org/NRE/resources)), revised 2014.**

We hope that our tool will be a useful aid in your efforts to improve pain management in your setting. Sincerely,

Betty Ferrell, Ph.D., C.H.P.N., F.A.A.N., F.P.C.N.  
Director and Professor, Division of Nursing Research and Education, Department of Population Sciences  
City of Hope

## Appendix C

### Letter of Recruitment

**Recruitment email for improving pediatric nurses' knowledge of postoperative care for the pediatric patient undergoing surgical correction of pectus excavatum: A quality improvement project**

Dear Nicklaus Nurse,

My name is Carmen R. Duque, and I am a student from the Graduate Nursing Department at Florida International University. I am writing to invite you to participate in my quality improvement project. The goal of this project is to improve the nurses' knowledge of postoperative care for the pediatric patient undergoing surgical correction of pectus excavatum. You are eligible to participate in this project because you are a registered nurse at Nicklaus Children's Hospital, and you provide or may provide care to postoperative pediatric patients. I am contacting you with the permission of your nursing director and the Nursing and Evidence-Based Council at Nicklaus Children's Hospital.

If you decide to take part in this project, you will be asked to complete and sign a consent form for participation. You will complete a pre-test questionnaire, which is expected to take approximately 10 minutes. Then, you will then be asked to view an approximately 15-minute-long educational presentation online. After watching the educational presentation, you will be asked to complete the post-test questionnaire, which is expected to take approximately 10 minutes. No compensation will be provided.

Remember, this is completely voluntary. You can choose to be in the study or not. If you'd like to participate, please click on the link provided (link for Qualtrix questionnaire). By clicking on the link, you are consenting to participate.

If you have any questions about the study, please email or contact me at [cduqu015@fiu.edu](mailto:cduqu015@fiu.edu) or 305-298-7897.

Thank you very much.

Sincerely,



Carmen R. Duque

## Appendix D

**IRB Approval Letter Florida International University**

**Office of Research Integrity  
Research Compliance, MARC 414**

**MEMORANDUM**

**To:** Dr. Charles Buscemi  
**CC:** Carmen Duque  
**From:** Maria Melendez-Vargas, MIBA, IRB Coordinator   
**Date:** February 22, 2021  
**Protocol Title:** "Improving pediatric nurses' knowledge of postoperative care for the pediatric patient undergoing surgical correction of pectus excavatum: A quality improvement project."

The Florida International University Office of Research Integrity has reviewed your research study for the use of human subjects and deemed it Exempt via the **Exempt Review** process.

**IRB Protocol Exemption #:** IRB-21-0061      **IRB Exemption Date:** 02/22/21  
**TOPAZ Reference #:** 110025

As a requirement of IRB Exemption you are required to:

- 1) Submit an IRB Exempt Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved prior to implementation.
- 2) Promptly submit an IRB Exempt Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
- 3) Submit an IRB Exempt Project Completion Report Form when the study is finished or discontinued.

**Special Conditions:** N/A

For further information, you may visit the IRB website at <http://research.fiu.edu/irb>.

MMV/em

## Appendix E

### IRB Approval Letter Nicklaus Children's Hospital



3/11/21

Dear Ms. Duque,

This letter is to confirm review and approval of your Quality Improvement project, "Does providing pediatric nurses with an educational course on the postoperative care of the pediatric patient undergoing surgical correction of pectus excavatum surgery improve their knowledge of postoperative care?" This project will be supervised through your advisor at Florida International University, and was reviewed and deemed to be Quality Improvement by the Florida International University IRB. Therefore, no IRB review or approval through Nicklaus Children's Hospital is required. The goals of this project align with those of our organization, and we welcome the opportunity to support this project at Nicklaus Children's Hospital.

Sincerely,

*Danielle Sarik, PhD, APRN-PC, RN*

Danielle Sarik PhD, APRN, CPNP-PC  
Research Nurse Scientist  
Nicklaus Children's Hospital  
(786) 624-2314