IMPLEMENTATION OF AN EVIDENCE-BASED INCENTIVE SPIROMETRY GUIDELINE: AN INITIATIVE TO PROMOTE PEDIATRIC SICKLE CELL NURSES' KNOWLEDGE AND DOCUMENTATION ADHERENCE

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Caroline A. Bell, M.S.

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Caroline A. Bell, M.S.

Thesis Advisor: Krista A. White, PhD

ABSTRACT

Over 50% of children with homozygous sickle cell disease (HbSS) will have at least one episode of acute chest syndrome in the first decade of life. Literature validates that incentive spirometry use in patients with sickle cell disease suffering from vasoocculsive crisis reduces the incidence of acute chest syndrome. The project site, an outpatient pediatric clinic, had no guidelines for the nursing staff regarding the initiation of incentive spirometry for sickle cell patients. The primary aim was to assess nursing knowledge and documentation adherence pre- and post-educational session about a new evidence-based incentive spirometry guideline. Secondary aims were to: (1) discover common themes about the implementation of the new guideline and (2) determine similarities or differences of adherence to documentation related to demographic characteristics of the nurses. First, a guideline was created to guide the proper use of incentive spirometry in sickle cell patients requiring urgent care. Education was then provided to the nurses surrounding this new guideline. Two informal focus groups (at 2 weeks and 9 weeks) were held to incorporate nursing feedback regarding guideline implementation. Documentation data were extracted from the charts to determine adherence to the new guideline. Nurses' knowledge (N = 13) about incentive spirometry usage improved significantly from pre-test (Mean = 2.92) to post-test (Mean = 4.62) (p = .002). The rate of documented adherence demonstrated the staff's willingness to incorporate the new guidelines as

14 out of 31 encounters included documentation. There is room for improvement. The qualitative data obtained during the focus groups supported the use of “nurse champions” and the use of verbal and printed reminders to encourage adherence. The use of “nurse champions” is important to sustain this practice change.

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Chapter 1

Introduction and Review of Evidence

The purpose of this chapter is to introduce and provide background information about sickle cell disease, acute chest syndrome (ACS), and incentive spirometry as it relates to the clinical question for the project. The five elements of a clinical question and key terms related to this subject are defined. This chapter also addresses the impact of ACS on pediatric patients, their families, and the healthcare system. Next, an organizational needs assessment and subsequent gap analysis are presented. A detailed explanation of the search strategy used to obtain relevant literature and analysis of that literature is articulated. The literature grading system is explained. Using Lewin's change model as the theoretical framework, the chapter also explores behavior change as it relates to nurse's use of incentive spirometry. Finally, rationale as well as aims for the Doctor of Nursing project are discussed.

Problem Description

Sickle cell disease is one of the most common genetic diseases effecting approximately 100,000 people in the United States and millions of people throughout the world (Tanabe et al., 2019). It is the most commonly inherited blood disorder in United States with approximately 2,000 newborns diagnosed each year (American Academy of Pediatrics [AAP], 2019). Of those affected with sickle cell disease in the United States, approximately 90% of patients are Black and approximately 10% are Hispanic (Tanabe et al., 2019). It is caused by a point mutation in the Beta globin gene, a single substitution of valine for glutamic acid (Neumayr et al., 2019). The result of this amino acid change is an abnormally shaped red blood cell. This structural abnormality causes the red blood cell membrane to become more rigid and thus results in a

multitude of pathophysiological complications for patients. Of the four most common genotypes, (HbSS, HbSBeta0, HbSC and HbSBeta+) HbSS and HbSBeta0 are generally the most clinically severe types of the disease (Tanabe et al., 2019). Some of the most common complications of sickle cell disease include acute chest syndrome, painful vasoocclusive crisis, stroke, retinopathy, priapism, pica, nocturnal enuresis, leg ulcers, gallstones, and avascular necrosis.

The pathophysiological complication of acute chest syndrome (ACS) is one of the most common causes of acute lung disease in patients with sickle cell disease. In sickle cell disease, ACS is defined as "the presence of fever and/or new respiratory symptoms accompanied by the presence of a new pulmonary infiltrate on chest X-ray" (Jain et al., 2017, p. 191). Long-term lung function is negatively impacted by childhood episodes of ACS (Reagan et al., 2011). More than half the children with homozygous sickle cell disease (HbSS) will have at least one episode of ACS resulting in an increased level of morbidity and mortality in this population (Jain et al., 2017). ACS can be precipitated by a vasoocculsive crisis with or without respiratory symptoms. The treatment for ACS includes antibiotics, analgesics, incentive spirometry, intravenous hydration and in some cases, oxygen, or blood transfusion support (Jain et al., 2017).

For 25 years, literature has suggested that the use of incentive spirometry in patients with sickle cell disease suffering from painful vasoocculsive crisis reduces the incidence of ACS (Bellet et al., 1995). More recently, studies have shown incentive spirometry use is crucial for all sickle cell patients experiencing a vasoocculsive crisis, as even patients with non-pulmonary symptoms and pain can progress to ACS (Ahmad et al., 2011). Currently, there are evidence-based guidelines developed by the National Heart, Lung, and Blood Institute (NHLBI) for the prevention of ACS in sickle cell patients that include encouraging the use of incentive spirometry every two hours while awake (National Heart, Lung, and Blood Institute [NHLBI], 2014).

Nurses play a key role in the administration of this treatment and supportive care measures for pediatric sickle cell patients.

Impact of Acute Chest Syndrome on Patients and Families

ACS is a leading acute cause of mortality in all patients with sickle cell disease (Ruhl et al., 2019). Because of the acute nature of the disease and propensity for children to decompensate rapidly, ACS in the pediatric sickle cell population is managed in an inpatient hospital setting. Consequently, there is increased anxiety and stress to the parents and hospitalizations are burdensome to families. Research has shown that caregivers of children with chronic illnesses experience stress as they are forced to balance work, taking care of siblings and being physically and emotionally present for their often critically ill child (Moody, 2021). This problem further highlights the pivotal role of the outpatient nurse in providing incentive spirometry to patients in a timely manner to decrease the incidence of early onset ACS. Nurses in both the inpatient and outpatient settings play a key role in not only the care of these patients but also in providing family support and reducing parental stress and anxiety.

Impact of Acute Chest Syndrome on Providers, Institutions, and the Health Care System

Caring for a pediatric patient with ACS is challenging for healthcare providers as there are limited evidence-based guidelines due to the shortage of data from trials in the pediatric population (Tanabe et al., 2019). This paucity of data has often been attributed to the patient demographics and the "conscious or unconscious racial bias" that exists surrounding Black and Hispanic Americans (Tanabe et al., 2019, p. 27). Although pulmonary complications are the most common etiology of increased morbidity and mortality in children with sickle cell disease, the existing guidelines from the NHLBI lack high quality data and limit their usefulness in treating ACS (Ruhl et al., 2019).

Management of ACS may be a challenge for clinicians who are not familiar with children with sickle cell disease as ACS can develop in any sickle cell patient who presents with a vasoocclusive crisis, even if the patient is not experiencing respiratory symptoms (Ahmad et al., 2011). Nursing staff in the outpatient setting must be skilled in evaluating subtle changes in breathing or vital signs that may indicate a patient who is having a vasoocculusive crisis is now developing ACS. Use of an incentive spirometer every two hours while awake combined with proper analgesia to relieve the pain of splinting is important to decrease the risk of ACS in these patients (Ahmad et al., 2011; Bellet et al., 1995). Through vigilant monitoring of pain control and early initiation of incentive spirometry, outpatient nurses can play an important role in the prevention of ACS.

ACS also presents a significant economic impact on the healthcare system of the United States. Data analyzed between 2009 and 2012 by Bou-Maroun and colleagues (2018) showed that hospitalizations for sickle cell patients with ACS averaged $162,797,570 in yearly expenditures with the median hospital charge of $22,631 per admission. Prevention of ACS through nurse led interventions beginning in the outpatient setting, such as the use of incentive spirometry, can help decrease these significant healthcare expenditures.

Ethical Issues of Funding and Access

Sickle cell disease occurs in mainly Black and Hispanic Americans, racial and ethnic groups that often have inadequate access to healthcare and are profoundly affected by the social determinants of health (Ruhl et al., 2019). As a result, health disparities continue to affect a limited understanding of the disease progression and complications (Ruhl et al., 2019). In fact, although sickle cell disease is three times more prevalent than cystic fibrosis (a disease generally affecting Caucasians) it received the same amount of funding from the National Institutes of

Health from 2008-2018 (Farooq et al., 2020). Ethical concerns exist secondary to insufficient funding for research into new therapies for sickle cell disease, and inequitable access to resources for the populations it affects. While mortality for children with sickle cell disease living in areas with adequate access to resources has improved, mortality related to pulmonary complications such as ACS, remains a significant burden during a patient's lifetime (Ruhl et al., 2019).

In addition to lack of adequate funding, another ethical challenge lies in adequate access to properly trained healthcare professionals. This results in many patients with sickle cell disease lacking "consistent disease-specific access to quality care" (Ogu et al., 2021 p. 103). This lack of exposure to patients with sickle cell disease can lead to a nursing knowledge deficit in best practice guidelines such as those surrounding the use of incentive spirometry. As a result of this inequity, the American Society of Hematology (ASH) and the Association of Pediatric Hematology Oncology Nurses (APHON) have placed renewed emphasis on research and care improvement initiatives to advance the quality of healthcare for children living with sickle cell disease (ASH, 2021). Educating nursing staff about the importance of early use of incentive spirometry to reduce the risk of ACS can be the first step in combatting this ethical issue.

Organizational Needs Assessment

Organizational needs assessments are used to determine the necessities of a particular organization through a collection of information and observations (Moran et al., 2020). A needs assessment is necessary to identify gaps and to improve practices within an organization. This section examines the deficits identified at the project site after completion of a gap analysis.

Project Setting

This Doctor of Nursing (DNP) project took place in a large outpatient hospital-based hematology oncology clinic in the northeastern region of the United States. At the time of project implementation, the healthcare team was comprised of 15 attending physicians, nine nurse practitioners, 15 Registered Nurses, six licensed practical nurses, four nursing assistants, two phlebotomists, and one nurse manager. This team cares for pediatric patients from birth to 21 years old with various diagnoses related to hematological and oncological disorders. Examples of common diagnoses include sickle cell and various anemias, bleeding disorders, thromboses, and various types of cancer. Approximately 150 children with sickle cell disease are cared for per month in this clinic for routine and acute sickle cell care. On average, six of these children with sickle cell disease per month will develop ACS, therefore the focus of this project was on the acute or urgent care portion of the clinic.

Gap Analysis

Gap analysis is a process in which the gap between the current state of an organization and the potential or target state of an organization is determined (Davis-Ajami et al., 2014). Gap analysis results found that in the *current state* of clinical practice no guidelines exist surrounding the use of incentive spirometry for patients with sickle cell disease who urgently come to the clinic with pain. The absence of a practice guideline regarding the use of incentive spirometry impacts the quality of pediatric patient care, as staff are often left to decide what is best for a patient based solely on their own clinical experience and judgment. Best practice guidelines from the NHLBI indicate that all patients with sickle cell disease and pain of any kind and in any location should be using an incentive spirometer to help prevent ACS (Bellet et al., 1995; Ruhl, et al., 2019). Nurses within the outpatient clinic play an integral role in patient and family teaching on a regular basis. Education of nursing staff combined with a change in clinical

practice can help bridge this gap. A *target state* would be development of a clinic wide practice guideline, education of nursing staff surrounding this guideline, and subsequent practice change.

Clinical Question

Use of the PICOT format is defined as the best approach to formulate a good clinical question. Clinical questions and the elements of PICOT provide key terms for searching literature (Melnyk & Fineout-Overholt, 2014). The PICOT question for this scholarly project was: *Among outpatient pediatric nurses who care for sickle cell patients, how does the implementation of an evidence-based best practice incentive spirometry guideline and education around that guideline, compared to no standardized incentive spirometry education impact nurses' knowledge level and adherence to incentive spirometry documentation over a period of eight weeks?*

Definition of Terms

Pediatric nurses. Registered Nurses (RNs) are frontline staff who directly care for children from birth through 21 in the outpatient setting at the project site.

Sickle cell disease. Sickle cell disease is an autosomal recessive genetic condition where a single base pair mismatch "alters the shape and function of the hemoglobin molecule, causing red blood cells to take on the shape of a sickle or crescent" (Tanabe et al., 2019, p. 26).

Pediatric patient. Individual between the ages from birth through 21.

Acute Chest Syndrome. Acute Chest Syndrome (ACS) is a clinical syndrome defined as "the presence of fever and/or new respiratory symptoms accompanied by the presence of a new pulmonary infiltrate on chest X-ray" (Jain et al., 2017, p. 191). ACS only occurs in patients with sickle cell disease with an incidence of 12.8/100 patient years for patients with homozygous

sickle cell disease (Castro et al., 1994). It is a leading cause of acute mortality in patients with sickle cell disease (Ruhl et al., 2019).

Incentive spirometry. An incentive spirometer is small, plastic handheld device that "measures the inspiratory capacity of the lungs and is designed to encourage deeper inspiratory effort" (Bellet et al., 1995, p. 699). Incentive spirometry is a nurse led intervention that is defined as "a non-invasive approach to prevent hypoventilation and pulmonary complications by encouraging regular deep inspiration" (van Tuijn et al., 2020, p. E161). Incentive spirometry is a key component of reduction and prevention of ACS in patients with sickle cell disease.

Vasoocclusive crisis. A vasoocculusive crisis or vasoocculusive event is defined as "new onset of severe pain that lasts more than four hours for which there is no explanation other than vasoocclusion" (Tanabe et al., 2019, p. 28). Physiologic similarities in vasoocculusive crisis and ACS suggest that the mechanism for these events, vascular occlusion, is the underlying process for both complications (Castro et al., 1994).

Incentive Spirometry Guidelines for Pediatric Sickle Cell Disease (IS-SCD). An evidence-based best practice clinical practice guideline developed by the Principal Investigator (PI) using existing literature including the landmark article from Bellet et al. (1995).

Nursing knowledge. A comparison of the pre-knowledge survey and post-knowledge survey was analyzed to determine knowledge gained through the education session.

Documentation Adherence. Chart audit, completed by the PI, of all urgent visits for the nine weeks following the implementation of the new practice guideline and nursing education session to determine adherence with incentive spirometry documentation.

Search Strategy

Terms relevant to the topic and the elements of the clinical question were combined using Boolean operators and were searched in two professional databases, Ovid MEDLINE and EMBASE. The terms included sickle cell disease (Medical Subject Headings or MeSH) "OR" sickle cell disease.mp (keyword) "OR" HbSS "OR" sickle cell disease "OR" sickle cell anaemia "AND" ACS (MeSH) "OR" ACS.mp (keyword) "OR" ACS "AND" incentive spirometer (MeSH) "OR" incentive spirometer.mp (keyword) "OR" spirometry (MeSH) "OR" spirometery.mp. Web of Science and PubMed searches were subsequently conducted. The search in all databases was then limited to English language. Exclusion criteria were as follows: articles unrelated to the PICOT question and population, conference abstracts and posters, expert panels, and opinion pieces. No date range was set due to the dearth of literature related to this topic.

The Ovid MEDLINE search resulted in 27 articles of which three articles (Ahmad et al., 2011; Bellet et al., 1995; Crabtree et al., 2011) were retained. These articles included the landmark randomized controlled trial (Bellet et al., 1995) and follow up study by Ahmad et al. (2011) highlighting the importance of the use of incentive spirometry to prevent ACS in children with sickle cell disease. The third article described a quality improvement project that presented important data surrounding standardized clinical practice guidelines and ACS reduction (Crabtree et al., 2011).

The EMBASE search resulted in 107 articles which was narrowed by those unrelated to the elements of the PICOT question. After review of titles and abstracts, one article was retained (DeBaun et al., 2014). This article helped to identify factors that placed pediatric patients at increased risk for ACS. Some of the factors discovered in this prospective observational cohort study included asthma, history of ACS at an early age, wheezing causing shortness of breath, and

allergy history confirmed on skin test (DeBaun et al., 2014). These factors highlight the need for incentive spirometry use in this population.

Using the landmark study (Bellet et al., 1995) as a search term, the Web of Science search results showed that it was cited 157 times. From this search, four articles (Madhi et al., 2019; Patterson et al., 2018; Reagan et al., 2011; Takahashi et al., 2018) were obtained. The researchers in each of these studies reviewed clinical factors or interventions that would reduce ACS in pediatric sickle cell patients. Madhi et al. (2019) was a prospective observational study that focused on the laboratory markers associated with ACS, noting that half of all ACS occur after an acute vasoocculusive crisis. The article emphasizes the importance of incentive spirometry in reducing the risk evolution of ACS during a vasoocculusive crisis. Patterson et al. (2018) was a retrospective chart review that identified that longer length of hospital stay was associated with an increased risk of ACS, thus highlighting the importance of measures to decrease the risk of ACS including the use of incentive spirometry. The Reagan et al. (2011) study focused primarily on educational interventions and implementation of a standardized clinical pathway that reduced the incidence of ACS through the combination of proper pain management and use of incentive spirometry. Takahashi et al. (2018) was a large retrospective chart review that reviewed the epidemiological risk factors associated with development of ACS.

Finally, a PubMed search was conducted using the terms "spirometry sickle cell acute chest" which resulted in 34 articles. One article was retained (Duckworth et al., 2020). This study assessed the role of spirometry testing in ACS reduction in patients with asthma and sickle cell disease. In total, nine articles were retained for analysis.

Available Knowledge

The literature involving the use of incentive spirometry to prevent ACS was appraised using the Let Evidence Guide Every Decision (LEGEND) system. This system was designed as a "three-dimensional matrix with the study design and domain of the clinical question mapped against the quality level" (Clark et al., 2009, p. 1057). The LEGEND system was used to grade qualitative, quantitative, or mixed methods studies by assigning an alpha-numeric rating of evidence-based upon the type and quality of evidence. The numerical system graded each study from 1 to 5 with level of evidence according to type of evidence and study design. Next, each study was appraised as "good quality, lesser quality, or lacking validity, reliability, or applicability" (Clark et al., 2009, p. 1057). This appraisal helped to determine the lettering as an "a" or "b" after the numbering l indicating a "good quality" or "lesser quality" study. The final grade ranged from the highest quality evidence as 1a, which included systematic reviews and meta-analyses, to the lowest quality of evidence 5b, which included case reports and published opinion.

After reviewing the quality of each individual study, the LEGEND system was used to grade the entire body of evidence. The assignment of a final grade of high, moderate, or low allows the clinician to draw conclusions about the quality of the evidence and make best practice recommendations surrounding the chosen topic. The process of characterizing the strength of the recommendations was based on a tool called "Judging the Strength of a Recommendation" (Cincinnati Children's Hospital Medical Center, 2012b). This tool lends credibility to an assessment and allows standardization across different types of studies.

Of the nine studies selected and analyzed only two, a randomized controlled trial (Bellet et al., 1995) and a prospective cohort study (DeBaun et al., 2014), received a grade of 2a based on the LEGEND rating system. Two of the prospective cohort studies (Reagan et al., 2011;

Madhi et al., 2019) were graded as a 3a. Five studies were retrospective reviews and thus, were determined to be a 4a using the LEGEND rating system (Ahmad et al., 2011; Crabtree et al., 2011; Duckworth et al., 2020: Patterson et al., 2018; Takahashi et al., 2018).

Despite this lack of quality evidenced-based data, there were some similarities throughout the literature that can be highlighted. Age (birth to 21 years) was consistent across eight of nine studies (Ahmad et al., 2011; Bellet et al., 1995; Crabtree et al., 2011; DeBaun et al., 2014; Madhi et al., 2019; Patterson et al., 2018; Reagan et al., 2011; Takahashi et al., 2018). Duckworth et al. (2020) was the only study included where some patients were greater than 21 years of age.

Seven of the nine studies were conducted with the pediatric sickle cell population in the United States (Ahmad et al., 2011; Bellet et al., 1995; Crabtree et al., 2011; Duckworth et al., 2020; Patterson et al., 2018; Reagan et al., 2011; Takahashi et al., 2018). The remaining studies took place in Europe or in multicenter trials across two countries. Madhi et al. (2019) was conducted at a hospital outside of Paris, France. DeBaun et al. (2014) was conducted in centers in both the United States and the United Kingdom. This international perspective lent additional credibility to the findings, making them more generalizable outside of the boundaries of the United States.

Three studies (DeBaun et al., 2014; Duckworth et al., 2020; Takahashi et al., 2018) were multi-institution studies lending additional credibility and generalizability of findings. The additional six studies (Ahmad et al., 2011; Bellet et al., 1995; Crabtree et al., 2011; Madhi et al., 2019; Patterson et al., 2018; Reagan et al., 2011) took place in single institutions. Although they took place at single institutions, many of the results were statistically significant and likely reproducible at other institutions. This included a statistically significant reduction in ACS after use of incentive spirometry (Ahmad et al., 2011; Bellet et al., 1995) and the potential benefit to a

multimodal approach including the use of incentive spirometry to reduce ACS (Reagan et al., 2011).

Bellet et al. (1995) was a prospective randomized trial of 29 pediatric patients with sickle cell disease who had a total of 38 hospitalizations for pain. In this study, patients who presented with pain were randomized to either the incentive spirometry or control no spirometry group. The patients in the incentive spirometry group used the incentive spirometer every two hours while awake. The study showed a significant decrease in ACS in patients who were assigned to the incentive spirometry group. In the incentive spirometry group, pulmonary complications developed in one of the 19 hospitalizations while in the no spirometry group eight of 19 hospitalizations developed pulmonary complications.

Ahmad et al. (2011) was a retrospective cohort study that reviewed a total of 488 charts before and after the implementation of an evidence-based incentive spirometry guideline to assess the effect of this guideline on the reduction of ACS. This study noted a decrease in development of ACS for all patients after implementation of the incentive spirometry guideline and a statistically significant decrease in ACS for patients presenting with back pain even without respiratory symptoms.

Reagan et al. (2011) studied the effect of the implementation of a multimodal guideline for hospital admission of pediatric sickle cell patients with pain (N = 332). This guideline included standardized order sets with incentive spirometry and provider/patient education. The incidence of ACS declined by 50% in participants after the implementation of the incentive spirometry and education guideline and highlights the importance of incentive spirometry as part of a multipronged approach to ACS prevention. Six studies (Ahmad et al., 2011; Bellet et al., 1995; Crabtree et al., 2011; Madhi et al., 2019; Patterson et al., 2018; Reagan et al., 2011)

evaluated whether the use of standard clinical guidelines, including the use of incentive spirometry, would reduce the risk of ACS. The conclusions from this research indicate that the use of incentive spirometry is an important step in preventing ACS.

After the analysis of literature, the body of evidence was graded using the LEGEND system (Cincinnati Children's Hospital Medical Center, 2012a). Within this literature, there was one single high quality clinical trial and multiple high quality observational studies. According to this rating the final overall body of evidence received a grade of *moderate* based on the LEGEND system. This literature, along with the practice guidelines from the NHLBI, strongly endorse the use of incentive spirometry in pediatric patients with sickle cell disease suffering from vasoocclusive crisis to reduce the incidence of ACS.

Theoretical Framework

Lewin's three step model in change management is widely accepted as a model for implementing a change. A change model was applicable to the project as discovered during the gap analysis that there was no guideline surrounding the use of incentive spirometry in patients with sickle cell disease requiring urgent care at the project site. This well-known theoretical framework describes the promotion of change in three steps: Unfreezing, Moving and Freezing (Lewin, 1947).

The first step of "unfreezing" prepares the stakeholders to accept necessary change by creating a compelling argument for why this change needs to occur (Lewin, 1947). In this project, the issue was demonstrated to the stakeholders by citing the current literature that exists surrounding best practices for the use of incentive spirometry to help reduce the risk for ACS in patients with sickle cell disease. The nurses working in the outpatient pediatric hematology oncology clinic were educated about the importance of the use of incentive spirometry in patients

with sickle cell disease and vasoocculusive crisis and introduced to the new clinical guideline outlining this best practice. Clinic leadership reviewed the guideline and mandated staff education about this topic, thus emphasizing the importance of this issue.

The second step, known as "moving," involves demonstrating the benefits of this change (Lewin, 1947). Through evidence-based education, the nurses learned that better patient outcomes are achieved with the use of incentive spirometry in patients with sickle cell disease experiencing a vasoocculusive crisis. The new practice guideline reiterated these outcomes and provided an algorithm for the nurses to initiate this change. "Moving" also involves mobilizing the stakeholders to allow them to incorporate this new guideline into practice. Working with the patient care coordinators and central supply team, the supply room was adequately stocked with incentive spirometers to ensure easy access for nurses.

The final stage of "freezing" is integrating this change so it remains a permanent part of the culture (Lewin, 1947). As part of the "freezing" stage of this project, reminder posters were placed in the medication rooms, stock rooms, and patient rooms. These posters served as a cue to prompt the nurses to remember to provide incentive spirometers and teaching to all sickle cell patients experiencing a vasoocculsive crisis. The new incentive spirometry guideline was placed in the nursing guidelines book at the nurses' station. Par numbers of incentive spirometers were increased in the stock room to make the change easier for nursing staff. Throughout this process, frontline nurses and managers were invested in this "freezing" stage. Celebrating the success of this new guideline and creating a group culture of engagement around it helped solidify this change.

Rationale for the Project

Both seminal works and current literature confirm that incentive spirometry use in patients with sickle cell disease suffering from vasoocculsive crisis reduces the incidence of ACS (Ahmad et al., 2011; Bellet et al., 1995; Patterson et al., 2018; Reagan et al., 2011). Evidence-based best practice guidelines from the NHLBI suggest that incentive spirometry use in patients with sickle cell disease is important in preventing ACS (NHLBI, 2014).

While many nurses working in the outpatient hematology oncology clinic at the time of project implementation may have received informal training during orientation regarding use of incentive spirometry with sickle cell patients, it was not frequently used in practice. There was no practice guideline in place in the outpatient clinic regarding which patients should be encouraged to use incentive spirometry. Further, there had been no formal nursing education on use of incentive spirometry for patients with sickle cell disease and vasoocculusive crisis who are at risk for ACS.

Specific Aims

The project was designed and intended to be quality improvement (QI) conducted internally in one outpatient pediatric hematology oncology clinic. Knowledge gained would likely not be generalizable but was used for continuous quality improvement of the patient experience. The *primary aim* of this QI project was to assess nursing knowledge and documentation adherence pre- and post-education about a new evidence-based incentive spirometry guideline (Incentive Spirometry - Sickle Cell Disease, IS-SCD). There were two *secondary aims* of this project: (1) to determine similarities or differences in adherence to documentation as it related to demographic characteristics present in the sample of nurses; and

(2) to discover common themes about the implementation of the IS-SCD guideline using two informal focus groups.

Conclusion

This chapter introduced and provided background information about sickle cell disease, ACS, and use of incentive spirometry as it relates to the PICOT question. It defined the five elements of a PICOT question and key terms related to this subject. An organizational needs assessment and subsequent gap analysis was presented followed by a detailed explanation of the search strategy used to obtain the literature relevant to the PICOT question. The change theory used to guide the project was articulated. Finally, rationale as well as aims for the Doctor of Nursing project were discussed.

Chapter 2

Methods

This chapter describes the methods used to design and implement this QI project. It also discusses the context as well as the intervention in this scholarly project. The study of the interventions and the measures used to evaluate these interventions are described in detail. Finally, the measures used to evaluate these outcomes are discussed, followed by the data analysis plan.

Context

The project site was an outpatient pediatric hematology oncology clinic in a large academic medical center located in the northeastern United States. This outpatient clinic serves pediatric patients from birth to 21 years old with various diagnoses related to hematological and oncological disorders. Examples of common diagnoses include sickle cell and various anemias, bleeding disorders, thromboses, and various types of cancer. Approximately 150 children with sickle cell disease are seen per month in this clinic for routine and acute sickle cell care. On average, six of these children will develop ACS each month. The clinic functions similarly to an urgent care center where patients can receive intravenous infusions of pain medication, antibiotics, or hydration.

Prior to initiation of the project, a stakeholder assessment was conducted to ascertain the barriers and facilitators central to this project. Four stakeholders were identified including the nurse manager for the unit, two patient care coordinators who also work as RNs in the infusion area, and an RN who works in the infusion area. This project required participation from all the stakeholders identified as well as ancillary staff. Central supply staff, who supplied the incentive

spirometers, were also an essential facilitator. Barriers identified were the current limited numbers of incentive spirometers available in the stockroom, potential for resistance to change by staff, and nurses viewing the new guidelines as additional work. The main facilitators identified were enthusiasm for the project from leadership, highly motivated staff, and the potential for increased patient and family satisfaction with the implementation of current, evidence-based care.

At the time of project implementation, the hematology oncology clinic had no guidelines regarding the use of incentive spirometry for patients with sickle cell disease who came to the urgent care portion of the clinic for painful crises or for fever. As such, the current state of incentive spirometry use at the project site was zero. While nursing staff may have received some informal training regarding the importance of incentive spirometry in patients with sickle cell disease, there was no standard practice for the use of incentive spirometry in this patient population at the project site.

The NHLBI recommends that all patients with sickle cell disease and pain use an incentive spirometer every two hours while awake to prevent ACS (NHLBI, 2014). The project site is dedicated to enhancing patient outcomes through quality improvement and high-quality nursing care and offered its support for this project. Institutional support is evidenced in ongoing inpatient initiatives such as a best practice check list to improve ACS outcomes and the quality of sickle cell care.

Intervention and Study of the Intervention

The project commenced in September 2021 and was completed in January 2022. Because of the importance of the project to improve patient outcomes, clinic leadership mandated that all RNs, 15 at the time of project implementation, participate in the project.

Practice Guideline Development

The design of this QI project was the implementation of a clinic-wide evidence-based practice guideline regarding the use of incentive spirometry in patients with sickle cell disease "IS-SCD guideline" (Appendix A). The IS-SCD guideline was developed by the PI and was based on a review of the current literature and the existing guidelines for incentive spirometry (NHLBI, 2014). The IS-SCD guideline was reviewed and approved by the nurse manager for the unit and provided an algorithm for nurses to reference and troubleshoot issues with compliance. A copy of the IS-SCD guideline was housed in the nursing guidelines binder located at the nursing station in the clinic.

Participants and Recruitment

Nurses were informed of the new IS-SCD guideline both in person and through the circulation of an email. The project was also discussed during the daily morning huddle which took place either via conference call or in person. The discussion during morning huddle took place multiple times over the course of the implementation of the new guidelines to ensure none of the nursing staff was missed due to scheduling. The patient care coordinators and central supply team were aware of this project and ordered and supplied the incentive spirometers to stock in the clinic appropriately.

All pediatric RNs working in the hematology oncology outpatient urgent care center at the project site were eligible to participate in the project. Any participant outside of the role of RN working in the pediatric hematology oncology clinic was excluded from the sample. Due to the nature of the project, eligible participants were obtained via convenience sampling.

Education Session for Nurses

An education session was provided to the nurses and consisted of a lecture with supporting slide show presentation adapted with permission from an online open access presentation entitled “Incentive spirometry to reduce the risk of acute chest syndrome in patients hospitalized with sickle cell disease” (Vandewalle & Tanabe, 2021). To maintain consistency, all education sessions for the RNs were conducted by the PI who is an employee of the clinic and who is a pediatric nurse practitioner with more than 15 years of experience in the field of pediatric hematology and oncology.

The 20-minute education session for the RNs was held at the nursing station to make it easily accessible and convenient for the nurses. The session was comprised of four components: (1) The session reviewed the etiology of ACS and the role of incentive spirometry in reducing the incidence of ACS. This portion of the session was completed using a slide presentation. (2) The PI then reviewed the new IS-SCD guideline with the nursing staff. (3) A discussion of the nurses’ role in patient education regarding proper use of an incentive spirometer and the documentation of that patient education was reinforced. (4) After the completion of the presentation, a question-and-answer session was held to address any questions the nurses may have had related to the education session. Per leadership requirement, attendance at the education sessions was tracked. During the sign in process, nurses were asked for their highest level of education and current employment status.

Measures

Primary and secondary data were collected to examine the aims of the project.

Documentation Adherence

The *primary objective* of the project was to measure adherence to this new guideline via nursing documentation in the electronic health record. Following the implementation of the IS-

SCD guideline, clinical review of records and data extraction was manually performed for a total of eight weeks. Nursing notes from every emergent or sick visit to the hematology oncology clinic were reviewed by the PI to determine adherence to documentation related to incentive spirometry. The charts were also queried using the term "incentive spirometer" "spirometry" and "spirometer" to ensure that no documentation was overlooked during the data extraction. The information was coded either "Yes" for documentation and adherence to new guidelines or "No" for no documentation regarding the new incentive spirometer guidelines. This information was deidentified and entered in a password protected spreadsheet on the PI's computer. The number of incentive spirometers stored in the supply room was also tracked to ensure the par number was correct. Adjustments in the par number of incentive spirometers were made as needed.

Knowledge Survey

The *second portion of the primary aim* of this project was to evaluate nursing knowledge and used a quasi-experimental, single group, pre-test, and post-test design. Prior to the education session each RN participant was given a numbered paper survey regarding knowledge of incentive spirometry. The participants were asked a series of five multiple choice questions about the use of incentive spirometry for pediatric sickle cell patients. These five questions were labeled with choices "a," "b," "c", "d" with only one of the answers being the correct answer. Immediately following the education session, the same five questions were asked to assess RN knowledge level of the content covered in the session. Participants were asked to place surveys in a labeled folder to maintain anonymity. The folder was then immediately collected by the PI. No patient information was present on these surveys.

Data collection consisted of the pre-test and post-test survey information. Each knowledge survey was scored by the PI based on the number of correct answers ranging from

zero to five. The number of correct answers was compared from pre-education session to post education session (See Appendix B).

Demographic Information

The first portion of the final aim of the project was to determine similarities or differences in adherence to documentation as it related to demographic characteristics present in the sample of nurses. This information was collected via the sign in sheet at the information session where nurses were asked to state their name, highest level of education and employment status.

Focus Groups

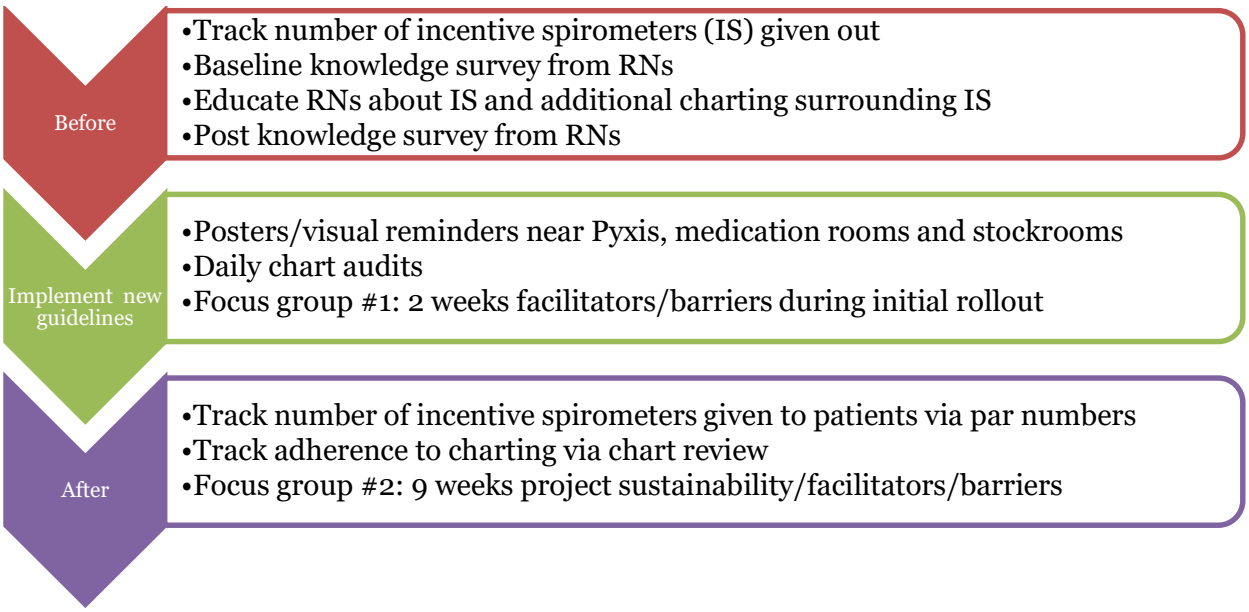
The *final aim* of the project was to compare qualitative data using focus groups with the staff nurses at the urgent care clinic, two weeks after the implementation of the IS-SCD guideline and again at the end of nine weeks. These time points were chosen to elicit nursing input at the early stages of the project and then again upon project completion.

Two weeks after the education session, the initial focus group was held with the nurses. This focus group consisted of a series of open-ended questions to incorporate feedback from the nurses regarding the initial project roll out. The goal of the initial discussion was to help identify barriers and facilitators to the implementation of the IS-SCD guideline. Adjustments to the project implementation were made based on nursing input during this discussion.

A second focus group with the same intention took place nine weeks after the education session. The data consisted of answers from the open-ended questions found in (See Appendix C) collected by the PI during the session. Common themes were extracted from the information learned in the group sessions.

Figure 1

Implementation and Measures



Human Subject Review

Prior to the initiation of this project, the PI completed the Collaborative Institute Training Initiative (CITI) training course. This course detailed the ethical treatment of study participants. Approval from both the Institutional Review Board (IRB) at Georgetown University and the project site was obtained prior to the implementation of the new IS-SCD guideline. The project was deemed to be QI by both review bodies.

The data collected were deidentified and remain in a secure, password protected database. All hardcopy data are housed in a secure cabinet in the PI's home office. The hardcopy pre- and post-knowledge survey information were entered into a spreadsheet and uploaded to the Georgetown-approved GU-Box for access and use by the statistician. The spreadsheet containing the chart data related to adherence was also uploaded to GU-Box. GU-Box is a password protected electronic repository approved by Georgetown University. Duo-authentication was required by all users to access GU-Box. Only the PI, the project faculty mentor, and the

statistician had access to GU-Box. Information will be destroyed at the end of the retention period of three years. Shredding of all hard copy information will occur after three years, and documents on computers will be deleted and then the trash box emptied on PI's computer. Documents and folders related to this project that are housed in GU-Box will also be deleted after the 3-year period.

Data Analysis

According to Moran et al. (2020) data collection can consist of various elements including but not limited to stakeholder assessment, pre-test/post-test survey, clinical review of records and data collection and participant focus groups. This scholarly project utilized each of these methods to collect primary and secondary data.

There were four measurements of data analysis during this project, three quantitative measures and one qualitative measure. The three quantitative measures included a pre- and post-knowledge survey, demographic information from the sign in sheet and a chart review to determine adherence to the new guidelines. The qualitative measure was derived from the common themes discovered during the two focus groups. There were 15 RNs who worked in the pediatric hematology oncology outpatient clinic at the time of project implementation. Thus, due to the small number of eligible participants, *a priori* power analysis was not performed.

The pre- and post-surveys data was reviewed, and the nonparametric Wilcoxon signed ranks test was used for data analysis. The chart review that assessed nursing documentation to the new guidelines as either "yes" or "no" was nominal level data and a z test of proportions was used to analyze this data. The nominal data collected from the sign in sheet was analyzed using percentages and frequencies. The qualitative data derived from the focus groups was described and analyzed using common themes and ideas.

Conclusion

This chapter described the methods used to design and implement this QI project. It also discussed the context as well as the intervention in this scholarly project. The study of the interventions and the measures used to evaluate these interventions were described in detail. Finally, the measures used to evaluate these outcomes were discussed, followed by the data analysis plan.

Chapter 3

Results

In this chapter the process measures and outcomes are described. Descriptive statistics explain the professional characteristics and demographic profile of the participants. The associations between outcomes, interventions, and relevant contextual elements used in this quality improvement project are reported. Finally, the modifications as a result of unintended consequences of the project are presented.

Process, Measures, and Outcomes

Evolution of the Intervention Process

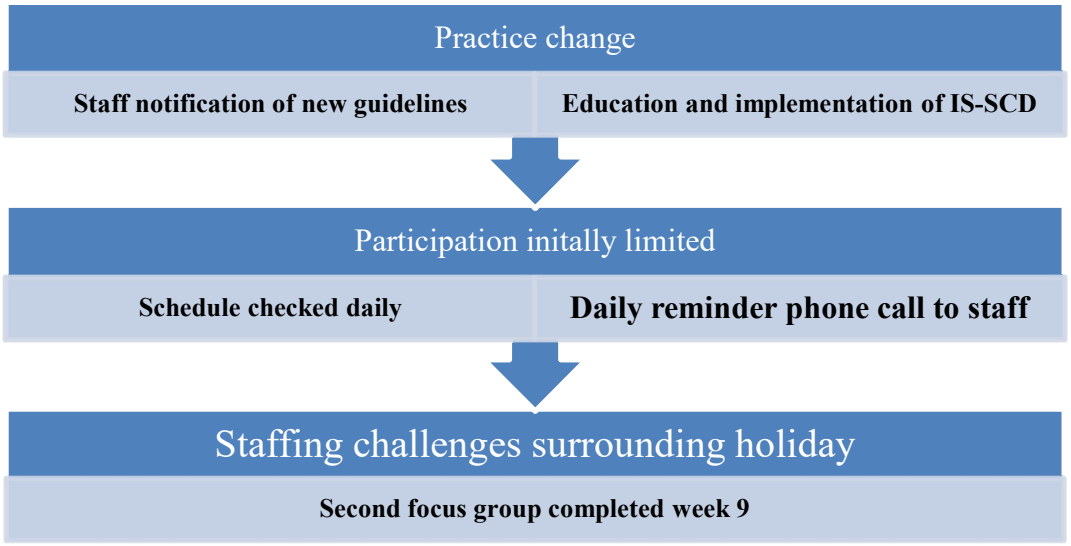
The project was conducted in one outpatient pediatric hematology oncology clinic after approval from the Georgetown University IRB and the project site. The process of QI involves constant modification of the initial process to achieve the desired outcome within the practice context. Throughout the course of the project, processes and outcomes were continuously evaluated and modified as needed.

Initially, the PI intended to conduct the education sessions with the nurses and monitor their adherence to documentation. After the first week when participation was limited, the PI modified this aspect and decided to review the daily schedule and place a call to the nursing staff to serve as a daily reminder of the project. An additional modification was made to the project during week eight when there was limited nursing staff available to participate in the focus group due to staffing limitations prior to a holiday break. The focus group was then held during week nine to incorporate maximum participation from the nursing staff. During this same time frame, there were no additional modifications needed for the par numbers of incentive spirometers

stocked in the clinic. The par numbers were monitored, and the incentive spirometers remained continuously stocked. Figure 2 highlights the initial expectations for the project and the modifications throughout the course of the project.

Figure 2

Quality Improvement Modifications



Participants

A total of 15 pediatric hematology oncology nurses in the outpatient clinic were eligible to participate in the project. Of the 15 eligible nurses, 13 nurses completed the project. One nurse took a full-time position at another institution and changed her employment status at the project site to per diem. The second nurse was on a leave of absence during the duration of the project. The demographic characteristics of the group of nurses were homogenous. All participants identified as female. All the nurses surveyed reported a Bachelor of Science in Nursing (BSN) as their highest level of education. Of the nurses surveyed, 100% reported their work status as full time. No additional demographic information was asked of the participants.

Measures and Outcomes

In healthcare research a *p* value of .05 or less is considered a statistically significant result (Sylvia & Terhaar, 2018). This significance level means that "there is less than a 5% chance that a statistically significant difference between groups could be reported in error" (Sylvia & Terhaar, 2018, p. 234). In this scholarly project, an alpha of .05 was set as the level of statistical significance.

Documentation Adherence

The primary aim of the project was two-fold. First, an aim was to measure adherence to the new IS-SCD guideline through the examination of documentation in the electronic medical record. Prior to the education session, there was no documentation of the IS-SCD guideline as the nursing staff had not received any education surrounding this topic. After the education session, the PI reviewed each patient encounter (when a sickle cell patient comes to the urgent care center for a sick visit) for the following eight weeks. Documentation of the new guideline was noted for 14 of 31 possible encounters.

To compare the rate of adherence from pre-education session to post-education session, the PI manually reviewed each potential patient encounter in the electronic medical record. The PI then created a spreadsheet for each potential patient encounter and scored it as a "yes" or if there was nursing documentation of incentive spirometry or "no" if there was no documentation of incentive spirometry. The number of "yes" encounters was then divided by the number of "no" encounters. A z-test for proportions was conducted to determine if there was a difference between these two groups. As previously mentioned, the adherence to the IS-SCD guideline prior to the education session was zero as there was no guideline in place. Post-education session there was a 45.2% rate of adherence to the new guidelines which was statistically significant at $p < .001$.

Nursing Knowledge

The second part of the primary aim was to evaluate nursing knowledge regarding the use of incentive spirometry for acute chest prevention in sickle cell patients. The pre- and post-education session knowledge survey was comprised of five multiple choice questions, as shown in Table 1, each with four possible answers. A correct response warranted a score of one point; thus, scores ranged from 0 to 5. The same knowledge survey was completed pre- and post-education. Based on statistical analysis, there was a significant increase in the nurses' knowledge about incentive spirometry use for patients with sickle cell disease from the pre-education session with a mean score = 2.92 (*SD* = 1.28) to a post-education session mean score = 4.62 (*SD* = 0.87) ($p = .002$). Since both test scores were significantly negatively skewed, and due to the small sample size, a nonparametric Wilcoxon signed ranks test was used to analyze the data. Scores for 12 of 13 nurses improved from pre-education to post-education, while the score for one nurse remained the same score at both time points. The percentage improvement by question is shown in Figure 3.

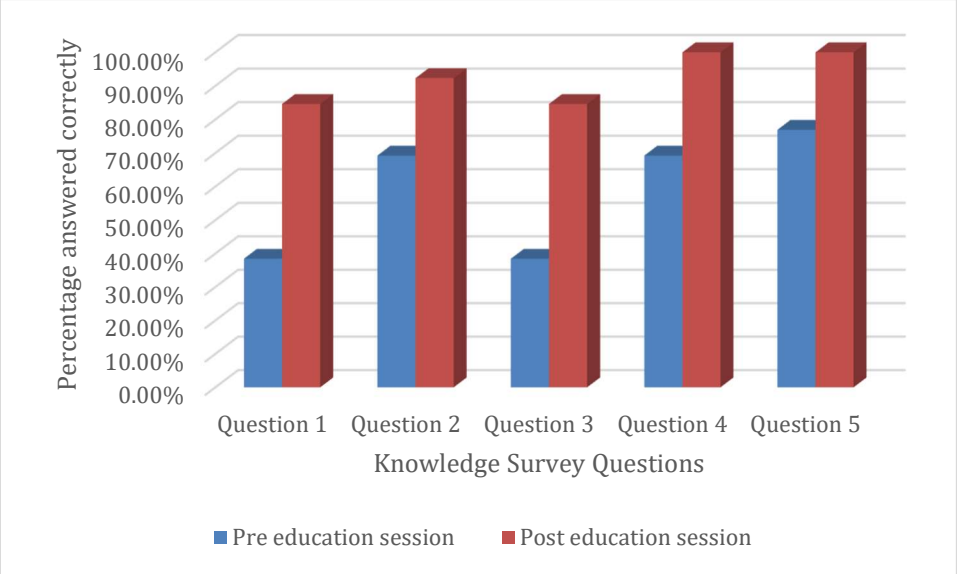
Table 1

Knowledge Survey Questions

Knowledge Survey Questions
1. How often should you instruct a patient to use an Incentive Spirometer?
2. Incentive Spirometers should be given to:
3. Which action demonstrates that the patient understands the correct use of an Incentive Spirometer?
4. A patient is struggling to use their Incentive Spirometer correctly. What advice can be provided to help them be more successful?
5. A nurse is providing a patient with Sickle Cell Disease (SCD) education on the proper use of an Incentive Spirometer. Which indicates that the client understands the teaching:

Figure 3

Knowledge Survey Improvement by Question (N = 13)



Demographic Characteristics and Documentation

The first secondary aim was to determine similarities or differences of adherence to documentation related to demographic characteristics of the nurses. Upon review of the data there was no difference in documentation rates related to the demographic characteristics of the nurses as the group of nurses examined were homogenous. Every nurse that received this training was a full time, BSN prepared nurse. Thus, no statistical analysis was completed to address this aim.

Associations between Outcomes, Interventions, and Relevant Contextual Elements

Nursing Focus Groups

The final secondary aim of the project was to discover common themes about the implementation of the new guideline using two focus groups. Focus group #1 was held two weeks after the implementation of the new IS-SCD guideline and the education sessions for the nurses. The intent of the focus group was to determine strengths and weaknesses during the

initial project rollout. During the focus groups, the nurses were asked intentional predetermined questions (See Appendix C). Through the discussion, the PI was able to determine that reviewing the daily urgent care patient schedule in the electronic medical record and placing reminder phone calls to the nursing staff was an additional way staff could remember to follow the IS-SCD guideline. This timepoint also served as a check in to monitor par numbers of incentive spirometers from the nursing perspective, and ensure the stockroom was adequately stocked.

Themes of Focus group #1 centered on the challenges surrounding a practice change, mainly incorporating this change into the RNs routine or "workflow." There were no issues identified surrounding the supply of incentive spirometers or patient engagement. During this discussion, it was determined that while the posters hanging in the outpatient urgent care center provided a reminder to comply with the IS-SCD guideline, the phone calls implemented by the PI had been more effective at reminding the RNs to comply with the new guidelines.

Focus group #2 centered around the long-term sustainability of the project. During this focus group facilitators and barriers to implementation were also discussed. Facilitators for the project included "nurse champions" and the team of RNs reminding each other about the implementation of the IS-SCD guideline. Barriers identified during guideline implementation included remembering to provide the patient (and caregivers) with the IS and to document receipt of the IS and the education provided in the patient chart. One nurse stated that it was "hard to remember if it is not part of your initial orientation workflow." This nurse had become accustomed to using a mental checklist when taking care of a patient during a sick visit. Per her explanation, she would run through the list of things the way she had always done them, which had not previously included giving an incentive spirometer to patients. This comment highlights the need for incorporating evidence-based incentive spirometry education into nursing

orientation. Another nurse recalled “there were sometimes that I would remember to hand out the incentive spirometer and teach the patient, but I would forget to document it.” This may have been in part due to the free text nursing documentation template that currently exists in the electronic medical record.

Areas for improvement with the new guideline implementation process included the use of “extra reminders” such as calling the staff or finding a “nurse champion” to help other staff members remember to follow the IS-SCD guideline. A few nurses pointed to one nurse who often reminded other nurses to follow the IS-SCD guideline. “Every time she saw a sickle cell patient walk in the door; she would make sure the nurse taking care of the patient had an incentive spirometer.”

Unintended Consequences

One unforeseen circumstance during the implementation of this project was the restrictions surrounding the hanging of posters in the outpatient urgent care center. As part of the reminder portion of project, the PI intended to place posters around various parts of the urgent care portion of the clinic. The practice had recently moved to a newly renovated space and the manager had placed constraints on the type of materials that could be used to hang posters on the wall. Prior to hanging, the reminder sheets for the nursing staff needed to be placed in plastic covering then hung with double-sided tape. As such, the PI needed to locate these materials prior to placing the material on the wall. Once the PI was able to secure the proper plastic covers, she was able to hang the nursing reminder sheets on the walls near the nursing station.

Another unintended consequence was identified in the form of patient knowledge gaps. While the PI thought patients would have some knowledge of incentive spirometry use to prevent acute chest syndrome, most had only previously used incentive spirometers while

hospitalized and immediately after discharge. Patients reported never using incentive spirometers as a preventative measure or in the outpatient setting. This knowledge gap highlights the importance of project sustainability and the importance of the incorporation of the IS-SCD guideline to bridge this patient knowledge gap.

Conclusion

In this chapter, the process measures and outcomes were described. Descriptive statistics explained the professional characteristics and demographic profile of the participants. The associations between outcomes, interventions, and relevant contextual elements used in this quality improvement project were reported. Finally, the modifications because of unintended consequences of the project were presented.

Chapter 4

Discussion and Conclusions

In this chapter Lewin's change theory as it relates to this scholarly project will be discussed. Documentation adherence and knowledge achievement as well as the interpretation of these topics are summarized and discussed. The chapter concludes with limitations of the study as well as implications for further research in this area.

Summary and Interpretation

The primary intent of this QI project was to create a new evidence-based practice guideline regarding the use of incentive spirometry, evaluate nursing knowledge before and after an education session around this new guideline, and obtain qualitative data from two focus groups held with the participants. The project aimed to determine if a nursing education session surrounding incentive spirometry for pediatric sickle cell disease led to an increase in documentation and patient education.

Revisiting the Change Theory

A practice change to evidence-based practice requires individual behavior change, which is a challenging process (Melnyk, & Fineout-Overholt, 2014). The large number of missed opportunities for providing and documenting the use of incentive spirometers highlights the difficulty of the change process. The change theory model proposed by Lewin which describes three main steps to promote a change "unfreezing, moving, and freezing" can frame the discussion about the complexities surrounding change (Lewin, 1947).

The first step of "unfreezing" which prepares participants for a change by framing a convincing argument for why this change needs to occur, took place in the form of an education

session (Lewin, 1947). Prior to this education session, nurses received both verbal and written communication, via the daily morning huddle and email, to notify them of the upcoming sessions. During this session, the RNs were introduced to the IS-SCD guideline, provided education surrounding the topic, and given the opportunity to ask questions. The nurse manager and leadership support also contributed to the "unfreezing" of this change.

The second step is known as "moving" and involves showing the benefits of this change (Lewin, 1947). If individuals are going to commit to change, they will need to see the direct benefits of this change (Melnyk, & Fineout-Overholt, 2014). While daily phone reminders were made to encourage adherence to the IS-SCD guideline and provide support for the nursing staff during this practice change, due to project time limitations, there was not enough time to perform the traditional "PDSA" (Plan, Do, Study, Act) cycles performed during a QI project which may have allowed stakeholders to directly observe the benefits from this project. The "moving" stage also involves the mobilization of stakeholders and participants. This piece involved the cooperation of the patient care coordinators and central supply team to ensure the supply room was adequately stocked with incentive spirometers. The par number was increased sufficiently, and the nurses reported adequate stock during both focus groups.

The final stage of "freezing" includes integrating the change so it remains a permanent part of the culture (Lewin, 1947). This was the most difficult stage to accomplish. To help facilitate "freezing" reminder posters were placed near the nursing station and in the medication rooms and the IS-SCD guideline was placed in the nursing guidelines book at the nursing station. Encouragement was provided to the RNs by celebrating the success of the project to help embed this change. Yet, according to Lewin (1947) "motivation alone does not suffice to lead to change" (p. 37). The decision to "freeze" is based on the individual or group linking motivation

to action. While this project did show some movement towards motivation to act in the 45.2% rate of adherence to the IS-SCD guideline, true "freezing" will require continued support from the nursing and ancillary staff.

Documentation Adherence

Overall, there was a statistically significant improvement in adherence with incentive spirometry education and documentation throughout the duration of this 8-week project. However, even though adherence was statistically significant, more than half of the eligible patient encounters were missed. The large number of missed opportunities in this sample highlights the challenge of practice change. Visual reminders and repetition regarding the vision and plan are key factors in a successful change (Melnyk, & Fineout-Overholt, 2014). The use of both verbal and written reminders in the form of phone calls and posters provided an important piece in the outcome of documentation adherence. Nurses were eager to be involved in this project and documentation adherence improved when these reminders occurred.

Collaborative sessions can facilitate development of approaches to improve care where there is a gap in evidence-based practice (Melnyk, & Fineout-Overholt, 2014). In this scholarly project, focus groups were used to spark discussion. Barriers to implementation of this project were discovered during the focus groups and included forgetting to document or educate the patient and not being part of a RNs routine.

Flexibility during the implementation portion of the project was another factor in the project's success. The initial focus group timeline had to be modified from week eight to week nine secondary to a holiday and staffing shortages during week eight. This flexibility allowed for the full participation of a greater number of RNs and a more robust conversation as the RNs were able to make time to concentrate on the focus group.

Incentive Spirometry Knowledge Achievement

In addition to adherence to the IS-SCD guideline, knowledge gained by the nurses during the education session was measured and evaluated. The knowledge gained during the nursing education session was found to be statistically significant. Participants gained an average of 1.7 points from pre survey score to post survey score during this time period. The open access education presentation along with the knowledge and expertise provided by the PI proved to be an important contribution to the RN's understanding of this concept. The final measurement which involved the two focus groups provided important insight surrounding project modifications and sustainability.

Through the interventions in this project, there was an overall increase in nursing knowledge and adherence to the IS-SCD guideline. This demonstrates the importance of continuing evidence-based education to support practice change. In addition to the educational presentation, the development and use of this guideline for nurses to reference provided important guidance for this practice change. While this project took place in the context of a large academic medical center, the IS-SCD guideline can easily transferred and utilized in another practice setting. As evidenced by Bellet et al., (1995) use of nurse led interventions such as the use of incentive spirometry every 2 hours while awake, reduced the rate of developing ACS from 42% to 5% when compared with the no incentive spirometry group, highlighting the importance of nursing knowledge surrounding this topic.

Limitations

Despite that the project was successful overall, limitations do exist. First the sample was drawn from a single outpatient pediatric hematology oncology practice and consisted of just the 13 nurses in the clinic. The sample was obtained using convenience sampling, making the results less generalizable to another population (Melnyk, & Fineout-Overholt, 2014). Additionally, the sample was a homogenous group making it potentially less generalizable to large heterogeneous groups.

Second, the project was limited by time. Change is difficult and cannot often be achieved in a short time frame. According to social psychologists, time to changing an established behavior ranges from 18-254 days (Lally et. al, 2010). Due to academic constraints the timeline on this project was limited to 56 days from start to finish. This limited time frame likely added to the challenge of a complete practice change.

Conclusions

This scholarly project attempted to determine if a nursing education session surrounding incentive spirometry for pediatric sickle cell disease led to an increase in documentation and patient education. While this was achieved through a statistically significant increase in documentation adherence, there are issues surrounding sustainability which warrant further discussion.

Sustainability of the Practice Change

During the implementation process, the reminder strategies were modified, and the PI placed phone calls to the nursing staff to remind them of the practice change. While the practice of placing reminder phone calls to the nursing staff proved to be successful for this project, this is not a long-term sustainable solution. Empowerment of individuals is essential to facilitate

behavior change (Melnyk, & Fineout-Overholt, 2014). Individual commitment and motivation are also linked to action (Lewin, 1947). Individual RN responsibility for their clinical practice must be achieved for the IS-SCD guideline to maintain long term success. Additional supports to this practice change were discussed during the focus groups and include the use of nurse champions and modification in the electronic medical record that requires documentation adherence of IS-SCD guideline to complete a nursing note. This documentation could be achieved by reformatting nursing notes to include a "hard stop" that would not allow a note to be signed without documentation of adherence to the IS-SCD guideline.

Another piece of sustainability relates to the incentive spirometer supply chain. Throughout the project the par numbers of incentive spirometers in the stock room were maintained. The continued success of this project hinges on the long-term coordination between the patient care coordinators and the stock room staff. Long term sustainability can only be achieved if this number is routinely evaluated, and incentive spirometers are replenished.

Administrative support for a change or innovation is linked to the diffusion of evidence-based practice (Melnyk, & Fineout-Overholt, 2014). Clinic leadership at the project site supports the continued revision of the process to incorporate and sustain the practice change. Future PDSA cycles that focus on the incorporation of reeducation sessions, popup reminders or the use of "hard stops" in the electronic medical record would be supported by the clinic leadership.

While the IS-SCD guideline has limited utility outside of the sickle cell patient population, this guideline could likely be adapted to include sickle cell patients of all ages and expanded to include inpatient populations as well. This guideline can be easily adapted and used at a variety of practice locations.

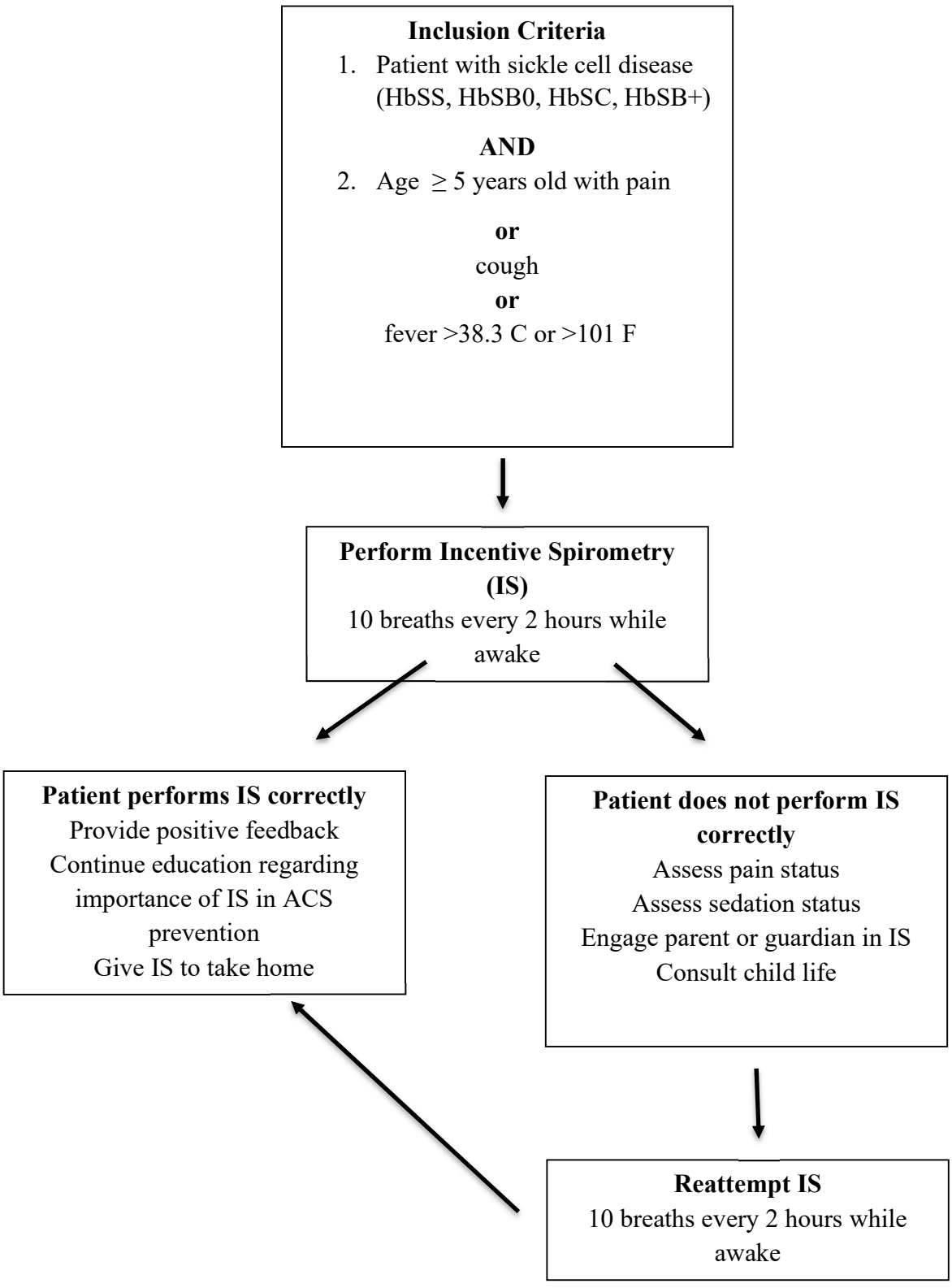
Implications for Practice and Research

Individuals who resist change often have anxiety or fear surrounding their role in the change process or are not clear on the benefits of change (Melnyk & Fineout-Overholt, 2014). The implications for future research on this topic should include the use of studies to establish individual's readiness to change prior to implementation. Since the time frame to conduct this project was limited, this type of assessment was unable to be completed.

Education of clinicians in a way that both explains the process of evidenced-based research as well as appeals to their ability to implement this research will improve the change process (Melnyk & Fineout-Overholt, 2014). Additional research can focus on the use of different educational tools to help facilitate and maintain this change in nursing practice and documentation related to IS-SCD guideline. In addition, another potential area for future research is the patient experience surrounding the use of this guideline.

This scholarly project demonstrated that the use of an evidenced based best practice guideline can produce a statistically significant increase in nursing knowledge and lead to improved documentation adherence. Further patient facing research would be a valuable addition to the body of existing literature. As noted, literature supports the reduction of ACS with regular incentive spirometry use (Ahmad et al., 2011; Bellet et al., 1995; Patterson et al., 2018; Reagan et al., 2011). Focusing on the incidence of ACS after implementation of the IS-SCD guideline would be an important contribution to this body of literature. Addressing the gap in patient and caregiver knowledge regarding the use of incentive spirometry as a preventative measure would be another important contribution as this has the potential to improve patient care and decrease overall incidence of ACS.

Appendix A
Incentive Spirometry Guideline for Pediatric Sickle Cell Disease (IS-SCD), 2021



Appendix B
Knowledge Survey

How often should you instruct a patient to use an Incentive Spirometer?

a. 12 times every hour
b. 10 times every hour while awake
c. 12 times every two hours
d. 10 times every two hours while awake

Incentive Spirometers should be given to:

a. any sickle cell patient > 5 years old with pain, cough or fever
b. only sickle cell patients with the diagnosis of acute chest
c. only sickle cell patients > 5 years old with a cough or fever
d. any sickle cell patient with pain, cough or fever

Which action demonstrates that the patient understands the correct use of an Incentive Spirometer?

a. The patient inhales and exhales quickly
b. The patient slowly inhales and exhales then holds breath
c. The patient inhales slowly and holds breath then exhales
d. The patient inhales slowly and holds breath then exhales into the mouthpiece

A patient is struggling to use their Incentive Spirometer correctly. What advice can be provided to help them be more successful?

a. Try to avoid coughing while using the Incentive Spirometer
b. Hug a pillow while using the Incentive Spirometer to reduce pain
c. If the piston doesn't reach the marker, lower the marker so you don't have to use as much effort
d. Use it only if you are feeling up to it

A nurse is providing a patient with Sickle Cell Disease (SCD) education on the proper use of an Incentive Spirometer. Which indicates that the client understands the teaching:

a. I will use the incentive spirometer every 3-4 hours
b. I will exhale into the incentive spirometer in order to make the piston rise as high as possible
c. Once the piston is as high as possible, I should hold my breath for 3-5 seconds
d. I will use the incentive spirometer for 10 consecutive breaths without taking a break

Appendix C
Focus Group Questions

Focus group #1 (2 weeks after IS guideline implementation)

Initial questions to the group

(1) What has worked well during the first two weeks since we have implemented the new IS guideline?

(2) Since the implementation of the IS-SCD guideline what might be some areas where we could improve?

(3) How effective is the "bee" sheet in reminding you to give, teach, and document IS? Are there any other types of reminders that might be helpful for you?

(4) How have you been able to incorporate IS teaching and documentation into your workday?

Additional questions if needed

Are there enough IS? Should we stock IS in the rooms or just in the stockroom?

Focus group #2 (9 weeks after IS guideline implementation)

Initial questions to the group

(1) How did you feel the implementation of the new IS-SCD guideline went?

(2) Since the implementation of the IS-SCD guideline what might be some areas where we could improve?

(3) What were the major issues or barriers to implementing the guideline?

(4) Do you have any suggestions to help continue the success of this practice change in the future?

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