

Improving the Care of Adult Sickle Cell Disease Patients Presenting with Acute Vaso-occlusive
Crisis to the Emergency Department via Education

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Abstract

Purpose: The purpose of this project was to improve pain management of sickle cell disease (SCD) patients presented to the emergency department (ED) with painful vaso-occlusive crisis (VOC).

Methodology: This project used a quasi-experimental pre-test post-test design. Registered nurses and other healthcare providers working in the adult ED participated in this project. A 30-min educational intervention on evidence-based pain management of SCD patients with VOC was carried out over a two-week period. A chart review was performed pre- and post- intervention to determine the impact of the intervention on pain management outcomes.

Results: Thirty RNs and four providers attended the educational sessions. The data analysis was based on review of 15 charts pre- and 12 charts post-intervention. There was no statistically significant improvement in assigning a higher triage level ($p=0.482$), starting a first dose of analgesics within 30 minutes after being triaged ($p>0.05$), reassessing pain within 30 minutes ($p=0.082$), escalating a dose of pain medications ($p=0.765$), and documenting pain at the end of the ED stay (0.542).

Implications for Practice: Future interventions should incorporate a pain management protocol in addition to educational sessions.

Keywords: sickle cell disease, vaso-occlusive crisis, pain management, and emergency department

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Improving the Care of Adult Sickle Cell Disease Patients Presenting with Acute Vaso-occlusive Crisis to the Emergency Department via Education

Patients presenting to the Emergency Department (ED) with Sickle Cell Disease (SCD) in vaso-occlusive crisis (VOC) are treated sub-optimally for pain (Jacob & Mueller, 2008). Acute pain is the most common reason SCD patients seek care at the ED (National Institute for Children's Health Quality [NICHQ], 2015). Delay in treatment of VOC corresponds to high mortality rates and secondary complications such as stroke, pulmonary embolism and sepsis (Tanabe, Hafner, Martinovich & Artz, 2012). Many clinicians lack education on the evidence-based pain management to treat VOC patients (Solomon, 2007). By educating the Emergency Department healthcare providers on evidence-based management of VOC, the aim was to improve the quality of care of patients with SCD.

Background & Significance

Sickle cell disease (SCD) is the most common genetic disease in the United States (U.S.) that affects 100,000 people, or 1 out of 365 births (CDC, 2017a). There are 4.4 million people living with SCD worldwide today and this population is expected to increase by 2050 (Benenson, Jadotte & Echevarria, 2017). Sickle cell disease is prevalent among people of African descent, Spanish-speaking regions in the western hemisphere, Saudi Arabia, India, and Mediterranean countries (CDC, 2017a).

Sickle cell disease is an autosomal recessive disorder of beta-chain hemoglobin, which means that the disease is inherited by a child when two parents have the sickle cell trait and pass it down to their offspring (Cools, 2012). In SCD, only abnormal hemoglobin, hemoglobin S, are produced (Benenson et al., 2017). When exposed to conditions of low oxygen, red blood cells

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containing hemoglobin S become inflexible and assume a sickle shape. Sickling causes occlusions of small blood vessels, tissue ischemia, and hemolysis. SCD affects every major organ and causes significant morbidity in this patient population. Secondary complications of SCD include stroke, sepsis, acute chest syndrome, pulmonary embolism, pulmonary hypertension, and renal failure (Tanabe et al., 2012). As a result of secondary complications caused by SCD, the median lifespan for women is 48 years old and 42 years old for men (Tanabe et al., 2012).

Acute tissue ischemia leading to severe pain is termed vaso-occlusive crisis, (VOC), which is the clinical hallmark of SCD (CDC, 2017b). Physical or emotional stress, dehydration, infections, and exposure to cold temperatures can lead to a VOC (Ahmed, 2011). However, in many instances, there are no identifiable triggers for VOC. Pain in VOC can range from mild to moderate or even severe, usually occurring in the extremities, chest, or back, and can be debilitating. The episode of acute pain can last anywhere from hours to weeks. Usually, there are no physical signs that accompany the pain. However, infrequently, patients in VOC may present symptoms such as swelling, localized tenderness, and erythema of joints. Fevers may occur along with achiness, numbness, and weakness in the areas affected (Jacob et al., 2005). There is no reliable laboratory data that helps to predict and diagnose patients with VOC.

VOC can occur in infancy and continue through adulthood which proposes negative effects on many avenues in life. When pain from SCD is inadequately managed, suffering occurs. In SCD, about 50% of patients will experience chronic pain, which leads to depression (Wallen et al., 2014). Depression and disturbances in sleep are prevalent in SCD patients. Up to 30% of SCD patients are diagnosed with depression, which is five times as high as that of the

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general population (Wallen et al., 2014). Chronic pain and excessive burden of the disease negatively affects the health-related quality of life for SCD individuals, which closely resembles quality of life outcomes for dialysis patients. Chronic pain, depression, and sleep disturbances in sickle cell patients can lead to an increase in severe pain incidences, emergency room visits, and admissions to the hospital (Wallen et al., 2014). SCD patients have absences in school and work due to pain episodes that can reoccur (Benenson et al., 2017). Relationships with family and friends, academic performances, finances, and quality of life are negatively affected in patients with SCD (Benenson et al., 2017).

Vaso-occlusive pain is often unrecognized, underrated, and undertreated (Benenson & Porter, 2018). Unsatisfactory pain relief may lead to a syndrome known as pseudo-addictive behavior. The treatment with inadequate doses of medications leaves patients with the alternative of either suffering or asking for more medications, complaining about their treatment, groaning, or crying in order to make healthcare professionals aware of the pain they are experiencing (Wright & Adesoun, 2009). Many healthcare professionals may think this behavior is associated with addiction instead of pseudo-addiction (Wright & Adesoun, 2009). However, from the patient standpoint, inadequate treatment of pain is a cause of needless suffering and negative attitudes toward healthcare professionals and institutions (Nuseir, Kassab & Almomani, 2016).

The National Heart, Lung, and Blood Institute (NHLBI, 2014) released an expert panel report on treating VOC in the emergency department, (ED). Based on this report, SCD patients with pain should be given an Emergency Severity Index, (ESI), level 2 triage upon arrival to the ED, which means these patients are high priorities. The ESI is a system that allows the ED to group patients from 1 to 5 levels of triage, which is based on acuity of the patient. Level 1 triage

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is most urgent, while Level 5 triage is least urgent (Agency for Healthcare Research and Quality [AHRQ], 2014). Pain medication should be administered within 30-60 minutes upon arrival and then be reassessed every 15-30 minutes until an adequate pain level is met (NHLBI, 2014). Pain should also be reassessed upon leaving the emergency department, (discharge or admission) (NHLBI, 2014).

Sickle cell disease patients can usually manage their pain at home and only have one to two visits to the ED per year (Tanabe, Friermuth, Cline, & Silva, 2017). More than two hospital admissions per year for each patient is not frequently observed (Benenson et al., 2017). However, the minority of SCD patients contribute to the majority of SCD-related health care cost (Ender et al., 2014). About 200,000 ED visits occur yearly due to SCD with approximately 75,000 admitted to the hospital (CDC, 2017a). In the U.S. alone, the cost of SCD is \$1 billion annually, an average admission cost for SCD per patient is \$7,638, and a lifetime cost of care per patient is \$460,151 (Benenson et al., 2017). Frequent hospitalizations are not only costly, they are also associated with adverse clinical outcomes and premature death (Benenson et al., 2017; Cline, Silva, Freiermuth, Thornton & Tanabe, 2018).

Patients in VOC usually seek help in the emergency department. There are many challenges of managing VOC in the ED; one of them is ED overcrowding (Tanabe et al., 2017). When a patient with SCD is portrayed as a frequent visitor, healthcare professionals may develop negative attitudes toward this population (Tanabe et al., 2017). In addition, some patients who require a high dose of opioids may be perceived as drug seekers (Benenson, Jadotte, & Holly, 2018). Negative providers' attitudes may lead to poor management of pain and lead to patients suffering and frustration (Benenson et al., 2018).

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Another barrier to have effective ED management of VOC is a lack of objective measures that can identify the severity of sickle cell disease pain (National Heart, Lung, and Blood Institute [NHLBI], 2014). Due to the subjective nature of pain experience in SCD patients, pain management is a difficult issue with healthcare providers (Ender et al., 2014). Lack of awareness and knowledge by the providers leads to ineffective pain management of SCD patients in acute pain (Ender et al., 2014; Sunghee, Brathwaite & Kim, 2017).

Sickle cell disease patients manage chronic pain utilizing opioids. The chronic use of opioids can result in a tolerance which can lead to a required dose escalation during an acute pain episode (Tanabe, Martinovich, Buckley, Schmelzer & Paice, 2015). Many ED providers are hesitant to administer high doses of opioids to SCD patients present with VOC (Tanabe et al., 2015). Utilization of a pain management protocol in the ED with analgesic guidelines that allow weight-based doses of opioid analgesics occur every 20 or 30 minutes, with a maximum of three doses until pain significantly improves within in SCD patients in VOC (Tanabe et al., 2017).

Healthcare remains non-compliant with the utilization of the evidence-based guidelines for treating sickle cell disease patients which often leads to major delays in analgesic treatment (Kim, Brathwaite & Kim, 2017). The American Pain Society, (APS), published an evidence-based guideline to manage sickle cell disease patients in acute pain in 1999. These authors were Benjamin, Dampier, Jacox, Odesina, & Phoenix and published by the APS in 1999. When utilizing a protocol to help manage pain in patients in VOC, 84% had pain relief, 81% were discharged home, and 40% of them had adequate pain relief within one hour of an ED visit (Benjamin, Swinson, & Nagel, 2000). It was found that when a pain management protocol was not utilized, 92% of SCD patients were admitted to the hospital (Benjamin et al., 1999). When

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there is a delay in pain management, there is an increase in admission rates (Benjamin et al., 2000). According to Solomon (2010), a sub-therapeutically treated patient often leads to frequent revisits in the ED due to pain. If a protocol is in place for pain management, it will aim to prevent sub-therapeutic treatment and improve care of SCD in VOC. It is recommended that a facility who had SCD patients in VOC have a pain management protocol in place (Rees et al., 2003).

Needs Assessment

Evidence based-pain protocol utilization in the Emergency Department demonstrated statistically significant outcomes, such as improved pain management, improved health outcomes, decreased length of stay in the ED, and reduced admissions for SCD patients (Sunghee et al., 2017). Education regarding the NHLBI evidence-based practice (EBP) guidelines to physicians, physician assistants, nurse practitioners, and registered nurses in the ED provided success in implementation and compliance on use of the EBP guidelines (Sunghee et al., 2017). In this project, educating on the NHLBI EBP guidelines for SCD experiencing VOC was implemented in the ED with the aim to improve their care.

This project took place at a 643-bed suburban, level 2 trauma center that also had a 50-bed pediatric ED. The suburb which the hospital was located had a population that is 35.2% African American; the surrounding city had a population that is 46.8% African American (U.S. Census Bureau, 2018). In 2018, this facility cared for 128 sickle cell disease patients in VOC in the emergency department. Of those 128 patients, 57% were admitted to the hospital.

The intervention of this project was to educate the emergency department staff, including registered nurses and healthcare providers on the NHLBI EBP guidelines. The NHLBI treats

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heart, lung, and blood disorders by providing leadership in research, training, and education globally (National Institute of Health, 2018). By doing so, they help enhance the health of patients for them to live longer lives. This project was intended to have better outcomes for SCD patients who come to the ED in an acute pain phase.

In this specific ED, there was no education provided on the NHLBI EBP guidelines. The ED had the proper medications to help treat patients in VOC and based on NHLBI (2014) EBP guidelines, there was an opportunity for improvement in managing these patients. Patients with SCD often experienced delays in timely pain management due to being viewed by ED staff as drug seekers (Booker, Blethyn, Wright, & Greenfield, 2006). The majority of SCD patients are treated sub-therapeutically which lead to delays in treatment, patients leaving in pain, and frequently returning to the ED (Solomon, 2010). In order to reduce these variations in care, the ED utilized the NHLBI guidelines on treating SCD patients experiencing VOC.

A strength, weakness, opportunity, and threat (SWOT) analysis was conducted to explore the facilitators and barriers to this project. Nurses in the ED were already utilizing the ESI triage system when patients first present in this ED was a strength to this project. A weakness to this project was the lack of utilization of the recommended ESI triage guidelines in the ED for SCD patients at the site. Nurses were unaware of the guidelines recommended by ESI for SCD in VOC. NHLBI suggests a triage level 2, meaning high priority, for all patients with SCD experiencing VOC (NHLBI, 2014). At the project site, nurses tended to under-triage SCD patients. Another weakness that this project experienced was the amount of SCD patient visits to the ED. The general ED census varies annually, including those patients with SCD/VOC. The ED physicians, nurse practitioners, physician assistants, and staff nurses were not utilizing the

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NHLBI guidelines for SCD patients experiencing VOC which was considered a weakness to this project.

The opportunity for this project was that there were external guidelines and management of SCD/VOC that were available to manage sickle cell disease in acute pain. When patient acuity and volume of patients rise it often leads to a hectic, fast-paced environment in the ED. When the staff were working in a fast-paced environment, they may have forgotten to utilize NHLBI guidelines and recommendations leading to a threat to this project because there were no clear expectations on how to manage these patients (Emergency Nurses Association [ENA], 2017).

Problem Statement

Sickle cell disease is the most common genetic disease in the U.S. (CDC, 2017a). Patients presenting to the ED with SCD in VOC often have delays in treatment and are treated sub-therapeutically (Adewoyin, 2015). Sub-therapeutic treatment in VOC leads to patient's suffering, poor quality of life, and distrust in the healthcare system (Benenson et al., 2018). In addition, poor pain control increases healthcare utilization and elevates the risk of secondary

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SCD complications (Tanabe et al., 2012). Education on the NHLBI guidelines may help improve the care of sickle cell disease patients.

Clinical Question

The clinical question that guided this project was, “How will education to the Emergency Department staff impact the care of SCD patients in acute pain?”

Aims & Objectives

The aim of this DNP project was to improve the care of those with sickle cell disease (SCD) in vaso-occlusive crisis (VOC) that present to the Emergency Department (ED). To achieve this aim, the objectives were:

- Educate the physicians, physician assistants, nurse practitioners, and registered nurses in the ED on NHLBI guidelines for patients presenting to the ED in VOC
- Evaluate the effectiveness of the protocol utilization using the following measures obtained pre and post-implementation:
 - a) timeframe from triage to first analgesic dose
 - b) notifying the physician, physician assistant, and/or nurse practitioner of SCD patient arrival in ED
 - c) assigned triage level
 - d) frequency of pain reassessment
 - e) escalation of pain medication dose
 - f) documentation of pain level at end of the ED visit (admitted or discharge home)
 - g) medications utilized

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Review of Literature

A literature review was conducted using the following databases: PubMed, MEDLINE, Joanna Briggs Institute Evidence-Based Practice Database, and CINAHL. The search was limited to those written in English only, human patients, and full-text publications from 2012 to present. The two specific pain management guidelines were published in 1999 and 2014. Several search words were used including *sickle cell disease*, *sickle cell anemia*, *vaso-occlusive crisis*, *vaso occlusive*, *acute pain*, *emergency service*, *emergency department*, and *emergency room*. A total of 41 potential articles were found. After a comprehensive review, a total of 10 out of the 41 articles were chosen that fit the clinical question. Those 10 articles were then appraised using the John Hopkins Research Appraisal Tool and included in the literature review (see Appendix A). Two articles were considered non-research and eight were research. A majority of the studies were Level II based upon critical appraisal.

Protocols for Pain Management in SCD

Sickle cell patients often seek pain management at their nearest emergency room when they are experiencing an acute pain phase called vaso-occlusive crisis when home remedies are not controlling their pain. Multiple guidelines are available for emergency departments to utilize for these patients when they arrive in VOC. Two of the available resources for these guidelines are NHLBI and the American Pain Society.

The NHLBI (2014) guidelines support both opioid and non-opioid analgesics for SCD patients in the ED experiencing VOC. The non-opioid analgesics that are suggested are nonsteroidal anti-inflammatory drugs, also known as NSAIDs (NHLBI, 2014). Utilizing the use of NSAIDs decreases the length of stay in the hospital and the pain levels in VOC (NHLBI, 2014). When patients experiencing VOC arrive to the ED, the patient should be triaged as a high

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priority (NHLBI, 2014). These patients should receive their first analgesic dose within 30 minutes after triage or within 60 minutes upon registration (NHLBI, 2014). The NHLBI (2014) recommends that patients receive either morphine sulfate or hydromorphone intravenously (IV). If IV access cannot be obtained in a timely manner, subcutaneous injections should be utilized (NHLBI, 2014). Reassessment should be done every 15 to 30 minutes following an analgesic dose. Escalation of medication doses by 25% should be given if pain is not controlled upon reassessment (NHLBI, 2014).

The APS was the first published, comprehensive evidence-based guideline to help treat and manage sickle cell disease patients experiencing pain (Benjamin et al., 1999). The APS guidelines suggest that the healthcare provider trust the patient's pain level and treat accordingly (Benjamin et al., 1999). Benjamin et al. (1999) were the authors of the first guidelines to be utilized and continually used with minimal change. These guidelines include treatment with a strong opioid analgesic administered parenterally, and then titrating the opioid maintenance dose by treating breakthrough pain every 30 minutes (Benjamin et al., 1999). If no pain relief is obtained with the first dose of analgesic, the next dose should be increased by 50%. If mild sedation is seen with the initial dose, or if there is pain mild relief, the next dose should be increased by 25% within 30 minutes of initial dose (Benjamin et al., 1999). Reassessment of pain should be done every 30 minutes which should include sedation level, respiration level, pain score, and pain relief (Benjamin et al., 1999). Opioid doses should be utilized with addition of non-opioid analgesics (Benjamin et al., 1999). Pain treatment for this patient in VOC should be aggressive for the first 6-8 hours upon ED arrival before determining disposition of being admitted to the hospital or discharged home (Benjamin et al., 1999).

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The NHLBI and APS both recommend that patients experiencing VOC be treated promptly and accordingly to their own specific pain. They should receive intravenous or subcutaneous analgesic doses within 30 minutes of arrival to the ED and be provided additional doses of pain management if required. Healthcare providers are not familiar with these guidelines which often leads to ineffective treatment for SCD patients experiencing VOC (Sunghee et al., 2017).

Timeliness of Pain Management in Emergency Department with SCD

Sickle cell disease patients in a VOC experience delays in treatment especially in pain medication administration despite the available recommended guidelines (Ender et al., 2014). When patients receive their first analgesic within 30 minutes upon arrival to the ED, it is shown to decrease length of stay, decrease hospital admissions, and decrease fatal complications (Ender et al., 2014). The recommended guidelines report that a patient experiencing an acute episode of pain, VOC, should be medicated with an analgesic within 30 minutes upon arrival to the ED and then, with repeated doses every 15-30 minutes as needed to improve pain level (Ender et al., 2014; Tanabe et al., 2017).

The utilization of a pain management protocol decreases the time to first dose of analgesic (Tanabe et al., 2015). Tanabe et al. (2015) developed an analgesic protocol for the emergency department which included a guide for nurses to use for the first dose of analgesic and then an extra dose after notifying the doctor. Ender et al. (2014) included a clinical pathway for their staff which included triage level, the pain medications administered within 30 minutes, and pain be re-assessed within 15 minutes. Both protocols initiated that the first pain medication be delivered within 30 minutes upon arrival to the ED. The time from triage to first dose of

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analgesic decreased from 74 minutes to 42 minutes (Ender et al., 2014). Initiating pathways and guidelines promote rapid initiation of treatment.

Education

Sickle cell disease is the most common life-threatening monogenic disorder worldwide (Po' et al., 2013). Sickle cell disease is a chronic condition that had been around for many decades and emergency personnel continue to struggle with proper treatment and management of this population of patients (Po' et al., 2013). When proper education including pain management, background of sickle cell disease, and its potential complications is provided to healthcare workers, an improvement in pain management shows a decrease in time to analgesics (Po' et al., 2013). The time for analgesic administration decreased from 87 minutes upon arrival to the ED to only 63 minutes after three educational sessions to the emergency personnel in north-east Italy (Po' et al., 2013). Patients presenting in VOC are recommended to have an ESI triage level of 2 (NHLBI, 2014). Emergency nurses are trained to assign higher acuity triage levels to sicker and medically unstable patients and VOC is not recognized as a medical urgency (Inoue et al., 2015). A low triage level is related to longer waiting time for analgesic therapy (Po' et al., 2013). After educational interventions, a higher acuity triage score increased from 40% to 72% (Po' et al., 2013). Sickle cell disease patients can experience life-threatening complications from vaso-occlusive crisis such as stroke, acute chest syndrome, and organ failure (Po' et al., 2013). Adequate care needs to be provided to these patients in order to prevent these complications. Nurses need to identify these patients as high acuity and assign an appropriate triage level. It is

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beneficial to ensure staff is educated appropriately in order to provide the necessary quality of care to these patients.

Delays in Treatment for SCD Patients

Patients experiencing acute pain related to VOC arrive to the ED looking for pain medications to help alleviate their suffering. Several reasons contribute to delays in treatment in the ED. Efficient patient care can be difficult to provide when EDs are overcrowded and in-patient units are at or above their full capacity (Tanabe et al., 2017). Providing care in a timely manner can be difficult for emergency staff when the department is overcrowded (Tanabe et al., 2017). This overcrowding in the ED leads to a delay in analgesic administration and suffering of SCD patients (Tanabe et al., 2017).

SCD patients present to the ED when pain is unable to be controlled at home and require higher doses of analgesics. These patients are prescribed opioids at home to help control their chronic pain. Many patients only are seen once or twice in the ED per year, but despite the low number of visits per year, these patients are often portrayed as frequent visitors which leads to negative attitudes from healthcare providers (Tanabe et al., 2017). Evidence-based guidelines are available for healthcare providers to utilize but many forget to use them which leads to inadequate pain management (Sunghee et al., 2017).

Inadequate pain management is often seen because providers have negative attitudes towards SCD patients (Tanabe et al., 2017). Sickle cell disease patients are often seen as drug seekers and abusers by providers (Sunghee et al., 2017; Tanabe et al., 2012). Having this misconception leads to delay in treatment for these patients (Tanabe et al., 2012). Patients experiencing VOC need higher doses of analgesics and at more frequent intervals (NHLBI, 2014). When providers are not aware of the recommended guidelines, they tend to believe SCD

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patients are looking for pain medications and the staff may not fully understand their pain level, and as a result, pain may not be addressed in an adequate time frame (Tanabe et al., 2012).

Providing education to ED staff members can help manage SCD patients in VOC more efficiently.

Analgesic Options

Pain can be managed by both pharmacological and non-pharmacological interventions. Some options for pharmacological are the use of opioids and non-opioids. A protocol was developed utilizing higher levels of opioids including morphine sulfate and hydromorphone (Tanabe et al., 2015). The protocol also included non-opioid medications including oral ibuprofen and oral diphenhydramine for severe itching (Tanabe et al., 2015). Routes of administration for morphine sulfate and hydromorphone included subcutaneously and intravenously. After initiating a high-dose pain protocol at a large, urban emergency department in midwestern United States, patients were noticing a decrease in their pain scores (Tanabe et al., 2015). An increase in subcutaneously versus intravenously was noticed in treating these patients especially the patients who were difficult to obtain IV access (Tanabe et al., 2015). Despite the higher doses of opioids administered, no interventions were needed for patient safety (Tanabe et al., 2015). Administering larger doses of opioids for patients in VOC is safe and patients have better outcomes (Tanabe et al., 2015).

There are multiple choices of opioids and routes of administration available to treat pain related to VOC in SCD patients. Another example of opioid use in treating VOC is a medication called fentanyl. Kavanagh et al. (2015) utilized intranasal fentanyl in a group of pediatric patients in an urban pediatric ED in a Level II trauma center. Intranasal fentanyl was used as the first parenteral line for pain in SCD patients in VOC (Kavanagh et al., 2015). Fentanyl used

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intranasally provides rapid relief for these patients especially for the pediatric patients who have trouble obtaining IV access (Kavanagh et al., 2015). Two doses were administered 5 to 10 minutes apart from each other (Kavanagh et al., 2015). The first dose of opioid administration time frame had a significant improvement from 56 minutes to 23 minutes (Kavanagh et al., 2015). Significant improvement of pain is seen when utilizing intranasal fentanyl when IV access is unable to be obtained (Kavanagh et al., 2015).

Discharge Pain Level

There should be six to eight hours of aggressive treatment before possible admission to the hospital for inadequate pain relief in SCD patients with VOC (Benjamin et al., 1999; NHLBI, 2014). Emergency room physicians and nurses have control over direct outcomes of patients in VOC such as effectively managing pain scores in the ED (Tanabe et al., 2012). The use of a nurse-initiated ED protocol had shown a decrease in pain scores during the ED visit of a patient in VOC (-4.1 vs 3.6, $t=2.6$, $p<0.001$) (Tanabe et al., 2012).

It is recommended that rapid administration of pain analgesics for patients who present to the ED in VOC should be initiated within 15 to 30 minutes from time of triage (Benjamin et al., 1999; NHLBI, 2014). Opioid therapy and the use of nonsteroidal anti-inflammatory drugs (NSAIDs) in treating acute pain in VOC shows efficacy in reducing pain levels during the ED visit (NHLBI, 2014). When there is a shorter time to opioid administration (TTO), it is associated with decreased pain level scores at the end of ED visit (Mathias & McCavit, 2015). In conclusion, a more aggressive approach to opioid administration had shown a decrease in discharge pain level in the ED during VOC (Molokie et al., 2017; Tanabe et al., 2012).

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Length of Stay

Implementation of an ED protocol decreases length of stay in the ED (Simpson et al., 2017; Sunghee et al, 2017). The implementation of the evidence-based practice standard of care (EBPSC) had similar concepts to the recommendations of the NHLBI guidelines (Sunghee et al., 2017). When utilizing the EBPSC a decrease of 283 minutes from triage time to disposition time ($p=0.010$) was identified (Sunghee et al., 2017). (Simpson et al., 2017). In conclusion, implementation of an ED protocol that encourages expedited opioid analgesic administration identifies a decreased length of stay for SCD patients in the ED.

The NHLBI (2014) and APS (Benjamin et al., 1999) both recommend analgesics be administered within 30-60 minutes of arrival to ED for patients in VOC. When time to opioid administration is decreased in an ED, there had been improved outcomes such as decreased total length of stay in the ED (Mathias & McCavit, 2015). When there is a decreased length of stay in the ED for patients, this allows increased resources and staff to be available for other patients entering the ED.

High Dose Opioid Administration for SCD

Many ED providers are hesitant on administering high doses of opioids to SCD patients presenting with VOC (Tanabe et al., 2015). High doses of opioids are required to treat acute pain related to VOC due to SCD patients use opioids daily to manage their chronic pain at home, which results in a tolerance of opioids (Tanabe et al., 2015). Administering high-doses of opioids for SCD patient experiencing VOC had been identified to be safe for the patient, requiring no need for administration of naloxone (Molokie et al., 2017; Tanabe et al., 2015). A total dose of 3.3 and 12.6 milligrams (mg) of intravenous morphine sulfate equivalents (IVMSEs) was shown to be safe but is significantly below what is normally required for SCD patient in VOC due to

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opioid tolerance (Tanabe et al., 2015). An average of 63 mg intravenous morphine sulfate equivalents over 203 minutes was administered, requiring no interventions or resuscitative measures ($P < .001$) (Tanabe et al., 2015). Aggressive opioid treatment with 5.19mg/hour IVMSEs ($P < 0.002$) allows the patient to have a lower risk of receiving below the standard dose of opioids, and no need to administer naloxone for resuscitative measures was shown (Molokie et al., 2017). In conclusion, higher doses of intravenous morphine had been identified as being safely administered to SCD patients in VOC.

Theoretical Framework

The Plan Do Study Act (PDSA) framework was used in project development. This framework was used to accelerate quality improvement. It is part of the Institute for Healthcare Improvement Model for Improvement (McGowan & Reid, 2018). The PDSA model was used to effectively test quality improvement thoughts before the full implementation. The four stages of the PDSA model included (a) plan, (b) do, (c) study, and (d) act. The *Plan* phase stated the change that needs to be implemented or tested in a certain environment. The *Do* phase was implementing the change. The *Study* phase was collecting the pre and post data and reflecting on the results. The last phase, the *Act* phase, was planning for the next cycle or changes that may be implemented to improve the project (Byrne, Gang & Carr, 2015). The PDSA framework was used to guide this project by educating the emergency department physicians, physician assistants, nurse practitioners, and registered nurses on the NHLBI EBP guidelines for SCD patients in VOC. The goal was to improve the time of first analgesic administration from time of triage, acuity level, reassessment of pain, notifying the physician, physician assistant, and/or

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nurse practitioner of SCD in VOC arrival to the ED, 30-minute pain re-assessment, escalation of opioid analgesics, and documentation of pain level upon leaving the ED.

This first stage, the *Plan* stage, was identifying the problem in the environment and understanding what processes are used in the ED. The aim was to improve pain management of patients with SCD in VOC that arrive to the ED. There was currently no education that included the NHLBI EBP guidelines for SCD patients in VOC at the site this project was taking place at. Educational sessions were implemented regarding the use of the NHLBI guidelines to treat SCD patients in VOC with the aim to improve the care of SCD patients. It was expected to observe a decrease in the time from triage to first dose of analgesic, improved triage acuity level assigned, an increase in reassessment of pain, an escalation of analgesic dosing, and a documentation of pain level at the end of the ED visit.

The next phase, the *Do* phase, was about creating and implementing educational sessions based on NHLBI guidelines for SCD in VOC that present to the ED. Education by the co-investigators was provided for emergency department physicians, physician assistants, nurse practitioners, and registered nurses. Education included four sessions of 30 minutes via PowerPoint and handouts (additional details about the education will be discussed in the methodology section). Education regarding the NHLBI EBP guidelines on recommended triage level and to notify the physician/PA/NP upon a SCD patient's arrival to the ED was provided to this study population including the ED physicians, physician assistants, nurse practitioners, and the registered nurses.

The third phase, the *Study* phase, was the time to measure the effectiveness of the implementation of the pain management protocol. This measurement was done via pre and post implementation of pain management protocol with a chart review. The chart review consisted of

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the measurement of triage time to first dose of analgesic administration, notifying the physician, physician assistant, and/or nurse practitioner, triage level assigned, frequency of pain reassessment, escalation of pain therapy, the documentation of pain level at the end of ED visit and medications utilized. The data was then analyzed (additional information discussed in the methodology section). It was anticipated that after education of the NHLBI guidelines, quicker first dose analgesic administration times would be seen, higher acuity levels would be assigned, frequent pain re-assessments were to be done, an escalation of analgesic doses would be noted, and a documentation of pain level at end of ED visit would be noticed.

The last phase, the *Act* phase, was where feedback was appreciated and then determined what the next step may be regarding editing the education. Modification could be made the next cycle depending on results. After the results were analyzed and showed a positive impact, the anticipation was that the material presented at the education sessions would continue to be implemented. If results showed a negative impact, re-education on importance of utilizing NHLBI EBP guidelines for treatment of sickle cell disease patients experiencing vaso-occlusive crisis in the emergency department would take place. See Appendix B for the conceptual framework.

Methodology

Design of Project

The design for this project was a quasi-experimental pre and post-test design. It consisted of a pre and post data collection following education to the emergency department

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physicians, physician assistants, nurse practitioners, and registered nurses that worked in the adult ED and care of patients 21 years of age and older at the project site.

Data was collected at two points: pre and post intervention. Data on timeframe from triage to first analgesic dose, notifying the provider, assigned triage level, 30-minute pain re-assessment, escalation of opioid analgesic, documentation of pain level at the end of the ED stay, and medications utilized was collected. All data was recorded on an Excel sheet. (Refer to Appendix C).

Setting

The site for this proposed project was in an adult ED in Monmouth County, NJ. This site was a Level II Regional Trauma Center, a Stroke Rescue Center, and had the region's only cardiac surgery program. It was a 643-bed facility that sees about 1,600 emergency room visits per year.

Study Population

The study population included ED physicians, physician assistants, nurse practitioners, and the registered nurses. The ED staff was invited to attend one of the four educational sessions over a two-week period. The desired sample size for the emergency staff attendance to the educational sessions were 40 registered nurses and 15 physicians, physician assistants, and/or nurse practitioners.

The inclusion criteria for the emergency department physicians, physician assistants, nurse practitioners, and registered nurses included: (a) all physicians, physician assistants, nurse practitioners, and registered nurses that work in the adult emergency department. The exclusion

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criteria included: (a) those not caring for adult patients, (b) nurses floated to the ED, and (c) agency nurses.

Study Recruitment

Recruitment flyers about educational sessions were posted in the nurse's station, the locker room, and the breakroom in the ED to inform the staff of the project. The primary co-investigators invited nurses to attend the educational sessions at day and night huddles in the ED once weekly, for no more than 8 huddles. This informed the staff of the upcoming project.

Consent Procedure

No consent was needed in this project due to this project.

Risks/Harms/Ethics

There were no foreseeable risks for this project. All clinicians involved in the education program were informed that participation is voluntary. Clinicians were only asked to attend an educational session.

The data collection tool had a unique coded number assigned with no identifiable link to the patient. Patient identifiers were not copied and/or used for research purposes. A waiver of HIPAA Authorization was requested from the [REDACTED] IRB to review medical records. All data collection points were collected and held on an encrypted USB drive and stored with the primary investigator and primary co-investigator. Only the primary co-investigators had access to the data. There was no need to return to re-access the patients' chart once data collection points were collected.

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Subject Cost and Compensation

Staff inquired no cost or compensation for participating in this study. However, light refreshments were served at all sessions.

Study Intervention

After obtaining IRB approval from both the project site and Rutgers University, ED staff including the physicians, physician assistants, nurse practitioners, and nurses attended an educational session. The research took place in the ED at project site and the conference room in the ED. ED staff including the physicians, physician assistants, nurse practitioners, and nurses attended one educational session and learned about the NHLBI guidelines on treating a patient who presents to the ED in a vaso-occlusive crisis. The educational sessions were conducted by the primary co-investigators. The intervention was 30-minute education sessions via PowerPoint presentation over a two-week period of time in September 2019. The presented information was based on the NHLBI (2014) EBP guidelines (Refer to Appendix F). A need for assigning triage level 2, immediately notifying a provider, providing analgesics within 30 minutes of arrival, re-assessing pain and escalating therapy if necessary was emphasized. After the two-week period of educational intervention, the staff began to utilize the EBP guidelines.

Outcomes to be Measured

Investigators developed data collection table for the retrospective chart review that was used to measure outcomes. Data collection consisted of timeframe from triage to first analgesic dose, notifying the physician, physician assistant, and/or nurse practitioner, assigned triage level,

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30-minute pain re-assessment, escalation of opioid analgesic, documentation of pain level at the end of the ED stay, and medications utilized.

The criteria for chart inclusion were the following: (a) patients older than age 21; (b) males and females, and (c) diagnosis of Sickle Cell Disease, Sickle Cell Anemia, and Vaso-occlusive crisis. The exclusion criteria were: (a) sickle cell disease patients that left the emergency department against medical advice; (b) unable to report pain; (c) had cognitive impairment; (d) pregnant women; and (e) patients with an ESI triage level of 1.

The charts were reviewed at two points of time: the two months following education (from September 19, 2019 to November 19, 2019) and the same two months in the previous year. This was designed to match volume of patients and eliminate a seasonal variation in patient volume as a confounding factor. It was expected that there would be at least 20 patients' charts that met the inclusion criteria.

The primary co-investigators obtained pre and post intervention data by reviewing electronic charts. The data was collected using a de-novo table created specifically for this purpose. The charts were identified by ICD codes. Diagnoses for the purpose of chart identification were Sickle Cell Disease, Sickle Cell Anemia, and Vaso-occlusive crisis. The list of patient names and MRN numbers were obtained from the ED educator and were retained by the co-investigators. The list was only used to obtain data. The data was deidentified prior to data analysis. All data was recorded onto an Excel sheet. Triage level was assigned a number 1-5 based on their acuity level assigned. The medications utilized during the patient's stay in the ED was listed by name. The rest of the data points collected as completed or not completed.

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Project Timeline

From the beginning to the project end, this project took a total of four academic semesters to complete this project (see Appendix G). Presentation of the DNP project to team took place in April 2019 followed by submission to the site's IRB in May 2019. Application for Rutgers University's IRB was submitted in July 2019. Retrospective chart review of the previous year began after IRB approval of both the site and Rutgers. Education sessions were implemented over the first 2 weeks in September 2019. Implementation of the newly learned guidelines began September 19, 2019 and ended on November 19, 2019. Retrospective chart review after implementation of protocol occurred the following week in November. Data analysis took place in December 2019 along with evaluation and writing of data analysis. The final presentation was done in January 2020.

Resources Needed/Economic Considerations

The co-investigators assumed all responsibilities related to time to educate, collect, evaluate, synthesize, and analyze data. There was no monetary compensation for this project. Costs related to the project included recruitment materials, educational handouts, USB drive, and light refreshments. The co-investigators were responsible for all costs of this project. An anticipated budget is located in Appendix H.

Evaluation Plan

Data Analysis Plan

All data from the chart reviews, pre and post, was entered into Microsoft Excel and Version 25 of Statistical Package for the Social Sciences (SPSS) software. Data was expressed as frequency, % for charts with completed outcomes. Triage level was expressed as ordinal data

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from 1-5. Frequencies of charts with completed data were compared pre and post intervention using chi-square test. SPSS statistical package was utilized for the analysis.

Data Maintenance/Security

Data collection points obtained from chart review were stored in an encrypted USB drive that was kept in a locked cabinet upon retrieval. Access was granted to the primary co-investigators. Data collection of patient's information did not require patient identifiers (medical record, age, date of birth and account numbers), and privacy was protected by utilizing an encrypted USB drive. Only de-identified data was included in the analysis. All electronic documents, Microsoft Excel, SPSS files will be erased three years after completion of the project.

Results

Findings

Thirty RNs and four providers attended the educational sessions. The chart analysis was performed to determine the efficacy of the educational intervention that was provided to the physicians, PAs, NPs and RNs of the site's ED. There were 15 charts pre-intervention and 12 post-intervention. Charts with completed variables and their percentages were calculated pre and post intervention. Chi square test was performed to determine whether differences in frequencies of completed charts were statistically significant. Prior to intervention 20% of SCD patients VOC were assigned a triage level 2, while post intervention the number of patients increased to 50%. However, this numerical increase did not reach statistical significance ($p = 0.482$). Pre-intervention zero patients received their first dose of analgesics within 30 minutes after being triaged. Post-intervention this number did not change ($p > 0.05$). Pre-intervention, 33.3% of

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patients were re-assessed within 30 minutes of receiving their analgesic. Surprisingly, post-intervention only 25% of patients were reassessed after receiving pain medications. There was no statistical significance pre and post intervention on this variable ($p = 0.082$). Pre-intervention, a healthcare provider was notified (within 30 minutes of patient arrival) in 46.7% of cases. This number increased to 58.3% post-intervention, though this rise was not statistically significant ($p = 0.736$). Only in 6.7% of cases there were an escalation of analgesic dosing pre-intervention, while post-intervention there were 16.7% patient for whom pain medication dose was increased ($p = 0.765$). Pain level was documented at end of ED stay only in 6.7% of the charts pre-education intervention. This number increased to 58.3% of charts post-intervention. This change did not show statistical significance ($p = 0.542$). A lack of statistical significance implies that there is no certainty that observed changes in outcomes occurred because of the intervention or by chance alone.

Medications utilized pre-education intervention were Dilaudid intravenously (IV), Percocet orally (PO), Morphine IV, and Toradol IV. Post-education intervention the medications utilized were Morphine IV, Percocet PO, Gabapentin PO, Benadryl PO, Benadryl IV, Dilaudid IV, Dilaudid intramuscular (IM), and Narcan IV. The results are summarized in Table 1.

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Table 1
Chart review pre and post intervention

Variable (charts completed)	Pre-intervention, (frequency, %)	Post-intervention, (frequency, %)	p-value (alpha 0.05)
Triage level 2	3/15 (20%)	6/12 (50%)	.482
First dose within 30 min	0/15 (0%)	0/12 (0%)	>0.05
30 min pain-reassessment	5/15 (33.3%)	3/12 (25%)	.082
Notification of a provider	7/15 (46.7%) _	7/12 (58.3%)	.736
Escalation of analgesic dose	1/15 (6.7%)	2/12 (16.7%)	.765
Pain at the end of ED stay	1/15 (6.7%)	7/12 (58.3%)	.542

Discussion

The results of this project showed there was a numerical improvement in most of the variables that were measured. However, although the changes were not statistically significant. It is likely that the project due to the small sample of reviewed charts did not have enough statistical power to detect differences. One the other hand, it is possible to assume that the educational intervention that attended primarily by RNs was not effective to change practice. Thirty RNs attended the educational sessions while only four physicians, PAs, and NPs attended. This small amount of healthcare providers attending the educational sessions may have impacted the results. The study was implemented during the site changing electronic medical record (EMR) systems. This may have had an impact on the results due to the ED staff concentrating more on the new EMR system rather than on the utilizing the NHLBI guidelines when a SCD patient arrives in VOC. There were many agency nurses during the time of education which may have affected the number of RNs that attended the educational intervention and that carried out

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the learned guidelines. More robust participation rates of providers and their “buying in” might have led to improvement in SCD-related clinical outcomes.

Limitations in this project included the timeframe the project was conducted over. The study collected data over two months post education, this could be lengthened in future research projects. The educational intervention was conducted over two weeks which included four sessions, in future projects this could include more sessions in order to allow an increase number of staff members participating. In future research, expanding the timeframe of the project can result in an increase sample size. Another limitation is that the intervention did not include implementation of a structured protocol or a checklist which might have allowed for variations in practice and deviations from the recommended standards of care.

The results of previous studies on the effect of educational interventions remain inconclusive. The study by Sunghee et al. (2017) that utilized educational intervention in combination with an evidence-based pain protocol, demonstrated that the protocol utilization in the ED had statistically significant improvements in care of SCD patients with vaso-occlusive pain (Sunghee et al., 2017). Another study that used only educational intervention without a required SCD-management protocol reported no improvement in time of first dose analgesic administration to the patient and higher triage levels were not assigned to SCD patients in VOC that presented to the ED (Po’ et al., 2013). The discrepancies in results can be explained by differences in interventions provided. Interventions that did not include a pain management protocol were destined to fail in improving care of patients with VOC. In this respect, this project is consistent with the previously published reports. Future quality improvement projects should include a built-in protocol for step-by-step pain management of SCD patients in the ED.

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Implications

Clinical Practice

Improving the care of SCD patients in VOC that present to the ED was the purpose of this study. The project failed to show improved patient outcomes. This was a small sample size especially for the healthcare providers. More sessions could be created in order to educate more of the ED staff members. There should be more involvement from the physicians, PAs, and NPs to attend educational sessions. The educational sessions could have been made mandatory to the staff. This may have improved the attendance.

The PowerPoint presentation could have been posted on an online platform for the ED staff to refer to at any time. Along with the education being posted online, small laminated cards with the guidelines could have been placed on all triage desks for the nurses to refer to and remember these guidelines when a SCD patients walked through the door.

Education of the SCD in VOC that presents to the ED should also be integrated into the new nursing orientation at the site. If new RNs are educated on the national guidelines right from the beginning, they may be more likely to remember these guidelines and their patient care can be improved. Along with new nurses learning these guidelines, experienced RNs should have the opportunity to learn more about these guidelines and treatment on SCD patients during their yearly competencies. Basic knowledge of the NHLBI guidelines for treatment of SCD patients in VOC should be included in the annual evaluations the site holds to evaluate the healthcare members' ability to carry out certain tasks appropriately.

At the site of study there are protocols that can be initiated by the staff for suspected diagnoses such as stroke, myocardial infarctions, and sepsis. A protocol for a SCD patient in VOC should be initiated to improve standard of care for this patient population and eliminate

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variations in care. This protocol can be initiated once a patient with SCD registers in the ED. In the triage process, the registered nurse can populate this protocol and begin the patient's treatment right away. The protocol of pain management should be based on nationally endorsed standards of care.

Healthcare Policy

Integration of the NHLBI EBP guidelines in the ED for SCD patients is necessary to provide standard of care. The NHLBI EBP guidelines can be utilized to create an ED-specific pain management protocol for SCD patient in VOC. The ED-site's pain management protocol can be initiated for SCD patients. If improvement of care is seen at this site, the protocol could become system wide to the five other hospitals in the network.

Quality & Safety

One of the considerations to start this project was to improve the care of SCD patients in VOC. Patients experiencing acute pain from a VOC can lead to many complications. It was hypothesized that if pain management is controlled or treated promptly in this patient population, these complications may be prevented. Quality and safety can be improved when proper education is provided to the staff and prompt treatment is initiated to these patients in the ED. Since there was not statistical improvement in pain and other quality outcomes, more research and more robust quality improvement projects are needed to determine whether educational initiatives targeting RNs and other healthcare providers improve quality and safety of SCD patients in VOC.

Education

The project demonstrated that there was not a statistically significant improvement in pain management of SCD patients followed the one-time low intensity (30 minutes) educational

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intervention to the ED staff. Next quality improvement projects should utilize prolonged and more intense strategies for staff education. The education can be expanded to use an electronic learning system. This could allow more physicians, PAs, NPs and RNs to participate in the educational intervention at their own time and pace. It can be suggested that a higher rate of participation in educational activities may increase providers' knowledge and awareness of nationally endorsed standards of care, and may eventually improve quality of pain management of SCD patients.

Economic

Medical costs for SCD patients in the United States from 1989-1993 were \$475 million and numbers are continuing to climb (Sunghee et al., 2017). In previously published studies educating staff members on EBP guidelines showed improvements in hospital revenues primarily due to a reduction in the ED and hospital utilization (Sunghee et al., 2017). This project did not intend to evaluate the economic impact of the educational intervention, therefore, future research should be done to determine whether staff educational initiatives are cost-effective strategies. It is possible to suggest that with an increase in knowledge related to SCD ED management healthcare providers can improve care of this population and reduce SCD-related healthcare costs.

Sustainability

The project was not designed to evaluate a long-term effect of the educational intervention, therefore the impact of this project on sustainability is unknown. Since the project didn't demonstrate statistically significant improvement in SCD pain outcomes, it remains uncertain whether the educational intervention should be continued as it was intended or whether it should be modified to include more providers and more robust strategies like mandatory

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education for all RNs and providers. It is possible to assume that future educational intervention can be expanded to nurses and providers on other units in the hospitals, which may allow to improve overall hospital care of SCD patient.

Plans for Future Scholarship

Future Research

This project utilized a limited educational intervention and didn't demonstrate statistically significant improvement in pain management of SCD patients. It is also important to notice that in general, the findings on the impact of staff educational interventions are mixed. Therefore, there is a need for well-designed prospective studies with a prolonged follow-up and a reasonable sample size to determine the effect of staff education on clinically important SCD pain outcomes. There is a necessity for future research to determine the appropriate methods of staff education, frequency and intensity of educational sessions. It is also essential to explore the role of incorporating evidence-based protocols/ checklists, making the educational sessions mandatory and inviting non-RN providers to participate. Future studies should be also focused on cost-effectiveness of the educational strategies and the impact of these interventions to reduce healthcare utilization, to improve quality of life of SCD patient and to reduce SCD-related complications.

Dissemination

The results from this project will be disseminated to the nurse manager, medical director, and the director of the emergency department at the project site. This project will be presented at Poster Day for Rutgers University in April 2020. The results of the project have been disseminated to Rutgers University for requirements of the DNP. This study will be submitted as an abstract to the New Jersey League of Nursing for a poster presentation for their 2020

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conference. Abstracts will be submitted to journals such as *Emergency Nurses Association*, and *Journal of Emergency Nursing*. The results will be presented to the organizational leadership including the nursing research board. They will use this project to present to Magnet Excellence® when they come to the site to evaluation. It is anticipated that the national guidelines continue to be utilized when caring for SCD patients in VOC in the ED. The final step in dissemination of the results will be the final project presentation. The results of this project will be shared with the site stakeholders including the ED staff on January 6, 2020.

Summary

This project showed no statistically significant improvement of clinically outcomes related to VOC. More robust quality improvement projects with stronger involvement of providers and implementation of an evidence-based pain protocol are needed to have a positive impact on quality of life of patients with SCD and a decrease in secondary complications such as stroke, and sepsis.

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Appendix A

Table of Evidence

Clinical Question: The following PICO question is guided by literature research: “How will education to the Emergency Department staff impact the care of SCD patients in acute pain?”

Date: 07/26/2019

Article #	Author & Date	Evidence type	Sample, Size, and Setting	Study findings that help me answer my EBP Question	Limitations	Evidence level and Quality
1	Tanabe, P., Hafner, J., Martinovich, Z. & Artz, N. (2012)	Quasi-experimental	n=342 adult patients (age >18) with chief complaint of vaso-occlusive crisis (VOC). 3 different academic medical centers with emergency medicine residency: 2 sites in urban area; 1 site mixed with urban and rural	An analgesic protocol was implemented in each medical center. Analgesics included morphine sulfate, hydromorphone, meperidine, fentanyl, hydrocodone /acetaminophen, ibuprofen and ketorolac given IV, SC, IM or orally. A decrease in pain scores from arrival to discharge in the ED was seen (-4.1 vs 3.6, t=2.6, p=<0.001)	The protocols were different at each site. Not a randomized control trial. A structured medical record review was conducted. Small amount of patients enrolled at site 3 during pre-implementation period.	Level II; high quality
2	Tanabe, P., Martinovich, Z., Buckley, B., Schmelzer, A. & Paice, J. (2015)	Quasi-experiment	n= 72 adult patients (age >18) treated with SCD in the ED at a large, urban ED with 80,000 annual visits per year	A high-dose pain protocol was implemented. Patients that received higher doses of opioids experienced abnormal vital signs (P=0.072). No	Single-site study. Unable to discern if supplemental oxygen administration via nasal cannula was administered as part of VOC care or in	Level II, good quality

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				interventions were needed.	response to abnormal vital signs.	
3	Tanabe, P., Freiermuth, C., Cline, D., & Silva, S. (2017)	Quasi-experimental	n=196 patients with SCD >18 years of age; Setting: two EDs in the southeastern U.S- both Level I trauma centers	Implementing a SCD analgesic protocol in the ED utilizing morphine sulfate, hydromorphone, and fentanyl with dosing intervals every 20 minutes with a max of 3 doses in the first 60 minutes. They both utilized the National Heart, Lung and Blood Institute (NHLBI) guidelines. Both sites had improvements in time to administration of initial analgesic prior to electronic health record (EHR) implementation. Site 2 times decreased after EHR implementation. Site 1 (z=4.16, p<0.001) and Site 2 (z=0.89, p=0.37)	Implementing a new electronic health record systemic during the project which showed the times were affected. Each site had slightly different protocols	Level II, good quality
4	Ender, K., Krajewski, J., Babineau, J., Tresgall, M., Schechter, W., Saroyan, J. & Kharbanda, A. (2013)	Quasi-experimental	n= 35 pre-pathway and 33 post-pathway that are greater than 6 months of age who presented to ED with sickle cell	A clinical pathway was implemented which included instructions for triage, monitoring, medication administration, and timing of assessments and interventions. Time	The ED was not utilizing computerized order entry	Level II, high quality

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			pain. Setting: pediatric ED of an urban tertiary care center with 50,000 ED visits per year	interval from time of arrival to first dose of analgesic improved from 74 to 42 minutes ($p=0.0012$) and the time interval for first opioid administration from time of arrival improved from 92 to 46 minutes ($p=0.0013$).		
5	Kavanagh, P., Sprinz, P., Wolfgang, T., Killius, K., Champigny, M., Sobota, A., Dorfman, D., Barry, K., Miner, R. (2015)	Quality Improvement	n= 289 pediatric patients (ages 2-21 years) with VOC moderate to severe pain greater than 5 on a pain scale of 0-10. Setting: urban pediatric Level II trauma center	First dose of parenteral opioid decreased from 56 to 23 minutes; second opiate IV dose decreased from 106 to 83 minutes	Did not consistently track when the algorithm was used for individual patients throughout the QI initiative. Did not record any adverse events in the course of the study. Maximal dose of Fentanyl is 100 per dose due to concentration and volume constraints- subtherapeutic doses were administered for patients >65 kg	Level V; poor quality
6	Po' C., Colombatti, R., Cirigliano, A., Da Dalt, L., Agosto, C., Benini, F., ... Sainati L. (2013).	Quasi-experimental	n=28 patients admitted with SCD; setting: tertiary teaching hospital in Padova, in north-east Italy	After three educational sessions, both pain evaluation and treatment improved. High acuity triage level increased from 40% to 72% ($p=0.049$). Waiting time for analgesic	Small sample size	Level II, good quality

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				decreased from 87 minutes to 64 minutes ($p=0.34$).		
7	Inoue, S., Khan, I., Mushtaq, R., Sanikommu, S., Mbeumo, C., LaChance, J., ... Sanikommu, S. R. (2016).	Non-experimental	Pediatric and adults patients who visited [REDACTED] Center's ED during three different periods. Criteria was: established diagnosis of homozygous sickle cell disease, at least one of the presenting complaints must be pain due to SCD, and patients must have received some form of analgesic in the ED; Setting: Level I trauma center ED in a mid-sized urban community in Michigan, USA	There was a progressive shortening of time to first parenteral analgesic over the three periods. The adults time to first analgesic was significantly shorter in period 3 than period 1 ($p<0.001$).	Retrospective nature and single institution observations; the study was not hypothesis-driven and the results are descriptive	Level III, low quality
8	Sunghee, K., Brathwaite, R & Kim, O (2017)	Quasi-experimental	n=124 adult patients experiencing VOC. Setting: urban academic tertiary medical	Triage order sets and pain analgesic guidelines for staff. Educational sessions were provided to review guidelines. The mean time of triage to first analgesic	Single-site. New EMR implementation which could have had inaccurate recordings of data and Hawthorne effect	Level II, good quality

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			center-urgent care unit	administration decreased by 92 minutes (p=0.001). The time of triage to disposition was decreased by 283 minutes (p=0.010)		
9	National Heart, Lung and Blood Institute. (2014)	Guidelines	n= 30 randomized control trial that included 1,800 people of all ages with SCD, 34 observational studies, and 30 case report	The expert panel supports the use of opioids in treating acute pain in VOC and nonsteroidal anti-inflammatory drugs (NSAIDs). Recommendations included triage level with high acuity, administering first dose of analgesic within 30 minutes of triage or 60 minutes from registration. Subcutaneously or intravenously medications could be administered. Pain should be re-assess every 15-30 minutes until pain is under control. Dose escalation can be given by 25%. Managing pain for 6-8 hours is recommended in the ED.	Certain studies were not included (the ones that had no evolution of pharmacology agents that decreased pain or reduced length of stay in hospital and medications that were not approved by FDA (Food and Drug Administration). There is no recommended doses for opioids	Level IV, low quality
10	Benjamin, L., Dampier, C., Jacox, A., Odesina, V., Phoenix, D., Shaprio, B., Strattford, M.	Guidelines	SCD patients of all ages	Treatment includes strong opioids via parenteral route. Adjuvants should be included with opioids. Pain re-assessment should be done every 30	Not specific for VOC, just managing pain in the ED	Level IV, low quality

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	& Treadwell, M. (1999)			minutes and repeat analgesic dose can be given if no pain relief. If no pain relief with first dose, second dose if increased by 50%. If mild sedation occurs with initial dose or mild pain relief, repeat dose is increased by 25% 30 minutes after the initial dose. Patients should be monitored for 6-8 hours in the ED		
11	Mathias, M. & McCavit, T. (2015)	Non-Experimental	n= 177 patient and n=410 visits. Inclusion criteria: established SCD diagnosis, presence of VOC, age below or equal to 18 years of age but not younger than 5 years of age, treatment of parental opioids. Setting took place in an Emergency Department in Texas.	A study of ED visits for VOC to assess time to opioid administration (TTO) was studied by using primary and secondary outcomes as measures. The primary outcome was hospital admission and secondary outcomes were change between the first 2 pain scores, area under the curve for pain scores at 4 hours, total length of ED stay and IV opioids dose total given. A multivariate analyses and univariate analyses showed decreased TTO was associated with decreased area	Limitations were that this study was done in a single center, medical records had flaw which could lead to inaccurate recordings during the study. An EMR was implemented during this study, which observed that the charted EMR times were more accurate.	Level III, good quality

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				under the curve for pain scores (b coefficient 287.0, 95% CI 2161.0 to 213.0) and decreased length of stay in the ED (b coefficient 2121.2, 95% CI 2181.6 to 260.7). There was a median total dose of 0.18mg/kg morphine equivalents used, both univariate and multivariate analyses showed decreased TTO was associated with increased total dose of opioids (b coefficient 0.042, 95% CI 0.009 to 0.076)		
12	Molokie, R., Motminy, C., Diaonisio, C., Farooqui, M., Gowhari, M., Yao, Y., Suarez, M., Ezenwa, M., Schlaeger, J., Wang, Z. & Wilkie, D. (2017).	Non-experimental	n= 148 patients with SCD who are 18 years of age or older, English speaking, received care from the ED or Acute care units (ACU). Setting took place at the ED and ACU at th [REDACTED] [REDACTED] The ACU is independent of the ED but	A study was done that measured the ED's vs ACU's pain at discharge, hospital admissions and length of stay, and opioid doses. Initial ED admission pain averaged 8.7 ± 1.5 and the ACU averaged 8.0 ± 1.6 . Pain on discharge in ED averaged 6.4 ± 3.0 vs ACU average was 4.5 ± 2.5 ($p < 0.001$). Opioid doses were measure in IV morphine sulfate milligram equivalent (IVMSEQ) to compare the ED	Limitations to this study was that the ACU gave care to uncomplicated pain crisis patients, and the medical records were not blinded.	

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			patients can receive care here Monday-Friday 8am-5pm instead of utilizing the ED	and ACU. There was a use of 2.26mg/hour IV MSEQ, $p<0.001$ in the ED while in the ACU was 5.19mg/hour IV MSEQ, $p<0.002$) which shows that the ACU had more aggressive medication treatment that lead to decrease in patient receiving below standard dose of opioids. None of the subjects in the ED or ACU had to receive Narcan to reverse opioid overprescribing. The ED and ACU first dosage level and hourly were highly significantly ($p=0.004$ and $p<0.001$).		
13	Simpson, G., Hahn, H., Powel, A., Lerverence, R., Morris, L., Thompson, L., Zumberg, M., Borde, D., Tyndall, J., Shuster, J., Yearly, D. & Allen, B. (2017)	Quasi-experimental	n= 10 patients defined as sickle-cell disease super utilizers that were 18 years of age or older who presented to the ED 12 time or more over a 12-month period. Setting was at a Level 1 trauma center at [REDACTED] that had a census of 70,000 visits in the ED.	An ED management protocol was initiated. The protocols goal was to precipitate analgesic administrations, reduce repeated labs testing and imaging for patient that had similar test in the last 5 day for similar complaints. Education was provided to ED residents, and ED nurses by a ED physician or nurse champion, along with a process team	Limitations included a small sample size and study was not blinded.	Level II, low quality

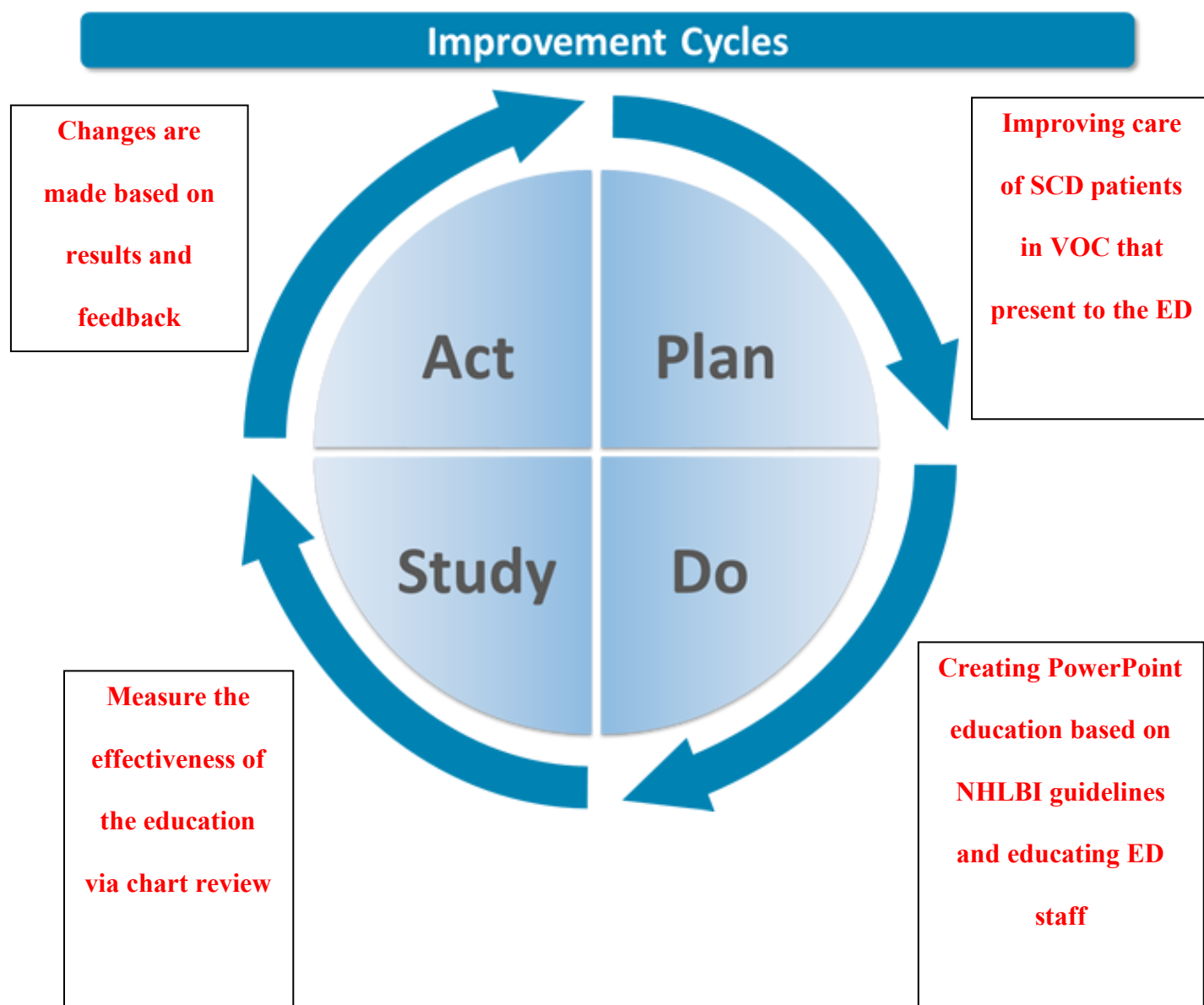
IMPROVING CARE OF SCD IN THE EMERGENCY DEPARTMENT

				<p>was formed and meetings were monthly.</p> <p>Measurement of ED length of stay (LOS) and left before treatment occurred in the study. The ED LOS had a decrease of 115.3 hour/pt-yr (95% CI [-82.9-313.5]) after implementation.</p> <p>There was reduction of 13.7 visits for patients left without being seen after implementation.</p>		
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IMPROVING CARE OF SCD IN THE EMERGENCY DEPARTMENT

Appendix B

Plan Do Study Act Framework



IMPROVING CARE OF SCD IN THE EMERGENCY DEPARTMENT

Appendix C

Data Collection Tool

Code #	FIRST DOSE OF ANALGESIC IN 30 MINUTES (yes or no)	PHYSICIAN, PHYSICIAN ASSISTANT, AND/OR NURSE PRACTITIONER NOTIFIED? (yes or no)	TRIAGE LEVEL 2 ASSIGNED (1-5)	ESCALATION OF MEDICATION (yes or no)	30 MINUTE RE-ASSESSMENT (yes or no)	PAIN LEVEL AT DISCHARGE (admitted or discharged home) (yes or no)	MEDS UTILIZED (list)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Appendix D

NHLBI Guidelines

Recommendations

The recommendations labeled “consensus” in this section were based on recommendations developed by the APS or on panel expertise. The remaining recommendations are based on the evidence review conducted by the methodology team. These recommendations are intended to be for all settings where patients present with VOC.

1. In adults and children with SCD and pain,

- When indicated, initiate diagnostic evaluation of causes of pain other than a VOC while beginning to treat pain.

(Consensus–Adapted)

2. In adults and children with SCD and a VOC,

- Determine characteristics, associated symptoms, location, and intensity of pain based on patient self-report and observation. If the VOC pain is atypical, investigate other possible etiologies of pain.

(Consensus–Adapted)

- – Rapidly assess the patient’s recent analgesic use (opioid and nonopioid). **(Consensus–Adapted)**
- – Rapidly initiate analgesic therapy within 30 minutes of triage or within 60 minutes of registration. **(Consensus–Panel Expertise)**
- – Base analgesic selection on pain assessment, associated symptoms, outpatient analgesic use, patient knowledge of effective agents and doses, and past experience with side effects. **(Consensus–Adapted)**

3. In adults and children with SCD and a VOC,

- Use an individualized prescribing and monitoring protocol (written by the patient’s SCD provider) or an SCD-specific protocol whenever possible (see [exhibit 7](#) on page 36) to promote rapid, effective, and safe analgesic management and resolution of the VOC.

(Consensus–Panel Expertise)

4. In adults and children with SCD and a VOC associated with mild to moderate pain who report relief with NSAIDs in the absence of contraindications to the use of NSAIDs, continue treatment with NSAIDs. **(Moderate Recommendation, Low-Quality Evidence)**

5. In adults and children with SCD and a VOC associated with severe pain, rapidly initiate treatment with parenteral opioids.

(Strong Recommendation, High-Quality Evidence)

6. In adults and children with SCD and a VOC associated with severe pain,

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- – Calculate the parenteral (IV or subcutaneous) opioid dose based on total daily short-acting opioid dose currently

being taken at home to manage the VOC.

(Consensus–Panel Expertise)

- – Administer parenteral opioids using the subcutaneous route when intravenous access is difficult. ***(Consensus–Panel Expertise)***
- – Reassess pain and re-administer opioids if necessary for continued severe pain every 15–30 minutes until pain is under control per patient report.

(Consensus–Adapted)

- – Maintain or consider escalation of the dose by 25 percent until pain is controlled. ***(Consensus–Panel Expertise)***
- – Reassess after each dose for pain relief and side effects. ***(Consensus–Panel Expertise)***
- – Initiate around-the-clock opioid administration by patient-controlled analgesia (PCA) or frequently scheduled doses versus “as requested” (PRN) administration. ***(Moderate Recommendation, Low-Quality Evidence)***

Appendix E



September 2019

ACUTE PAIN MANAGEMENT IN SICKLE CELL DISEASE

**Come learn more about how to
manage sickle cell disease patients!**

Pilot research project to evaluate the effectiveness of education to the ED staff in the emergency department for sickle cell disease patients in vaso-occlusive crisis

CONTACT ALEXIS OR KIM FOR FURTHER QUESTIONS

Healthcare
Providers and
Staff Nurses are
welcomed!

30 minute
educational
session followed
by Q&A

Better understand
patients
experiencing
acute pain
related to vaso-
occlusive crisis



**Emergency Department
Conference Room**

***REFRESHMENTS WILL BE
PROVIDED**

Appendix F

PowerPoint

Improving Care of Adult Sickle Cell Disease Patients Presenting with Acute Vaso-occlusive Crisis to the Emergency Department**Pathophysiology of Vaso-Occlusive Crisis**

- Autosomal recessive disorder
- In sickle cell disease (SCD) abnormal hemoglobin is produced, known as hemoglobin S (Benenson et al., 2018)
- This hemoglobin S becomes inflexible and sickle shaped when exposed to low oxygen.
- Occlusion of small blood vessels
- Tissue hypoxia
- Hemolysis
- Acute tissue ischemia leads to severe pain termed vaso-occlusive crisis (VOC)



Background & Significance

- Sickle cell disease patients in vaso-occlusive crisis (VOC) are treated sub-optimally for pain in emergency departments (Jacob & Mueller, 2008)
- Evidence-based guidelines for treating SCD patients in VOC are not being utilized, which often leads to major delays in analgesic treatment (Kim, Brathwaite, Kim, 2017)
- Delay in treatment leads to secondary complications and higher mortality rates (Tanabe, Hafner, Martinovich & Artz, 2012)
- Most die by their 4th decade of life!!



Background & Significance

- Utilization of an evidence-based practice pain management protocol has shown to increase the number of patients discharged from the ED, decrease admission rates, and decrease frequent re-visits in the ED (Benjamin, Swinson, & Nagel, 2000; Solomon, 2010)
- 200,000 ED visits/year due to SCD and cost \$1 billion annually in the U.S (Benenson, Jadotte & Holly., 2018; CDC, 2017)



Why are we educating you?

- When proper education including pain management, background of sickle cell disease, and its potential complications is provided to healthcare workers, an improvement in pain management shows a decrease in time to analgesics (Po' et al., 2013).
- After educational interventions, a higher acuity triage score increased (Po' et al., 2013).



Misconceptions

- There are delays in treatment in VOC patients: ED overcrowding, providers have negative attitudes, seen as drug seekers, abusers, and frequent visitors (Kim et al., 2017; Tanabe et al., 2017)
 - Two inpatient admissions per year or less for SCD population
- The prevalence of opioid addiction in SCD patients is only 2%, which is lower compared with addiction in other chronic pain syndromes (Kim et al., 2017)
- SCD patients are living with chronic pain, requiring prescribed opioids, resulting in tolerance and the need for higher doses of opioids when in VOC (Tanabe, Premiermuth, Cline & Silva., 2017)



Misconceptions

- Treatment with inadequate doses of medications leaves patients asking for more medications, complaining about their treatment, groaning, or crying in order to make healthcare professionals aware of pain they are experiencing (Wright & Adesoun, 2009).
- Many healthcare professionals may think this behavior is associated with addiction instead of pseudo-addiction (Wright & Adesoun, 2009)
- Unsatisfactory pain relief may lead to a syndrome known as pseudo-addictive behavior.



Needs Assessment

- # 1 cause of hospitalization in SCD patients are related to VOC (Tanabe et al., 2017).
- 33% of deaths occur during a VOC crisis (Niraimathi et al., 2016)



Needs Assessment

- 1:12 black of African Americans will have the disease (CDC, 2017)
 - 35.2 % of Neptune NJ population is African American (U.S Census Bureau, 2018)
 - 46.8% of Asbury Park, NJ population is African American (U.S Census Bureau, 2018)
- There is no current pain management policy for SCD patients in VOC that present to the ED at current facility.



National Heart, Lung and Blood Institute (NHLBI)VOC Guidelines

- NHLBI VOC Guidelines: developed by a panel of experts, based on their practice experiences and their exploration of current evidence
- NHLBI #1 Goal: evaluate expeditiously & early aggressive treatment for pain management
- The primary treatment for VOC is the use of opioids as analgesics



Main points: NHLBI Guideline Recommendations

- The ESI (Emergency Severity Index) triage system:
Triage level 2 for VOC patients
- Initial analgesia administration within 30 from time of triage
- Reassess q 15-30 minutes until pain significantly improved
- Consider escalation of the dose by 25 percent until pain is controlled



More NHLBI Guideline Recommendations

- Administer parenteral opioids using the subcutaneous route when intravenous access is difficult.
- If patient has mild-moderate pain then utilize NSAIDs if no contraindications
- If patient has severe pain from VOC, rapidly administer parenteral opioids
- Use adjunctive nonpharmacological treatments to treat pain such as local heat application
- If oxygen saturation <95% on room air, administer oxygen



Question for Project

- The question for this project is “How will education to the Emergency Department staff impact the care of SCD patients in acute pain?”



Aim and Objectives

- The ultimate aim of this project is to improve the care of those with sickle cell disease (SCD) in vaso-occlusive crisis (VOC) that present to the Emergency Department (ED).



Objectives

- Evaluate the effectiveness of the educational session based on NHLBI guidelines utilization using the following measures obtained pre and post-education
 - a) time to first dose of analgesia administration
 - b) Physician, Physician assistant and/or Nurse Practitioner notified of patients arrival to ER
 - b) assigned triage level
 - c) frequency of pain re-assessment
 - d) escalation of therapy
 - e) pain level at end of the ED visit (admit or discharge)
 - f) medications utilized for pain management



Something to think about....

- “If a patient comes in with diabetes or with heart failure, and they tell you the name of their drugs and what they need, we think they’re really smart. If a sickle cell patient comes in and says, ‘This is the dose of my opioid that really works...and this is what I really need,’ we just think they’re addicted to opioids.” (Tanabe, 2019)



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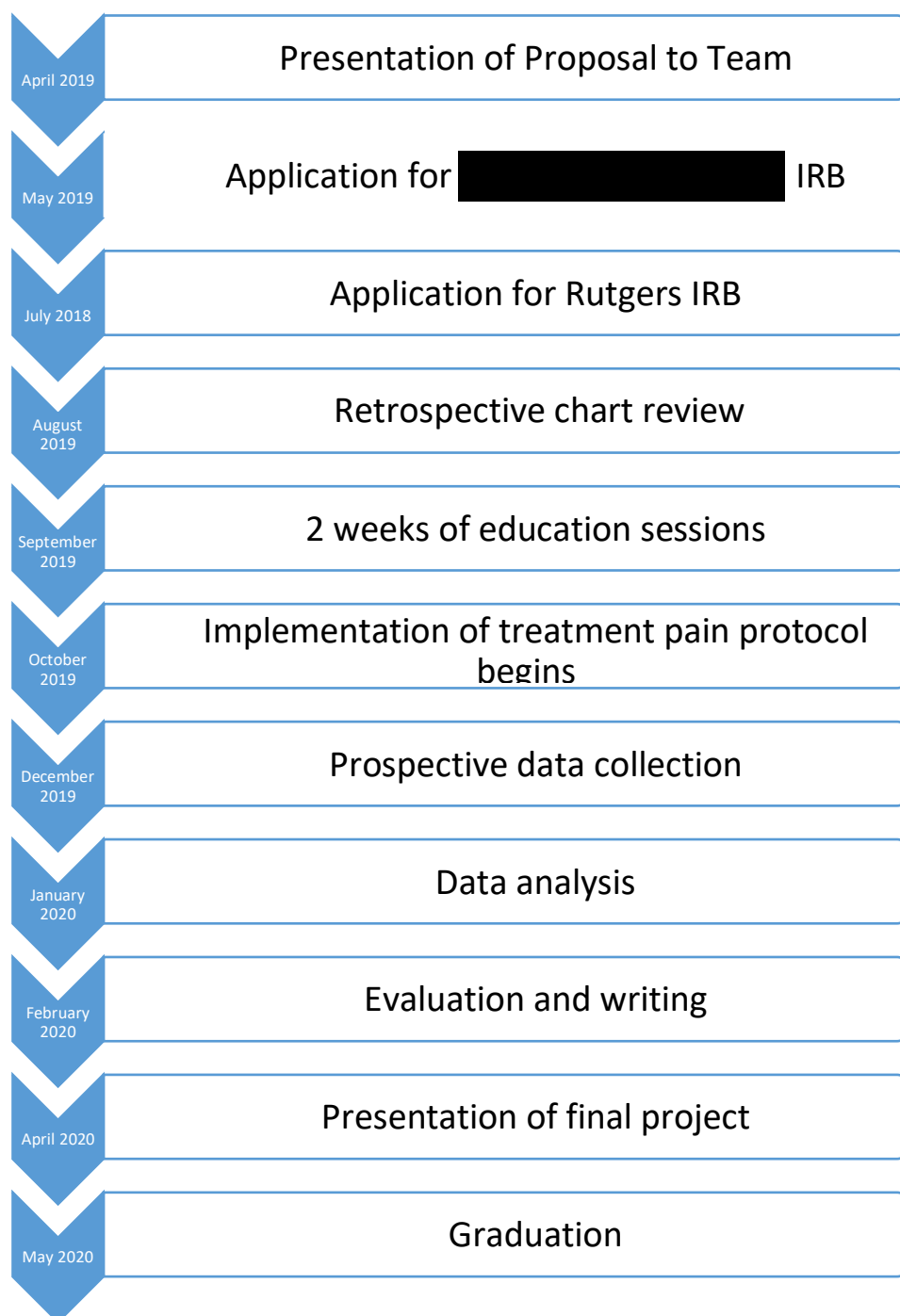
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Appendix G

Project Timeline



IMPROVING CARE OF SCD IN THE EMERGENCY DEPARTMENT

Appendix H

Budget

Expense	Cost	Total Cost
Light Refreshments	\$75.00 x 4 sessions	\$300
Recruitment Fliers	20 @ 15 cents	\$3.00
Protocol Handouts	50 @ 15 cents	\$7.80
Encrypted USB	\$100	\$100
Statistician Consultant	\$50/hr x 2 hrs	\$100
TOTAL BUDGET		\$510.80