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**Implementation of a Sickle Cell Disease Toolkit in the Emergency Department to Improve
Provider Knowledge and Confidence**

Kendra E. Sukke

Introduction

Sickle cell disease (SCD) is the most commonly inherited hemoglobinopathy worldwide among the African American population (Uwaezuoke et al., 2018) and over 100,000 individuals are living with SCD in the United States (Leger et al., 2018). With SCD, a mutation in the hemoglobin beta (HBB) gene causes RBCs to appear sickle shaped, leading to pain from blocked or damaged blood vessels, a condition called vaso-occlusive crisis (Leger et al., 2018; Stewart et al., 2021). Further, pain management for those with SCD receiving emergency services has been determined to be sub-optimal as a result of delays in administration of analgesia and lack of understanding of the care needs of the SCD population (Leger et al., 2018). Education has continued to play an essential role in healthcare, but given the variability in the volume of patients with SCD, the application of standards or guidelines in caring for this population are uneven.

Background and Significance

Acute pain crises for those with SCD can emerge without warning, making the emergency department (ED) a common location to receive acute pain management. Therefore, ED physicians require the knowledge to provide timely pain interventions for patients presenting with an acute sickle cell crisis (Martin et al., 2020). Two clinical practice guidelines (American College of Emergency Physicians, n.d.; National Heart, Lung, and Blood Institute, 2014) provide expert recommendations for the acute management of a vaso-occlusive crisis in a patient with sickle cell disease. The American College of Emergency Physicians (n.d.) guideline focuses primarily on care in the emergency department and addresses the importance of communication, triage, evaluation, treatment, and disposition. Evidence confirms that the first dose of opioids

should be administered with 60 minutes of registration or 30 minutes of triage, in addition to reassessment every 15-30 minutes, until pain is controlled or reduced (American College of Emergency Physicians, 2023.; National Heart, Lung, and Blood Institute, 2014; Glassberg, 2017; Telfer & Kaya, 2017; Lentz & Kautz, 2017; Tanabe et al., 2017; Arnold et al., 2022; Akindele et al., 2022; Arzoun et al., 2021). Opioid use has also been found to be safe and necessary during a vaso-occlusive crisis and should be administered parenterally within 60 minutes of arrival to the ED (Arzoun et al., 2021; Yawn et al., 2014). Yawn and colleagues (2014) noted that if the pain is mild or moderate, non-steroidal anti-inflammatory drugs (NSAIDs) can be used. Inpatient admission is warranted if the pain is not controlled within six to eight hours (Lentz and Kautz, 2017).

The National Heart, Lung, and Blood Institute (2014) further states that there is no empirical data to correlate rapid analgesic administration with improved outcomes. However, both the American College of Emergency Physicians (n.d.) and the National Heart, Lung, and Blood Institute (2014) do recommend that best practice includes rapid triage and administration of analgesics when a patient presents with severe pain and intravenous fluids in euvoletic patients should be avoided as these increase the risk of fluid overload and acute chest syndrome (National Heart, Lung, and Blood Institute, 2014).

Education is noted as a key factor in improving ED provider confidence, knowledge, and perception, including reducing bias, when working with the SCD population during an acute pain crisis (Freiermuth et al., 2014; Masese et al.; 2019) Further, education should emphasize the development of sound institutional protocols with the expectation of creating individualized pain management plans for each patient (Freiermuth et al., 2014; Masese et al.; 2019). A difference in educational outcomes has not been shown to be related to mode of delivery (Savage et al., 2022).

Savage and colleagues (2022) in a systematic review found no difference in learning outcomes between e-learning versus face-to face learning in emergency medicine and are therefore considered comparable approaches. However, Diniz and colleagues (2019) determined that e-learning is superior in course completion rates, given its convenience. Important content to address in an educational module on SCD should include pathophysiology, complications, and treatment of pain and “such educational models can reduce time-to-first-dose by helping providers understand how severe sickle cell pain can be, and that prompt evaluation and treatment may also prevent other life-threatening complications” (Glassberg, 2017, p. 414). Therefore, the purpose of this project was to determine if an online education module on acute pain management in SCD patients improves provider and nursing knowledge and confidence.

Methods

Study Design and Participants

This project design consisted of two major parts: 1) a pilot test of the accessibility and utility of an SCD educational toolkit with medical oncology providers and registered nurse volunteers; and 2) a pre/post survey design to test the effectiveness of the educational intervention with ED providers and registered nurse volunteers.

Sampling and Sample Size

Convenience sampling was employed to recruit medical oncology staff to pilot test the educational toolkit. Twenty providers (physicians and nurse practitioners) and 13 registered nurses were invited via email with the appropriate links to the pilot test and provide feedback on the SCD educational toolkit. Once the toolkit was finalized, 30 ED providers (physicians, nurse practitioners, and physician assistants) and 125 registered nurses were invited, also through

convenience sampling, to participate in the pre/post survey with the educational toolkit intervention. Participation was voluntary and consent was obtained from all participants. The facility Institutional Review Board concluded the project was exempt from review given anonymous and voluntary data collection methods.

Data Collection

Data for the educational toolkit pilot test was collected through an anonymous paper survey that was distributed to nurses and providers in the medical oncology department. The eight-question survey was created by this writer to evaluate the effectiveness and feasibility of the SCD toolkit. The educational toolkit was designed as part of this project and was based on the standards and guidelines on SCD emergency management from the American College of Emergency Physicians (n.d) and National Heart, Lung, and Blood Institute (2014) and focused on evidence around acute pain management best practices. A QR code was placed at the top of the survey for staff to access the project toolkit. Potential participants were asked to review the toolkit in its entirety and complete a post-survey once the toolkit had been reviewed..

Once the toolkit feasibility and utility was established, ED participants completed a pre-survey on knowledge and confidence around SCD. Next, the participants completed the toolkit educational module. Then, participants completed the post-surveys for knowledge and confidence. Permission was obtained from Wolters Kluwer Health Inc. to adapt and administer the 23-question demographic and knowledge survey, and from O'Brien (2022) to adapt the validated seven question confidence scale, which ranged from 0=no confidence to 100=maximum confidence.

Data Analysis

The data were entered into SPSS (version 29.0) and analyzed using descriptive statistics. The central measures of tendency used included minimum, maximum, mean, and standard deviation. The small resultant sample size did not allow for inferential analyses.

Results

Nine participants (5 RNs and 4 MDs) completed surveys on the accessibility and utility of the SCD toolkit. The average number of years in practice was 7.9 years. Three of the participants were female and six were male. Of the nine participants, 100% completed the survey in its entirety. Of the nine, 100% of respondents reported the toolkit as being easily accessible. Of the nine participants, 88.9% of respondents additionally reported usefulness of the toolkit, content, and supplemental materials. The data provided in Table 1 utilized a Likert-scale with four being very useful/likely, three as fairly useful/likely, two as a little useful/likely, and one as not useful at all.

Table 1.

Survey results addressing feasibility, and accessibility of a sickle cell disease educational toolkit

n= 9	Minimum	Maximum	Mean	SD
Overall usefulness of toolkit	3	4	3.89	.333
Usefulness of toolkit content	3	4	3.89	.333
Usefulness of supplemental materials	3	4	3.89	.333
Likelihood of using toolkit as a reference for SCD care	3	4	3.89	.333

User-friendliness of toolkit	4	4	4.00	.000
Accessibility of toolkit	4	4	4	.000

Next, seven (4 providers and 3 RNs) participants from the ED completed pre-survey data collection. Experience ranged from less than one year to more than 15 years. Five participants were male and two were female. Table 2 illustrates the demographics from the seven participants in the pre-survey.

Table 2.

Pre-survey demographic

Pre-Knowledge n = 7				
	Frequency	%	Valid %	Cumulative %
How many years have you been a provider or nurse in the Sanford Health Emergency Department?	< 1 year (1)	14.3	14.3	14.3
	1-5 years (3)	42.9	42.9	57.1
	> 5 years (3)	42.9	42.9	100.0
Please specify your role in the ED	ED staff attending (4)	57.1	57.1	57.1
	Nurse (3)	42.9	42.9	42.9

ED staff attending- How many years of post residency clinical experience do you have?	< 1 (1)	14.3	20.0	20.0
	1-5 (2)	28.6	40.0	60.0
	10-15 (1)	14.3	20.0	80.0
	> 15)1	14.3	20.0	
What is your gender?	Female (2)	28.6	28.6	28.6
	Male (5)	71.4	71.4	100.0
How likely are you to utilize a patient's reported pain score as an indication that the patient is in pain?	Very likely (3)	42.9	42.9	42.9
	Likely (1)	14.3	14.3	57.1
	Neutral (3)	42.9	42.9	100.0
How often do you utilize vital signs as an indication of patient's pain level?	Almost always (1)	14.3	14.3	14.3
	Often (1)	14.3	14.3	28.6
	Sometime s (3)	42.9	42.9	71.4
		28.6	28.6	100.0
	Not often (2)			

The knowledge survey results were based on seven participants in the pre-survey and two who completed the post-survey. For those who completed the post-survey, score percentages increased by 20% in five of the seven questions (Table 3). Question 6's knowledge score increased by 8%, and question 7 decreased from 71.4 to 0. Of the seven participants, the pre-total

knowledge score was 71.4%. Of the two participants that completed the post-survey, the post-total knowledge score was calculated at 57.1%.

Table 3.

Pre and Post Descriptive Results for SCD Knowledge

	Pre-Knowledge n = 7		Post-Knowledge n = 2	
	Frequency	% correct	Frequency	% correct
1. Do sickle cell disease emergency department pain management guidelines exist?	Yes (2) No (1) Unsure (4)	28.6	Yes (1) No (1) Unsure (0)	50.0
2. What is the standard level of triage for a patient with sickle cell disease presenting to the ED?	Level 2 (3) Level 3 (3) No standard triage level assigned (1)	42.9	Level 2 (1) Level 3 (0) No standard triage level assigned (1)	50.0

3.	Accordi ng to the national guidelines, what is the preferred route of administration once IV access has been established in a patient with severe pain?	Oral (0) Intranasal (0) Intramuscular (0) Intravenous (7)	100.0	Oral (0) Intranasal (0) Intramuscular (0) Intravenous (2)	100.0
4.	Accordi ng to the national guidelines, what is the expected time from triage to initial analgesia administration?	< 15 minutes (0) 15 minutes (1) 30 minutes (6) 60 minutes (0)	85.7	< 15 minutes (0) 15 minutes (0) 30 minutes (0) 60 minutes (2)	100.0
5.	How frequently should a pain score be reassessed following initial analgesic administration?	5-10 minutes (0) 15-30 minutes (7) 60 minutes (0)	100	5-10 minutes (0) 15-30 minutes (2) 60 minutes (0)	100.0

<p>6. Accordi ng to the American College of Emergency Physician guidelines, what standard or initial labs should be drawn (excluding any signs of acute complications)? (select all that apply)</p>	<p>Complete blood count (7)</p> <p>Comprehensive metabolic panel (4)</p> <p>Hemoglobin electrophoresis (0)</p> <p>Reticulocyte count (4)</p>	<p>42.8</p>	<p>Complete blood count (2)</p> <p>Comprehensive metabolic panel (2)</p> <p>Hemoglobin electrophoresis (1)</p> <p>Reticulocyte count (2)</p>	<p>50.0</p>
<p>7. NSAID S can be used as a sole pain medication in treatment SCD patients who present with mild to moderate pain</p>	<p>True (5)</p> <p>False (2)</p>	<p>71.4</p>	<p>True (0)</p> <p>False (2)</p>	<p>0</p>
<p>Total Score</p>		<p>71.4</p>		<p>57.1</p>

Confidence scores noted in Table 2 were one obtained using a confidence scale. SCD confidence scale with numbers in increments of 10 indicating low confidence with a score of 0-30, moderate confidence of 40-70, and high confidence at 80-100. Seven participants completed the SCD Confidence Scale pre-survey in its entirety and two participants completed the post-

survey. Of the seven participants in the pre-survey, the mean total confidence score was 67.311. Of the two participants in the post-confidence survey, scores were trending upward with a mean total confidence of 87.835.

Table 4.

Pre and Post Descriptive Results for SCD Confidence

	Pre-Confidence n = 7		Post-Confidence n = 2	
	M	SD	M	SD
My comfort level when caring for SCD patients in the ED	74.29	18.319	85.50	9.192
My general knowledge about caring for a patient experiencing an acute vaso-occlusive crisis in the ED	70.29	17.783	88.50	7.778
My ability to identify acute complications in a patient experiencing an acute vaso-occlusive crisis in the ED	69.43	12.739	86.00	5.657
My ability to make recommendations and informed decisions while caring for a SCD patient in the ED	67.57	16.521	88.0	4.243
My ability to identify evidence-based guidelines for a standard practice of care	59.86	25.109	88.50	4.950

My ability to serve as a member of an interdisciplinary team for a SCD patient in the ED	62.43	23.451	90.50	4.950
Total Score	67.311	17.208	87.835	6.130

Feedback from the ED providers and nurses on the utility of the toolkit was also sought. Of the nine respondents in the ED, 88.9% of participants reported that they would use this toolkit to reference SCD care. Around 11% of the nine participants felt there was too much information in the toolkit and the remaining reported that the toolkit contained a suitable amount of information. Table 5 represents the dichotomous question with zero for a response of no and one for a response of yes.

Table 5.

Survey results for the amount of information provided in the toolkit

	0 = No, 1 = yes	Frequency	Percent	Valid Percent	Cumulative percent
Valid	0	8	88.9	88.9	88.9

	1	11.1	11.1	11.1	100
Total		9	100.0	100.0	

Discussion

In order to determine the overall effectiveness of the toolkit, Kirkpatrick’s Four Levels of Learning Evaluation Model were applied (Hickey & Giardino, 2022). The purpose of Kirkpatrick’s model was to evaluate based on four key conceptual elements which include reaction, learning, behavior, and results (Mahmoodi et al., 2019). The scope of the model ranges from person/participant to organization/system based on the level of the model (Hickey & Giardino, 2022). The indication for choosing this model is its ability to evaluate an educational program through four crucial elements. Use of the Kirkpatrick’s Four Levels of Learning Evaluation Model will help to successfully determine if the sickle cell disease education was beneficial while evaluating if there was an impact on the organization following this project.

Table 6.

Evaluation of a sickle cell disease educational program using Kirkpatrick’s Four Levels of Learning Evaluation Model

Level	Purpose/Description	DNP Project Relation to Each Level
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<p>Level 1 Evaluation- Reaction</p>	<p>Evaluation of the individual’s reaction to training; used to determine if the participants enjoyed their experience and if the content provided is useful in practice (Hickey & Giardino, 2022).</p>	<p>Following the feasibility/accessibility survey, 100% of participants felt the teaching method used via a website was user-friendly and easily accessible. 88.9% participants reported anticipation of using the website as a reference for SCD care. 11.1% of participants felt there was too much information provided in the toolkit.</p>
<p>Level 2 Evaluation- Learning</p>	<p>Determines the level of knowledge participants have acquired; easy to measure (Hickey & Giardino).</p>	<p>The educational model did not improve knowledge in participants that completed a pre- and post- test. Data collection for determining knowledge is lacking due to a lack of responses from pre/post survey participants.</p>
<p>Level 3 Evaluation- Transfer</p>	<p>Analysis 3-6 months post implementation of training; emphasizes behavioral changes in knowledge or skills related to the training (Hickey & Giardino, 2022).</p>	<p>Determining long-term implementation, behaviors, and practice changes 3-6 months following the education cannot be fully evaluated due to timing of when the data was received.</p>
<p>Level 4 Evaluation- Results</p>	<p>Comprehensive review of the training objectives and if they were achieved by participants or the organization (Hickey & Giardino, 2022).</p>	<p>Overall, ED provider and nursing confidence increased following review of the education module. Only two participants completed the post-knowledge survey. The data was equivocal and did not support an increase in knowledge following review of the education module.</p>

Medical oncology staff found the content in the toolkit relevant and feasible as a reference when providing care to SCD patients. There were participants that felt there was too much information in the toolkit, but overall, the majority of participants felt the amount of information was appropriate. Level of knowledge did not improve following review of the toolkit, but an increase in confidence was noted overall in participants. Given the data was recently retrieved, this writer was unable to determine long-term implementation impacts on this project. This DNP project overall did achieve increased confidence in participants. The two surveys that were completed following the education did not show a change in level of knowledge. Given the lack of participants, this made it difficult to fully assess the effectiveness of the toolkit in its entirety.

Outcome measures were used to further analyze the collected data. Outcome measures are a type of quality measure used to identify areas where improvement is needed and the effectiveness of the intervention in order to determine if the outcomes compare with the goal that was desired (Hickey & Giardino, 2022). The outcome measure for this project included knowledge, confidence, feasibility, and accessibility. The objective for this project was to increase provider and nursing knowledge in the ED through the use of a web-based education module.

The intended outcome of this project was to increase provider and nursing knowledge and confidence following review of the education module. It was hypothesized that using an education module in the ED would be beneficial to staff given the inconsistency and size of the population in this community. In addition, a goal of this education module was to improve confidence in practice when caring for SCD patients in the ED. After data analysis, it was

determined that of the nine participants who completed the pre-test, two completed the post-test. Following the education module, the data showed an increase in provider and nursing confidence when caring for SCD patients in the ED. The level of knowledge following the education module based on the two participants who completed both pre- and post- surveys was unchanged. Overall, however, the data supported that the toolkit was user friendly, and easily accessible. This could lead to increased utilization and simple integration into the facility's intranet used for future protocols. The toolkit was relevant and provided the most up to date SCD care with some participants sharing that they would use this as a reference for SCD care.

This project was limited by a very small sample size, whereas only 2 participants completed the post-surveys. Additional limitations of this project include challenges with communication, access to participants, and access to data. Systems currently in place restricted the principal investigator's direct access to data, so it was unclear how many subjects completed surveys until several weeks into the project. Therefore, delays in communication disallowed additional recruitment and access to data in a way that restricted measures that could have improved the sample size. However, because the toolkit itself was determined to be valuable by responding participants, a recommendation is to integrate the knowledge from the toolkit into the institutional software/database for access to others in the future.

Conclusion

The analysis of this data concluded that the web-based educational toolkit displayed feasibility, user-friendliness, and accessibility from the majority of participants. Change in level of knowledge and confidence could not be compared in its entirety given the post-survey sample size ($n = 2$). Additional research will be required to make further assumptions regarding whether a web-based educational toolkit improves provider knowledge. Evidence here did show that

confidence levels were trending upwards through the use of a web-based educational toolkit. The research obtained provided guidance on SCD education, allowing for growth in the future for the organization, providers, and nursing staff.

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