



# Exploring Emergency Department Provider Experiences With and Perceptions of Weight-Based Versus Individualized Vaso-Occlusive Treatment Protocols in Sickle Cell Disease

**La’Kita M. J. Knight, MSN, FNP-C, BSN, BS, RN**

**Elijah O. Onsomu, PhD, MPH, MS, MCHES**

**Hayden B. Bosworth, PhD**

**Regina D. Crawford, MD**

**Theresa DeMartino, BS**

**Jeffrey Glassberg, MD**

**Judith A. Paice, PhD, RN**

**Christopher N. Miller, MD, MS**

**Lynne Richardson, MD**

**Paula Tanabe, PhD, RN, FAEN, FAAN**

## ABSTRACT

Treatment of vaso-occlusive episodes (VOEs) is the most common reason for emergency department (ED) treatment of sickle cell disease (SCD). We (1) compared perceptions of the usability and ability to manage VOE pain between ED nurses and other ED provider types, ED sites, and VOE protocols (individualized vs. weight-based), and (2) identified ED nurse and other provider protocol suggestions. A secondary analysis of provider survey data collected immediately after caring for a

**Author Affiliations:** School of Nursing, Winston-Salem State University, Winston-Salem, North Carolina (Ms Knight and Dr Onsomu); Department of Population Health Sciences (Dr Bosworth), Department of Medicine, Psychiatry & Behavioral Sciences (Dr Bosworth), Division of Hematology (Dr Crawford), Department of Medicine (Drs Crawford and Tanabe), and School of Nursing (Mss Knight and DeMartino and Drs Bosworth and Tanabe), Duke University, Durham, North Carolina; Icahn School of Medicine at Mount Sinai (Drs Glassberg and Richardson); Division of Hematology-Oncology (Dr Paice) and Feinberg School of Medicine (Dr Paice), Northwestern University, Chicago, Illinois; and Department of Emergency Medicine, University Hospitals Cleveland Medical Cen-

ter, Case Western Reserve University School of Medicine (Dr Miller).

This project was funded by the National Heart, Lung and Blood Institute (R34 HL121224A, Paula Tanabe, PhD, RN, FAEN, FAAN, principal investigator. Drs. Glassberg, Richardson, and Miller were coinvestigators and with Ms Martino all received salary support. Dr. Tanabe also has funding from the Agency for Healthcare Research and Quality, R18 RHS024501A, and the NIH, U01HL133964).

**Disclosure:** The authors report no conflicts of interest.

**Corresponding Author:** La’Kita Knight, MSN, FNP-C, BSN, BS, RN, Duke University, DUMC 3322, 307 Trent Dr, Durham, NC 27710 (lakita.knight@duke.edu).

DOI: 10.1097/TME.0000000000000232

patient enrolled in a randomized controlled trial comparing weight-based versus individualized opioid dosing for VOE. Research staff asked the ED nurses and other ED providers (nurse practitioners [NPs], physician assistants [PAs], residents, and attending physicians) 5 questions related to the protocol's ease of use and ability to manage pain. There were 236 surveys completed. Attending physicians ( $n = 15$ ), residents ( $n = 88$ ), PAs ( $n = 21$ ), and NPs ( $n = 1$ ) were more satisfied than nurses ( $n = 111$ ) with the clarity of the analgesic ordering (97.6% vs. 0%,  $p = 0.0001$ ) and ability to manage the patient's VOE pain (91% vs. 0%,  $p = 0.0001$ ). *When comparing both protocols with the usual ED strategy in their ED to manage VOE*, more nurses than other ED providers perceived the study patients' pain management protocol as better (100% vs. 35.2%,  $p = 0.0001$ ). Other ED providers perceived the individualized versus weight-based protocol as better at managing pain than their usual ED strategy (70.3% vs. 59.5%,  $p = 0.04$ ). The individualized protocol was perceived as better in managing VOE than the weight-based ED strategy. While physicians were satisfied with the clarity of the protocols, nurses were not. Improved protocol usability is required for widespread ED implementation. **Key words:** emergency care, pain, provider perception, sickle cell disease, vaso-occlusive crisis

IT IS ESTIMATED that more than 200,000 emergency department (ED) visits are accounted for by patients with sickle cell disease (SCD) each year (Lanzkron, Carroll, & Haywood, 2010). The most common reason for these ED visits is acute painful episodes referred to as vaso-occlusive episodes (VOEs; Wolfson, Schragger, Khanna, Coates, & Kipke, 2012). Despite the large volume of SCD patients being treated in the ED for VOEs, historically, evidence-based guidelines have been insufficient at guiding care and treatment of VOE is highly variable among individual EDs and ED providers (Lanzkron, Haywood, Hassell, & Rand, 2008).

In 2014, the National Heart, Lung, and Blood Institute (NHLBI) released evidence-based recommendations for SCD, which included 17 specific recommendations for the treatment of VOE (U.S. Department of Health and Human Services [HHS], National Institutes of Health [NIH], NHLBI, 2014). One of the recommendations suggested the use of individualized analgesic dosing protocols for SCD patients; however, the evidence level was only based on expert panel opinion. Because it is time consuming to develop individualized dosing protocols, an additional recommendation suggested using an SCD-specific analgesic protocol when it was not possible to develop individual protocols, and dosing details were not specified. The purpose of the SCD-specific protocol recommendation was to avoid provider variabil-

ity often used to treat VOEs. One recommendation based on high-quality evidence was treatment with opioids. Three moderate evidence levels included treatment with nonsteroidal anti-inflammatory drugs, use of patient-controlled analgesia, and a recommendation against blood transfusions for VOE management unless there were other indications for transfusion. Although these national guideline recommendations were evidence-based, many were supported by low-level evidence including expert consensus rather than randomized controlled trials (RCTs). Research is needed to support these recommendations and to better understand nurse and physician perceptions of their feasibility and effectiveness in EDs. It is important to examine the perception of both groups because the decision to implement recommendations and order sets is dependent on support from both physicians and nurses.

## RANDOMIZED CONTROLLED TRIAL DESCRIPTION

A pilot RCT was conducted in two EDs to compare patient-reported changes in pain scores when treated with an individualized versus weight-based or SCD-specific VOE protocol, as recommended by the 2014 NHLBI guidelines. A weight-based opioid protocol was used for the SCD-specific protocol. Briefly, after enrollment in an outpatient setting, and prior to an ED visit, SCD patients

were randomized to receive either an individualized protocol or a weight-based protocol at a future ED visit should one occur. Individualized VOE protocols were written by each patient's hematologist based on the patient's regular home pain management strategy. For patients randomized to the weight-based protocol, the hematologist determined VOE dosing based upon their weight. Each patient's VOE protocol was preloaded into the electronic medical record (EMR) for use in future ED visits for VOE should one occur. The results from this RCT are reported elsewhere; however, patients randomized to an individualized dosing protocol achieved both statistically and clinically greater reductions in pain from arrival to discharge and fewer hospital admissions than patients who received the weight-based protocol (Tanabe et al., 2018). When planning the RCT, it was critical to understand the perception of protocol use from the ED nurses' and other providers' perspective. Even if the protocol resulted in better pain relief, if the protocol was perceived to be too difficult to implement, the ability to disseminate the VOE protocols to EDs would be limited.

This article reports an analysis of the ED nurses and other ED providers (nurse practitioners [NPs], physician assistants [PAs], residents, and attending physicians) and their perceptions of feasibility and usability of individualized and weight-based VOE protocols and their perceptions of each protocol's ability to manage VOE pain. This research study reports (1) comparisons of perceptions of the usability and ability to manage VOE pain between ED provider types, ED sites, and VOE protocols (individualized vs. weight-based), and (2) ED provider suggestions for protocol improvement.

## METHODS

### Design

A descriptive study was conducted reporting ED provider perceptions after caring for a patient enrolled in the RCT study protocol. At the end of each ED study visit for treatment

of VOE, research assistants (RAs) conducted a brief interview with the primary ED nurse, NPs, PAs, residents, and attending physicians who provided the most care for the study patients. The study was approved by the two study site institutional review boards as well as Duke University and Winston-Salem State University because they conducted the analysis. Health care providers gave verbal consent prior to the start of the RA-guided interview.

### Setting

The project was conducted at two EDs that are academic medical centers in urban settings. The RCT and interviews were conducted over 13 months (Tanabe et al., 2018).

### Sample

The RA conducted interviews with the patient's primary registered nurse (RN) and the following other ED providers: attending physician, emergency medicine (EM) resident, fellow, PA, and/or NP. It is important to note that only three interviews were collected for each ED visit. The number of PAs and NPs who cared for the study participants was limited in both EDs. Their role was similar to the resident and thus they were invited to participate in the short interview in lieu of the resident physician.

### Procedures

The primary nurse and other ED health care providers were approached by trained RAs at the disposition of the patient's care. Disposition was defined as the decision to admit to the hospital, discharge home, or 6 hr in the ED after placement in a treatment space. The health care providers were asked to complete a brief five-question verbal interview administered by the research staff.

### Measurements

The ED health care providers' clinical practice characteristics included the providers' type or title. Demographic characteristics were not collected to protect anonymity

and encourage participation. Table 1 lists the questions used to assess the ED nurses' and other ED providers' perceptions of VOE protocol usability, feasibility, and satisfaction of use of the individualized and standard (weight-based) VOE protocols. These questions were developed by the research team specifically for this project and with the knowledge that ED providers are busy and the interview needed to be short. One of the questions asked providers to compare the protocol pain management with the usual ED strategy. Usual care was defined as the usual ED strategy to manage VOE at the study site. Usual care at each site was highly variable and determined by the individual provider. There were no protocols for the treatment of VOE in place at either study site.

**Data Analysis**

Both descriptive statistics and bivariate analysis using Fisher's exact test were determined using SPSS version 24.0 (IBM Corp, 2016). Bivariate analysis was used to compare perceptions of the usability and ability to manage VOE pain between the (1) different ED provider types, (2) ED study sites, and (3) VOE protocols (individualized vs. weight-based). Study sites were compared to examine any possible effects of site differences on study outcomes. When completing the data analy-

sis, some of the ED provider types were combined because of a small number in some groups. The EM resident category was collapsed with the other types of ED providers such as an ED fellow. Both NPs and PAs were combined because their role in diagnosis and treatment is similar to residents as opposed to the role of RNs. Responses to questions were compared between RNs and other ED providers (residents, attending physicians, NPs, and PAs). The RNs' and other ED providers' responses were compared because of their differing roles in prescribing versus administering analgesics. For Question 1, nurse responses were excluded from the analysis because only physicians, PAs, and NPs were responsible to locate the study protocol order set.

Qualitative analysis was used to examine text responses to Question 5. The text responses were transcribed into a Word document for analysis. The principal investigator trained the second evaluator on coding the text responses. Text responses to Question 5 were independently reviewed by the two evaluators. Nine categories were identified using de novo coding; a priori lists of codes were not created. New categories emerged during the coding process. Both coders met to discuss discrepancies, and new codes were created to determine the final coding structure. Two responses were not

**Table 1.** Survey questions

Question	Response options
1. Were you satisfied with your ability to find the order set within EPIC?	Yes, No, or N/A if a nurse
2. Were you satisfied with the clarity of the analgesic ordering from a provider's perspective?	Yes, No
3. Were you satisfied with the study protocol's ability to manage the patient's pain?	Yes, No
4. How do you compare this study patients' pain management protocol with the usual ED strategy (how VOE is usually treated in your ED) for the management of VOE?	Better, Worse, or About the same
5. What suggestions do you have to make the study protocol easier to access or use?	Free text

*Note.* ED = emergency department; VOE = vaso-occlusive episode.

Downloaded from http://journals.lww.com/edjournal by BMDi5eP7Kax1ZEcoun1QIN4a+K.LIHEZqpsH1o4XM0h0Cv MCV1AMWY0qJlOHHD33D00dR5Y7TVSFD4Q3VCA4OANPDDa8K2+Y66H515KE= on 01/26/2024

mutually exclusive and were included in multiple categories.

## RESULTS

A total of 236 surveys (111 RNs, 15 attending physicians, 87 residents, 1 fellow, 21 PAs, and 1 NP) were completed. Table 2 compares perceptions of the ability to find the order set, clarity of the order set, ability to manage the pain, and comparison of the protocols' ability to manage pain compared with usual care by *provider type*. As stated earlier, usual care was defined as highly variable and determined by each individual provider. The majority of other ED providers were very satisfied with the ability to find the order set (attending physician [ $n = 12$ , 80%], EM resident [ $n = 56$ , 63.6%], and PA/NP [ $n = 11$ , 50%]). When the other ED providers were compared with the nurses, the other providers were more satisfied with the clarity of the analgesic ordering than nurses ( $n = 122$ , 97.6% vs. 0%,  $p = 0.0001$ ). For the protocol's ability to manage patients' pain, other ED providers were more satisfied than nurses ( $n = 114$ , 91.2% vs.  $n = 111$ , 0%,  $p = 0.0001$ ). When asked about how the protocols compared with usual VOE treatment, 100% ( $n = 111$ ) of nurses reported the study protocols *were better than usual treatment*, whereas only 35.2% ( $n = 44$ ) of other ED providers believed the treatment protocols were better than usual care ( $p = 0.0001$ ).

Table 3 compares the ED providers' perceptions of the feasibility to manage VOE pain between the different *study sites and protocol types (individualized vs. weight-based)*. There was no significant differences between the two ED sites (University of Cincinnati:  $n = 124$  and Mount Sinai:  $n = 108$ ). The other ED providers' ability to find the order set ( $p = 0.898$ ), the clarity of the analgesic ordering ( $p = 0.75$ ), the study protocol's ability to manage the patient's VOE pain ( $p = 0.806$ ), and the differences in comparing the study pain management protocol with the usual ED strategy ( $p = 0.845$ ). Both RNs' and other ED providers' perceptions of the usability and ability to manage VOE pain between

the individualized ( $n = 121$  interviews) and weight-based ( $n = 111$  interviews) VOE protocols revealed that there was no significant differences between protocols in satisfaction with the ability to find the order set, clarity of the order set, or ability to manage the patients' pain between protocols. However, more RNs and other ED providers reported the individualized versus weight-based protocol as more effective for treating VOE than *their usual care for management of VOE* (70.3% vs. 59.5%,  $p = 0.04$ ).

Table 4 summarizes the responses to Question 5, which asked: "What suggestions do you have to make the study protocol easier to access or use?" A total of 147 participants responded to this question: RNs ( $n = 0$ ), attending physicians ( $n = 16$ ), EM residents ( $n = 87$ ), PAs ( $n = 26$ ), NPs ( $n = 3$ ), and other off-service residents ( $n = 15$ ), which included anesthesia, obstetric, and internal medicine residents. A total of nine categories or themes emerged from the provider responses. Table 4 displays each category or theme, the corresponding number of responses, and sample quotes for each. The most frequent comment was "no suggestions for improvement." The provider comments contained information about the user-friendliness of the order sets and provided specific suggestions for protocol improvements. In particular, there were comments related to how the order set could be clarified electronically by indicating the frequency of each dose and stating whether doses were scheduled or as needed. There also were helpful comments related to the dosing, such as rounding to the nearest whole number for all odd doses. Some comments reflected provider concern as the odd doses required "wasting" by the RN. The qualitative comments helped give meaning to the quantitative survey results.

## DISCUSSION

This study examined RN and other ED provider perceptions of the ease of use and perceptions of effectiveness of an individualized versus weight-based opioid protocol

**Table 2.** Healthcare provider survey responses by provider type

ED provider interview questions	ED provider types												RN vs. all other provider types, exact <i>p</i> value		
	Registered nurse			Attending physician			EM resident/fellow			Physician's assistant/nurse practitioner				All non-RNs	
	<i>n</i>	%		<i>n</i>	%		<i>n</i>	%		<i>n</i>	%			<i>n</i>	%
Q1. Were you satisfied with your ability to find the order set in EPIC? ( <i>N</i> = 125) <sup>a</sup>															
No	-	-	3	20	36.4	11	50	-	-	-	-	-	-	-	-
Yes	-	-	12	80	63.6	11	50	-	-	-	-	-	-	-	-
Q2. Were you satisfied with the clarity of analgesic ordering, from a provider's perspective? ( <i>N</i> = 236)															
No	111	100	0	0	3.4	0	0	3	3.4	0	0	3	2.4	0.0001	
Yes	0	0	15	100	96.6	22	100	122	97.6	0	0	122	97.6		
Q3. Were you satisfied with the study protocols ability to manage the patient's pain? ( <i>N</i> = 236)															
No	111	100	1	6.7	9.1	2	9.1	11	8.8	0	0	11	8.8	0.0001	
Yes	0	0	14	93.3	90.9	20	90.9	114	91.2	0	0	114	91.2		
Q4. How do you compare this study patients' pain management protocol to the usual ED strategy for the management of VOE? ( <i>N</i> = 236)															
Better	111	100	9	60	31.8	7	31.8	44	35.2	0	0	44	35.2	0.0001	
Not Better	0	0	6	40	68.2	15	68.2	81	64.8	0	0	81	64.8		

*Note.* ED = emergency department; EM = emergency medicine; non-RN = non-registered nurse (attending physician, EM resident/other, physician's assistant/nurse practitioner); VOE = vaso-occlusive episode. RN versus non-RN compared using 2 × 2 Fisher's exact tests. For Q4, the "worse" and "about the same" responses were collapsed into "not better."  
<sup>a</sup>RNs did not respond to this question.

**Table 3.** Healthcare provider survey by ED site and VOE protocol type

ED provider interview questions	ED sites				VOE protocols				p	
	University of Cincinnati (N = 124)		Mount Sinai, New York (N = 108)		Weight-based protocol (N = 111)		Individualized Protocol (N = 121)			
	n	%	n	%	n	%	n	%		
Q1. Were you satisfied with your ability to find the order set in EPIC? <sup>a</sup>										
No	25	37.3	21	36.3	24	38.1	22	35.5	0.898	0.762
Yes	42	62.7	37	63	39	61.9	40	64.5		
Q2. Were you satisfied with the clarity of analgesic ordering from a provider's perspective?										
No	60	48.4	50	46.3	50	45	60	49.6	0.75	0.513
Yes	64	51.6	58	53.7	61	55	61	50.4		
Q3. Were you satisfied with the study protocols ability to manage the patient's pain?										
No	64	61.6	54	50	55	49.5	63	52.1	0.806	0.793
Yes	60	48.4	54	50	56	50.5	58	47.9		
Q4. How do you compare this study patients' pain management protocol to the usual ED strategy for the management of VOE?										
Better	82	66.1	69	63.9	66	59.5	85	70.3	0.845	
Worse	5	4	6	5.6	9	8.1	2	1.7		0.04
About the same	37	29.8	33	30.6	36	32.4	34	28		

Note. ED = emergency department; VOE = vaso-occlusive episode.  
<sup>a</sup>RNs did not respond to this question, N = 125

**Table 4.** Categorized responses to Question 5 with sample quotes—“What suggestions do you have to make the study protocol easier to use or access?”

Category	Number of responses	Sample quotes
No suggestions	44	
Order set improvements	28	<p>“Order set improvements” related to the clarity of the orders in the EPIC computer system.</p> <p>“Confusing when the order set says every 20 min and then says discontinued. It was a problem with EPIC, not the study.”</p> <p>“I could not order the requested doses of Dilaudid in EPIC because the dose was too high and EPIC would not let me override.”</p> <p>Attending physicians stated: “Wording on the order set should clarify that the doses of medication are PRN not mandatory.”</p>
Ease of use	21	<p>“Ease of use” focused on the providers’ satisfaction of protocol use.</p> <p>Residents stated: “Very simple,” “worked great,” “ordering directions were very clear and easy,” “instructions right there.”</p> <p>“Could incorporate patient’s normal pain requirements to help with regimen.”</p> <p>Other provider stated: “Ordering was a breeze.”</p>
Doses, odd, insufficient, high, or confusing	18	<p>“Doses: odd, insufficient, high, or confusing” provided information about the difficulties of the protocol doses.</p> <p>PAs stated: “Round to the nearest whole number to make it easier/faster for the nurse to access the meds.”</p> <p>“Dosing difficulty for administration (i.e., 2.3 mg or 2.9 mg); more user-friendly dosing.”</p> <p>Residents stated: “Good concept in general; hard because these are not even doses so we need a witness to waste the medicine.”</p> <p>“Dosage was confusing. Didn’t know if I was supposed to give patient 0.025 mg or 2.04 mg of Dilaudid.”</p>
Nurse-directed comments	13	<p>“Nurse-directed comments” focused on challenges for nurses associated with medication administration.</p> <p>An attending physician stated: “Nursing support-nursing is the rate-limiting factor in the patient receiving timely meds.”</p> <p>A PA stated: “Having difficulty getting nursing to follow the protocol. So getting them on board is key.”</p> <p>Residents stated: “Assign the nurse to administer series of meds,” “better pre-education of RN staff prior to implementation,” “focus on increased RN/MD communication about pain needs,” “it is hard for nursing to follow the Q20–30 minute schedule.”</p>

*(continues)*

Downloaded from http://journals.lww.com/epjournal by BhDM55pHKy17ZEcunt1QIN4a4K.LJHEZqpsH1o4XM0h0Cv MCK1AMW1YQpJlCHHD33D00DFY7TVSFA4Q3VCA4OANPDDa8K2+Y66H615KE= on 01/26/2024



**Table 4.** Categorized responses to Question 5 with sample quotes—“What suggestions do you have to make the study protocol easier to use or access?” (*Continued*)

Category	Number of responses	Sample quotes
ED location for protocol administration	12	<p>“ED location for protocol administration” reflected the difficulty of using these protocols in the ED.</p> <p>PAs stated: “Can’t be done here in the ED when it’s busy.”</p> <p>“In order for the timing to work it must be in a more controlled environment.”</p> <p>“Protocol should only take place at inpatient unit”</p> <p>“Whoever the provider is should say what’s going to be done. How will this work when there are more patients in the ED? When busy this may pose a problem.”</p> <p>Other provider stated: “This should not be done in the ED due to chaotic environment.”</p>
Research related	7	<p>“Research-related” comments were related to the research study.</p> <p>Residents stated: “Have it pop up and alert that the patient is research.”</p> <p>“I had no idea that the patient was enrolled. Poor communication on MD part. I would have been more aware and giving pain meds on time.”</p> <p>Other provider stated: “The protocol was easy to access, but I wouldn’t have realized he was in the study unless research coordinator found me.”</p>
Miscellaneous	4	<p>“Miscellaneous comments” did not fit into the other categories.</p> <p>Attending physician: “Although I do believe patient’s symptoms were less acute from previous patients in crisis.”</p>
Dissatisfaction with protocols	2	<p>“Dissatisfaction with protocols”: Providers expressed their dissatisfaction of the protocols.</p> <p>The two residents stated: “I think if patients expect this treatment, they won’t be happy.”</p> <p>“I am not a fan of this particular weight-based protocol. It is not nursing friendly.”</p>

*Note.* ED = emergency department; PA = physician assistant; PRN = as needed.

to treat VOEs in the ED. Overall, other ED providers were satisfied with the ability to find the order set and the clarity of the analgesic ordering. However, nurses were not satisfied with the clarity of the analgesic ordering, which further suggests the need to modify the order sets to improve clarity for easier implementation by nurses. Qualitative

data suggest that the dissatisfaction with the clarity of the orders was due to the odd doses and the “expiration” of the every 20-min repeat order, which required additional doses. The odd doses required nurses to waste additional medication volume and led to a cumbersome process. Unfortunately, none of the nurses replied to survey Question 5; thus,

answers were based on other ED providers. Anecdotally, at research team meetings, the research staff expressed the same concern and observed frustration among the ED nurses related to odd doses that resulted in medication wasting. Before widespread adoption of these recommendations is possible, it is important to determine a dose rounding strategy to avoid unnecessary medication wasting.

Nursing teams will need to embrace the benefits of the recommendations and determine team-based strategies to facilitate nurse availability to reassess and readminister opioids initially until pain is adequately controlled. Future recommendations and/or orders should include reassessment and readministration of opioids every 15–30 min until VOE pain is relieved. Often, orders were for three doses of opioids. Frequently, in our experience, after three doses, pain is more controlled. The clinical staffing needs and workload for the primary nurse should be compared with previous acute myocardial infarction protocols that required the administration of intravenous  $\beta$ -blockers every 15 min times three doses. To compare the effect on workload, most EDs have between two and four visits per day for SCD patients in comparison with the large volume of patients with chest pain.

Several differences were found between provider types in satisfaction with the ability of both study protocols to manage pain and the comparison with the usual pain management strategy used in their ED to manage VOEs. All of the RNs were dissatisfied with the protocol's ability to manage the patient's pain, but they perceived the study protocol as better than the usual strategy in their ED. In contrast with 0% of RN providers, 91.2% of other ED providers were satisfied with the study protocol's ability to manage pain. When other ED providers compared their satisfaction with the study protocol's ability to manage the patient's pain to usual care, only 35.2% of other ED providers indicated that the study protocols were better than the usual strategy. These differences in findings between questions and provider types indicate that al-

though the study protocols were still not adequate in managing pain, 100% of the nurses perceived the study protocol as better at managing the patient's pain as compared with the usual strategy for VOE treatment in their ED.

Providers compared the two protocols (individual vs. weight-based dosing) related to usability and pain relief. More providers perceived the individualized protocol (70.3%) as better than the weight-based protocol (59.5%) than the usual ED strategy for managing VOEs. Although provider perceptions are interesting, the actual patient perception of pain relief is the gold standard (McCaffery, 1968). In this trial, patients who received the individual dosing protocol reported a clinically and significantly greater reduction in pain from arrival to discharge and were hospitalized less frequently than the weight-based protocol (Tanabe et al., 2018). These results provide important data to support the need for individual protocols similar to those of other studies (Ender et al., 2014; Kato-Lin, Krishnamurti, Padman, & Seltman, 2014; Kavanagh et al., 2015; Krishnamurti et al., 2014).

Results from the open-ended question added value to the quantitative results. Overall, there were many positive responses and recommendations for protocol improvements. These provider comments highlight the need for continued protocol modifications before future dissemination and use by other ED nurses and health care providers.

Although the majority of the providers were in support of the protocol, a few providers suggested it was not feasible to administer the protocol in the ED. However, optimal pain management for treatment of VOEs requires rapid and aggressive analgesic management. Patients seek care in the ED, and in this setting, it is important to provide evidence-based pain relief according to the NHLBI recommendations. To maximize VOE protocol usage in EDs, further research is needed to explore ways to increase adherence of protocols by nurses and other health care providers. An alternative to rapid opioid administration is a patient-controlled analgesic (PCA) pump. The expert panel

recommended use of a PCA pump for treatment of VOEs (HHS, NIH, NHLBI, 2014). Initial setup of a PCA pump is time consuming, however, and anecdotally has been found to lead to decreased delay to administration of an initial analgesic dose. Alternatively, it is possible to start a PCA pump within the first hour and administer parenteral doses until the PCA pump is available. Although many EDs do not typically use PCA pumps, anecdotally, some EDs have successfully incorporated the use of PCA pumps in the ED. Incorporation of routine use of PCA pumps in the ED would require significant education for both nurses and physicians.

This study provides important data from nurses and other ED providers who treated patients using the evidence-based recommendations from the NHLBI for the treatment of VOEs. Nurses can use these results to support implementation of individualized or weight-based protocols in their local ED. Quality improvement projects can be conducted to evaluate success of implementation.

### Limitations

There were several limitations to this study. The project was conducted at only two EDs, both were academic medical facilities. Findings may not generalize to nonacademic EDs. On the basis of the experiences of the researchers in this study, the majority of patients with SCD are treated in large academic medical centers. Additional research with more EDs is required to increase the generalizability of findings.

Another limitation was the protocols at both sites used the same EMR, EPIC. It is possible other EMRs may be more challenging to use.

Another limitation was that the ED provider interviews were anonymous and individual providers could have completed multiple interviews if they cared for more than one patient on the study protocol. However, each interview was specific to the patient they just cared for, and patients could have been on either study protocol. To encourage responses, ED provider demographics were not

collected and analysis was unable to control for nested effects within each provider who provided multiple assessments for each protocol or patient visit. Another limitation was no RNs responded or provided feedback to Survey Question 5, which asked for suggestions for protocol improvements. However, we did receive 111 responses from nurses on the other four questions. Similarly, we received only 22 responses from PAs and/or NPs. This ratio of nurses compared with PAs and NPs working in the ED reflects the number of nurses and advanced practice providers working at these two ED study sites. Nurse staffing ratios were a limitation, as several ED providers commented on how challenging it was to implement these protocols in the ED due to the uncontrolled work environment. Differences in nurse/patient ratios at different EDs may affect protocol implementation.

Finally, the patients' perception of the protocols were not reported here but those findings were reported elsewhere (Tanabe et al., 2018). The emphasis of this article is to report the perceptions of providers' ability to manage VOE pain in SCD patients using an individualized or weight-based VOE protocol. The patients' perceptions of these protocols are relevant as they will inform implementation in other EDs.

### CONCLUSION

It was possible to implement individualized and weight-based analgesic protocols for the treatment of VOEs in the ED. Use of online predeveloped order sets facilitated their use and was acceptable to most non-RN providers. More ED nurses and providers perceived the individualized versus weight-based VOE protocols as better at managing pain than the usual ED strategy. Modifications in the dosing will be necessary to avoid the need for wasting of opioid dosing and clarification of the order set for nurses. In addition, an increase in national protocol adherence by nurses and health care providers is needed to improve the overall management of VOE in EDs.

## REFERENCES

- Ender, K. L., Krajewski, J. A., Babineau, J., Tresgallo, M., Schechter, W., Saroyan, J. M., & Kharbanda, A. (2014). Use of a clinical pathway to improve the acute management of vaso-occlusive crisis pain in pediatric sickle cell disease. *Pediatric Blood & Cancer*, *61*(4), 693–696. doi:10.1002/pbc.24864
- IBM Corp. *IBM SPSS Statistics for Windows, Version 24.0*. Armonk, NY: IBM Corp; 2016.
- Kato-Lin, Y. C., Krishnamurti, L., Padman, R., & Seltman, H. J. (2014). Does e-pain plan improve management of sickle cell disease associated vaso-occlusive pain crisis? A mixed methods evaluation. *International Journal of Medical Informatics*, *83*(11), 814–824. doi:10.1016/j.ijmedinf.2014.08.003
- Kavanagh, P. L., Sprinz, P. G., Wolfgang, T. L., Killius, K., Champigny, M., Sobota, A., . . . Moses, J. M. (2015). Improving the management of vaso-occlusive episodes in the pediatric emergency department. *Pediatrics*, *136*(4), e1016–e1025. doi:10.1542/peds.2014-3470
- Krishnamurti, L., Smith-Packard, B., Gupta, A., Campbell, M., Gunawardena, S., & Saladino, R. (2014). Impact of individualized pain plan on the emergency management of children with sickle cell disease. *Pediatric Blood & Cancer*, *61*(10), 1747–1753. doi:10.1002/pbc.25024
- Lanzkron, S., Carroll, C. P., & Haywood, C., Jr. (2010). The burden of emergency department use for sickle-cell disease: An analysis of the national emergency department sample database. *American Journal of Hematology*, *55*(10), 797–799. doi:10.1002/ajh.21807
- Lanzkron, S., Haywood, C., Jr., Hassell, K. L., & Rand, C. (2008). Provider barriers to hydroxyurea use in adults with sickle cell disease: A survey of the Sickle Cell Disease Adult Provider Network. *Journal of the National Medical Association*, *100*(8), 968–974. doi:10.1016/s0027-9684(15)31419-x
- McCaffery, M. (1968). *Nursing practice theories related to cognition, bodily pain, and man-environment interactions*. Los Angeles, CA: University of California Print.
- Tanabe, P., Silva, S., Bosworth, H. B., Crawford, R., Paice, J. A., Richardson, L. D., . . . Glassberg, J. (2018). A randomized controlled trial comparing two vaso-occlusive episode (VOE) protocols in sickle cell disease (SCD). *American Journal of Hematology*, *93*(2), 159–168. doi:10.1002/ajh.24948
- U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute. (2014). *Evidence-based management of sickle cell disease: Expert panel report, 2014*. Retrieved from <https://www.nhlbi.nih.gov/sites/www.nhlbi.nih.gov/files/sickle-cell-disease-report.pdf>
- Wolfson, J. A., Schrager, S. M., Khanna, R., Coates, T. D., & Kipke, M. D. (2012). Sickle cell disease in California: Sociodemographic predictors of emergency department utilization. *Pediatric Blood & Cancer*, *55*(1), 66–73. doi:10.1002/pbc.22792