

Decreasing Pain in Hospitalized Patients by Increasing Topical Anesthetic Use for Peripheral IVs

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Abstract

Introduction: Venous access is a common source of pain for hospitalized patients. Topical anesthetics are effective at decreasing needle pain, can improve success rate, and decrease procedure time; however, use before peripheral intravenous line (PIV) placement is inconsistent. The aim was to reduce pain experienced by hospitalized pediatric patients by increasing topical anesthetic use for PIV placement from a mean of 11% to 40% within 6 months. **Methods:** The Model for Improvement was utilized. An institutional clinical pathway and PIV order panel were developed. Pre-checked orders for topical anesthetics were added to order sets. Visual aids were placed on IV carts, including reminders for anesthetics, pathway use and scripting examples. Nurses received individual feedback. Statistical process control charts were posted weekly on daily management system boards on medical-surgical floors, and data were shared at daily nursing huddles to increase awareness of performance and discuss opportunities for improvement. **Results:** Topical anesthetic use for PIV placement increased from a mean of 11% to 46%. Documentation of comfort measures during PIV placement increased from a mean of 6% to 13%. The percentage of PIV placements with an order for a topical anesthetic in the electronic health record increased from a mean of 14% to 54%. PIV procedures with documentation of placement attempts increased from a mean of 47% to 70%. **Conclusions:** Through systems and culture change, awareness of the importance of pain prevention for venous access procedures increased, and patient-centered care improved with greater collaboration between nurses, providers, and families for venous access planning. (*Pediatr Qual Saf* 2024;9:e753; doi: 10.1097/pq9.000000000000753; Published online August 9, 2024.)

INTRODUCTION

Pain in hospitalized pediatric patients is not well managed.¹⁻⁴ Venous access procedures

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are the most common procedure performed in the hospital and have been rated as both the worst and most significant source of pain and anxiety for patients and families.^{2,5,6} In addition to the immediate distress caused during painful procedures, pain experiences associated with medical care in childhood can be traumatic and lead to chronic pain, depression, anxiety, and healthcare avoidance in the future.^{2,5,7,8} Managing pain is also a high priority for parents.⁹

Topical anesthetics (4% liposomal lidocaine cream, lidocaine 2.5% and prilocaine 2.5% cream) reduce pain for needle procedures and increase procedural success.^{2,10-15} Vapocoolant spray reduces pain before needle procedures but is less effective than numbing creams.^{2,16,17} Additional nonpharmacologic comfort measures, including breathing techniques, distraction and positioning, as well as oral sucrose, nonnutritive sucking and breastfeeding for infants, have been shown to reduce pain.^{2,13,18,19} Pain management for infants and patients with intellectual disability is often overlooked due to limitations in pain expression. However, topical anesthetics are effective in these populations.^{20,21} Despite the evidence and recommendations for pain reduction during needle procedures, interventions are not commonly used.^{1,22}

Quality improvement (QI) methodology has been successfully used to increase the use of topical anesthetics for painful procedures. Rosenberg et al conducted a QI initiative targeting pediatric procedural pain management at a large multisite academic center and increased topical lidocaine use for inpatient admissions from 10% to 36.5%.²² Nursing pain knowledge scores and parent satisfaction specific to procedural comfort also increased. Friedrichsdorf et al implemented a comfort bundle across all inpatient units, emergency departments (EDs), outpatient laboratories, and clinics to reduce pain associated with needle procedures, which included topical anesthetics, breastfeeding for infants, comfort positioning, and distraction.⁵ A point prevalence survey after implementation showed decreased pain from needle procedures and an overall reduction in pain prevalence.⁶ Other hospitals have used multidisciplinary teams, education on evidence-based practice, and protocols to decrease pain related to peripheral venous access.^{23–25} Additionally, clinical pathways are an effective strategy to improve the delivery of evidence-based care.^{26–30}

Within our institution, topical anesthetic use before venous access procedures was minimal, and there was little consideration of emotional or behavioral support for the patient and caregiver during the procedure. Recognizing the impact of needle procedures on our hospitalized population, the global aim of our QI initiative was to reduce unnecessary pain experienced by pediatric patients during peripheral intravenous line (PIV) placement during hospitalization. The SMART (Specific, Measurable, Actionable, Relevant, Time-bound) aim was to increase the use of topical anesthetics for PIV placement for patients admitted to medical-surgical floors from a mean of 11% to 40% within 6 months. The secondary aims were to increase the use of comfort measures, increase topical anesthetic orders for PIV placement, and increase documentation of PIV placement.

METHODS

Context

This QI project was implemented at an urban, tertiary-care pediatric academic hospital with an annual volume of over 7,000 admissions. Topical anesthetics on the formulary were lidocaine 4% and vapocoolant spray. PIVs are commonly placed by nurses and rarely by residents, advanced practice providers, and attending physicians. There is no dedicated IV team. The focus was on the medical-surgical floors as it was the area over which project leaders had the most influence, and the acute care setting has less time pressure for treatment compared with the ED or intensive care unit. Our institution has a robust Clinical Pathways Program, which updates pathways annually.

Population

All admitted patients were included between November 28, 2018, and March 1, 2020. Topical anesthetics can be safely used in children 36 weeks corrected gestational age and older.^{2,31}

Planning

Historically, there was a successful institution-wide program to reduce pain at our institution. However, these efforts were not sustained.³² The institution's multidisciplinary Pain Steering Committee was reestablished before this initiative. We obtained support from the committee and created an interdisciplinary QI project team, including a child life specialist, a patient care advocate, a pharmacist, a pediatric resident, a pain medicine physician, nurse champions, and pediatric hospitalists. Potential interventions were identified using a failure mode and effects analysis (Fig. 1). Additionally, we received input from stakeholders on why topical anesthetics were not routinely used. We also received feedback from patients and caregivers on topical anesthetic use for PIV placement through random interviews and the hospital's Patient Advisory Committee. A key driver diagram helped guide interventions (Fig. 2).

Interventions

Utilizing the Model for Improvement, multiple Plan, Do, Study, Act (PDSA) cycles were completed to increase the use of topical anesthetics before PIV placement. PDSA ramps of different interventions were completed and fell into the following categories: development and implementation of a clinical pathway, education, electronic health record (EHR) modifications, and daily reminders and feedback.

Development and Implementation of a Clinical Pathway (See Supplemental Digital Content 1, figure 1, <http://links.lww.com/PQ9/A588>.)

An institutional evidence-based peripheral venous access clinical pathway was developed by a multidisciplinary team and implemented to standardize care. The pathway introduced a standard process for procedure planning before every venous access procedure to encourage the utilization of topical anesthetics and comfort measures.

Education

We identified several team member knowledge gaps. We educated nurses, residents, advanced practice providers, and attending providers through oral presentations and electronic education via emails and online modules. Child Life created scripting examples to address the staff's unfamiliarity with discussing PIV placement and topical anesthetics with patients and families.

EPIC EHR Modifications

Feedback from nursing identified the lack of an order for a topical anesthetic as a barrier to use. A PIV order panel

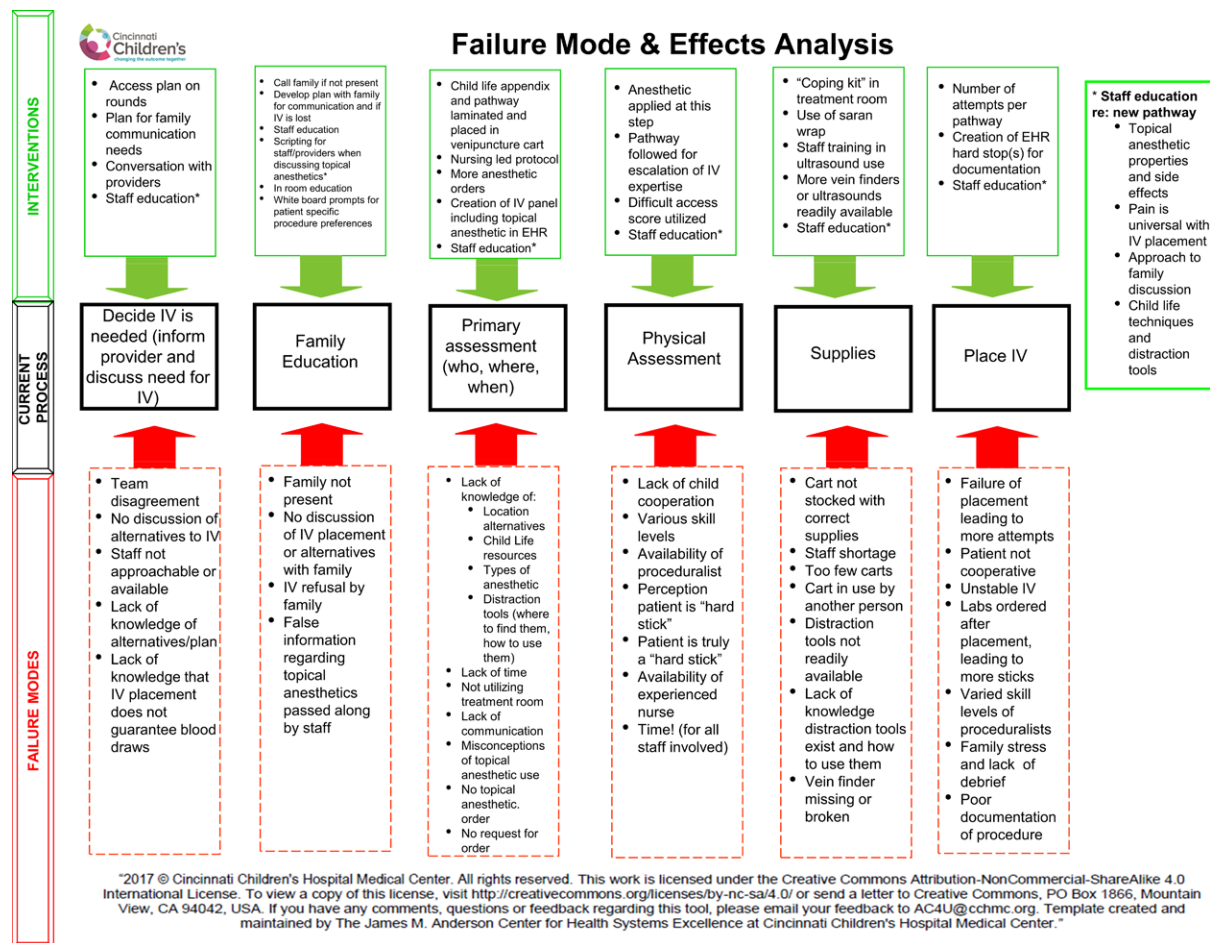


Fig. 1. Failure Mode and Effects Analysis.

with age-appropriate preselected orders for topical anesthetics was developed and added to admission order sets. PIV placement was not part of the required nursing documentation and was often incomplete. Nursing flow sheets in the EHR were updated to include documentation of topical anesthetic use and comfort measures. Hard stops were added to promote more complete documentation.

Daily Reminders and Feedback

Visual reminders for topical anesthetic and clinical pathway use were placed on IV carts. Statistical process control (SPC) charts were posted weekly on daily management system (DMS) boards on each medical-surgical floor, and the data were reviewed at daily nursing huddles at the beginning of each shift to increase awareness of performance. Nurse managers provided real-time individual feedback to nurses who did not use topical anesthetics for IV placement.

STUDY OF INTERVENTION

The results of PDSA cycles for each intervention were analyzed at team huddles and meetings. All PIVs placed on the medical-surgical floor were included in the data collection. Weekly retrospective data were collected for

21 months, starting with the preintervention period from June 2018 to November 2018 and then the postintervention period from November 2018 through February 2020. Data were pulled from the EHR and validated by the study team. The data were entered into SPC charts and reviewed by the project team to determine the need for further interventions.

MEASURES

The primary outcome measure was the percentage of PIVs placed on the medical-surgical floors using topical anesthetics, as documented in the medication administration record and WALDOs (Wounds, Airways, Lines, Drains, Other) in the EHR. PIV placement was selected as a measure because there was no required documentation for venous access attempts for phlebotomy, and the practice patterns were thought to be similar for both procedures. Secondary process measures included the percentage of PIV placements with documented use of comfort measures (ie, comfort positioning, distraction, breathing techniques) and the percentage of PIV placements with an order for a topical anesthetic. There was low compliance with PIV documentation. Therefore, the metric of the percentage of PIV placements with documentation of several

Key Driver Diagram (KDD)

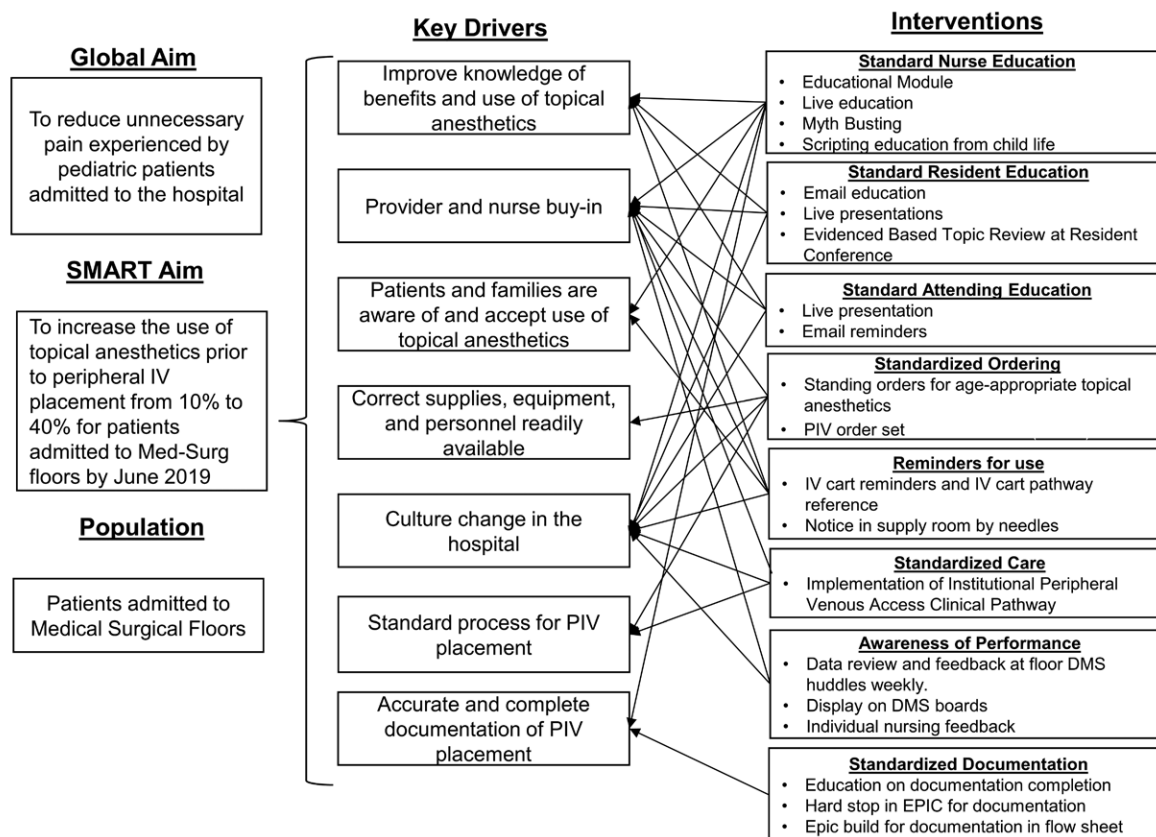


Fig. 2. Key Driver Diagram.

attempts was used as a proxy measurement for completion of documentation.

Due to patterns noted in the outcome measure review over the study period, we stratified the primary measure by day and night shift and by age less than and greater than 1 year to target interventions better.

There was no reliable way to collect patient pain scores associated with PIV placement as they were not documented in the EHR, and our institution has a low response rate for patient satisfaction surveys. Our study team considered balancing measures, but they were challenging to collect. The cost was examined, though the topical anesthetic product costs are minimal. We reviewed all charts for several weeks to determine if topical anesthetic use led to a clinically significant delay in intravenous medication or fluids. No adverse delays were noted, so this metric was retired.

ANALYSIS

Weekly data for each measure were followed in run and SPC charts to evaluate the impact of interventions. Control limits were set at three SDs from the mean. Standard rules were used to determine special cause variation. Demographic data pre- and postinterventions were analyzed to determine if populations were similar. Age, sex, and length of stay were compared using *t* tests and

Mann-Whitney tests. Chi-square and Fischer exact tests were used to compare race and ethnicity.

Ethics

The institutional review board determined this project exempt from review as QI work and was not considered human subject research.

RESULTS

One thousand five hundred ninety-eight patients were included: 393 during the baseline period and 1205 during the study period. Most patients were greater than one year old (79%). There was no statistical difference between age, sex, race, or ethnicity between the pre- and postintervention groups. However, more patients had race and ethnicity documented as refused, other or unknown in the postintervention group. Length of stay was longer in the preintervention group ($P < 0.001$) (Table 1). During the baseline period, topical anesthetics were used for 11% of patients before PIV placement compared with 46% after implementation of study interventions (Fig. 3).

For patients older than 1 year, topical anesthetic utilization before PIV placement increased from a mean of 9% to 52% (Fig. 4); however, topical anesthetic use for infants remained lower. At baseline, variation was

Table 1. Demographics and Length of Stay of Hospitalized Pediatric Patients with PIVs Placed

Variable	Preintervention (n = 393)	Postintervention (n = 1205)	P (t test, Mann Whitney)
Age: (Mean, Std Dev), (Median, IQR)	(8.35, 6.8), (8.0, 14.0)	(7.76, 7.1), (14.0, 44.0)	(0.14, 0.09)
Age (<1 year only): N, (Mean, Std Dev), (Median, IQR)	75, (94.4, 111.3), (35, 165)	256, (103.84, 107), (59.5, 176)	(0.52, 0.23)
Sex (% female)	183/393 (46.56)	602/1205 (46.56)	(1.0, 1.0)
Race (%)			
Asian	11 (2.8)	26 (2.16)	0.49*
AA	84 (21.37)	213 (17.68)	0.11†
NH or PI	1 (0.25)	2 (0.17)	—
White	184 (46.82)	541 (44.90)	0.51†
PatientRefused/unknown/other	113 (28.75)	421 (34.9)	0.02†
Ethnicity (%)			
Hispanic	106 (26.97)	340 (28.22)	0.63†
Non-Hispanic	280 (71.25)	804 (66.72)	0.09†
PatientRefused/unknown	7 (1.78)	61 (5.06)	0.004*
LOS Days: N, (Mean, Std Dev), (Median, IQR)	393, (11.89, 32.51) (4.17, 5.38)	700, (4.02, 5.91), (3.13, 2.63)	(<0.001, <0.001)

*Fisher exact test.

†Chi-square test.

noted in topical anesthetics between day and night shifts, with increased use during the day shift. Throughout the project, the gap between day and night shift utilization decreased (Fig. 5).

The percentage of encounters with documented comfort measures for PIV placement increased from 6% to 13% (See Supplemental Digital Content 2, figure 2, <http://links.lww.com/PQ9/A589>).

The percentage of patients with PIVs who had orders for topical anesthetics increased from 14% to 54% (See Supplemental Digital Content 3, figure 3, <http://links.lww.com/PQ9/A590>). The encounters with documented PIV attempts increased from 47% to 70% (Supplemental Digital Content, Figure 4, <http://links.lww.com/PQ9/A591>).

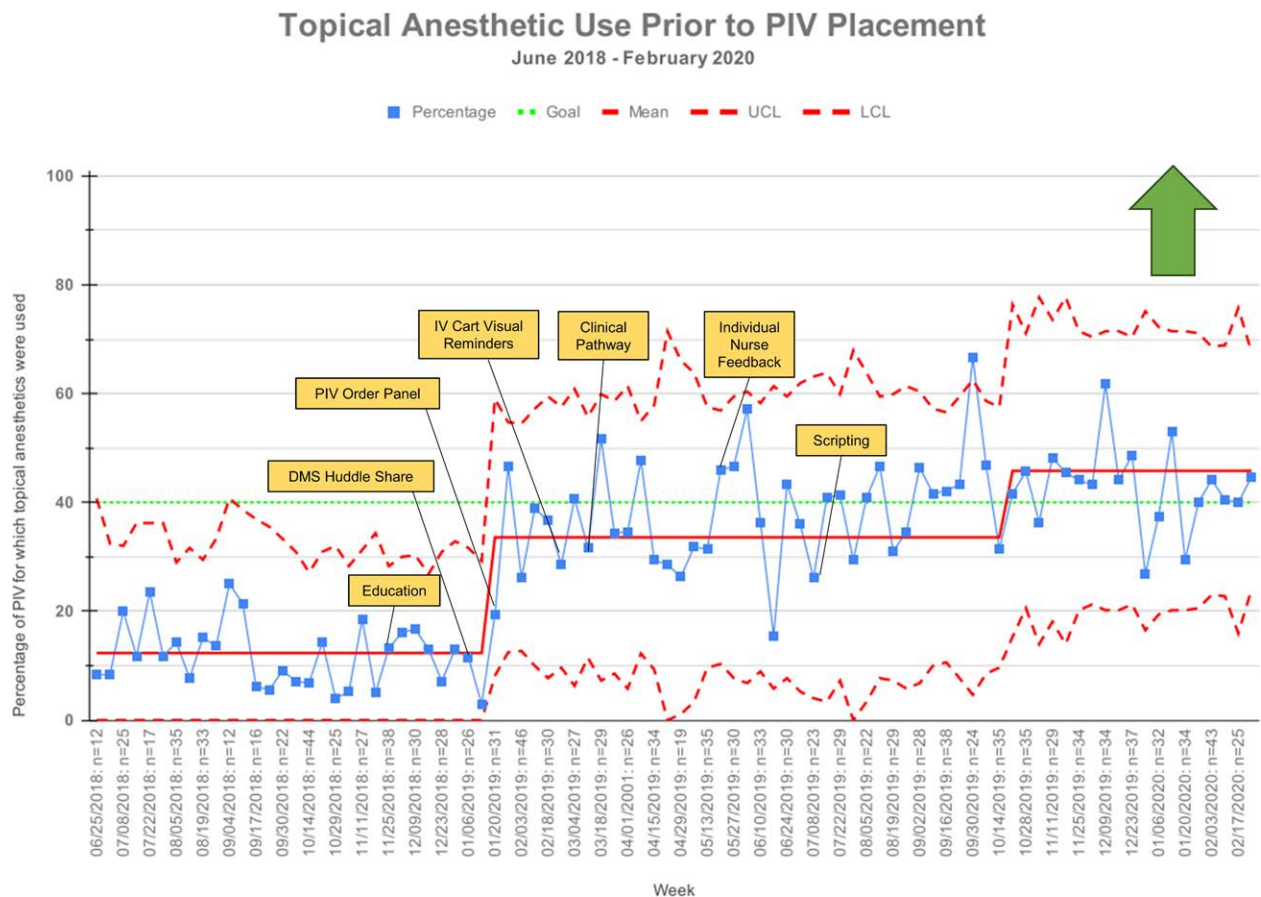


Fig. 3. P chart Topical Anesthetic Use before PIV Placement, June 2018–February 2020.

Topical Anesthetic Use Prior to PIV Placement Children >1yo

July 2018 - February 2020

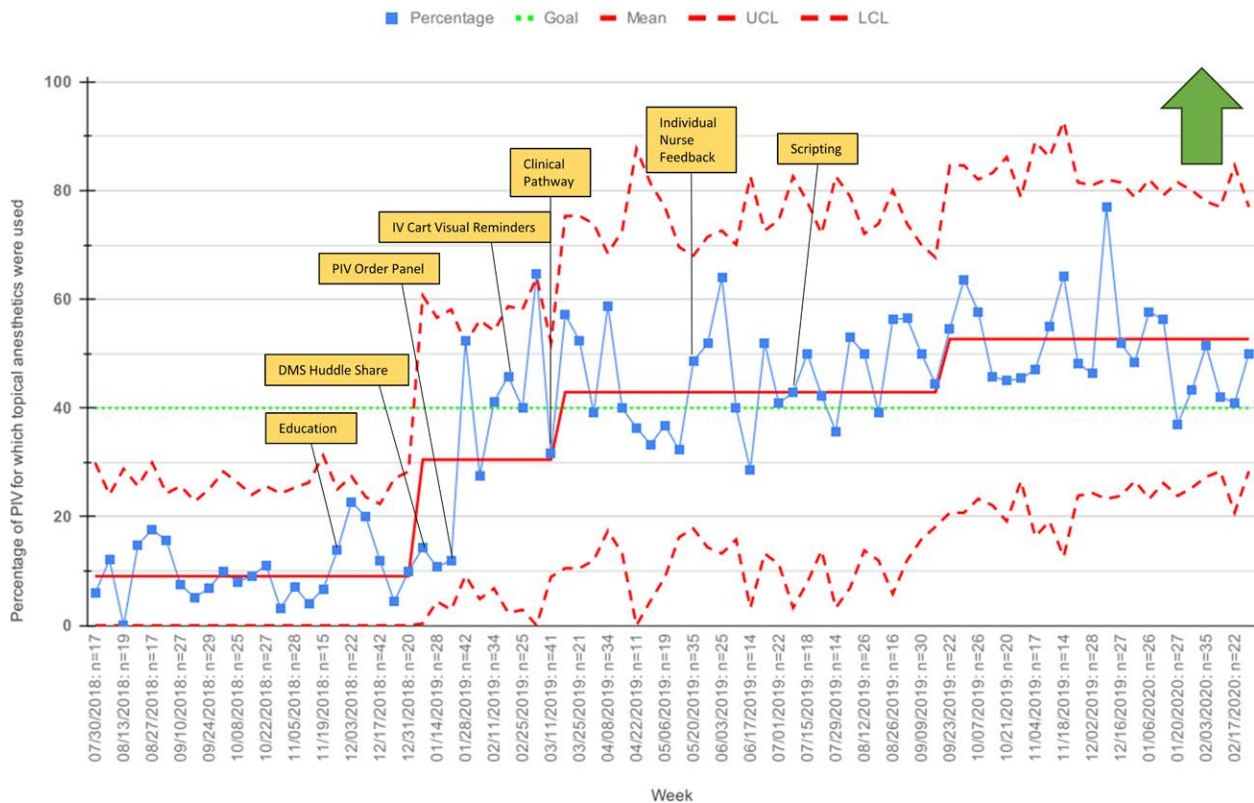


Fig. 4. P chart topical anesthetic use before PIV placement for children more than 1 year old, July 2018–February 2020.

DISCUSSION

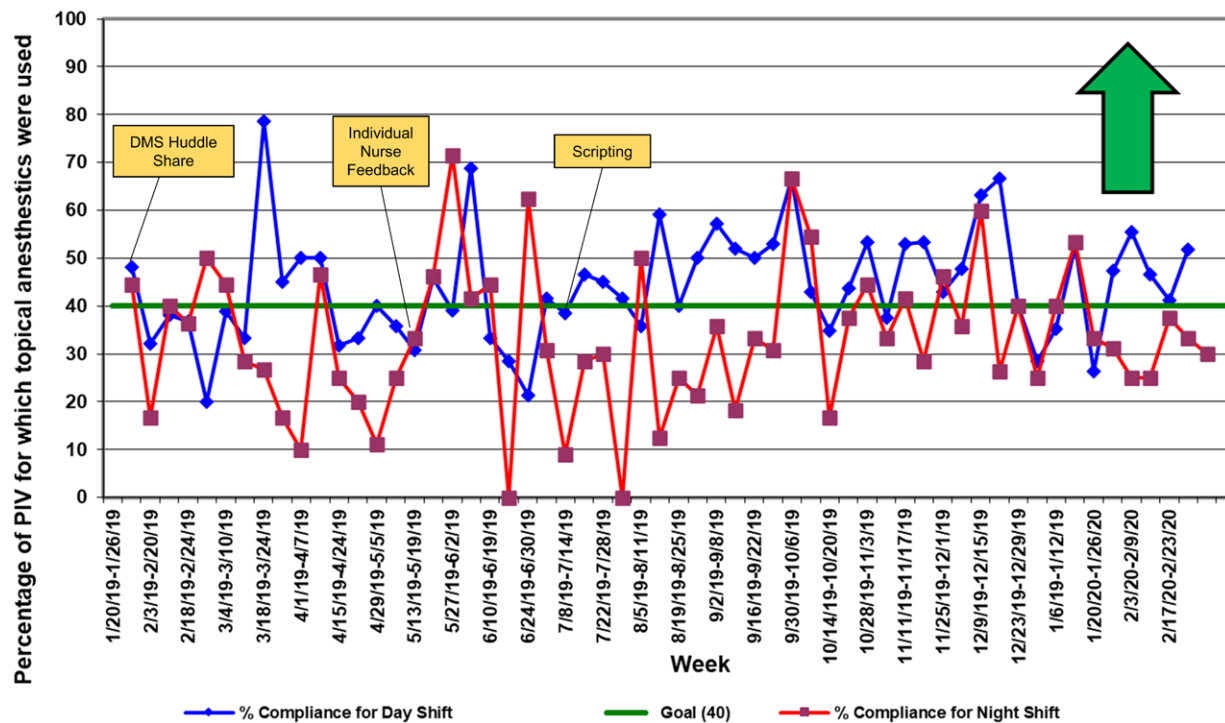
Summary/Interpretation

Utilizing QI methods, we exceeded our aim to increase topical anesthetic use before PIV placement from 11% to 40%. Interventions with the strongest impact resulting in centerline shifts included education, DMS huddle sharing, and clinical pathway implementation. Due to minimal knowledge regarding topical anesthetics’ importance, effectiveness, and use, education was necessary to engage nurses and providers. It was addressed through ongoing in-person scheduled and asynchronous online learning. DMS huddles, where information pertinent to patient care, flow, and safety is shared at the beginning of each nursing shift, are a part of standard work for nursing at our institution. DMS huddle discussions occurred twice daily on the importance of topical anesthetics and procedural support for PIV placement. Sharing data comparing the three inpatient floors and day versus night shifts increased buy-in and utilization. Our institution has a robust clinical pathways program that providers regularly reference—creating a clinical pathway specific to venous access provided indications and instructions for the use of topical anesthetic and a proposed standard of care for PIV placement. Additionally, timely individual feedback from nurse managers to nurses not utilizing topical anesthetics before PIV placement effectively changed behavior.

Our project had many strengths, leading to its success. The multidisciplinary team brought perspectives from all hospitalized patient care team members, which was essential when planning and implementing interventions and engaging stakeholders. We used the principle of alignment with support from nursing leadership. Hospital leadership support was instrumental in changing nursing practice and behavior. Clinical pathways are an effective tool for implementing evidence-based clinical care, and this was a key intervention in our project.^{26–30} Through the institution’s formal clinical pathways program’s standardized processes for pathway implementation, there was widespread dissemination of the pathway and accompanying education. Additionally, we modified the EHR, specifically the nursing flow sheet, allowing for more accurate documentation. It increased clinical utilization as it served as a reminder for use and was monitored by nursing leadership to provide feedback and address barriers. PIV order panels with prechecked orders for topical anesthetics were added to hospital admission order sets. Both EHR interventions were effective as they standardized essential tasks and made the default the desired action.

Lower yield interventions included visual reminders placed on IV carts and nursing scripting. The visual reminders were intended to serve as a memory aid to use topical anesthetics; however, they did not significantly

Topical Anesthetic Use Prior to PIV Placement Day vs. Night Shift



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Fig. 5. Run chart topical anesthetic use before PIV placement, day vs night shift, January 2019–February 2020.

impact behavior change. Some patients and families declined topical anesthetics due to a lack of knowledge of the product’s benefits and/or familiarity. Nursing scripting was created to address discussing topical anesthetics with patients and families. Although this education was important and necessary, it was underutilized.

Variation in topical anesthetic use was noted, with less utilization of topical anesthetics in patients younger than 1 year. This may be related to a lack of consideration of pain in infants, as well as myths about the safety of the use of topical anesthetics in this age group. Similarly, prior studies have shown inadequate pain management for patients with intellectual disabilities.^{20,21} Although it was not measured, there was anecdotal evidence from child life, nurses, and providers of less utilization in patients with complex care needs. We did not specifically look at variation in topical anesthetic use by race/ethnicity; however, this is an important focus for future work as literature supports that black children are less likely to receive medication for pain.^{33–35}

There was also initial variation in topical anesthetics between the day and night shifts, with increased utilization during the day. This variation was likely due to multiple factors, including child life presence during the day to advocate for pain management techniques, fewer providers and a lower nurse-to-patient ratio at night. This lower

ratio led to more hesitancy from nurses to reach out for orders and attempts to minimize interruptions and interventions overnight. The gap between day and nighttime topical anesthetic use decreased with QI interventions.

The documented use of nonpharmacologic comfort measures increased during PIV placement but remained low. Although this is an area for continued improvement, we believe the utilization of comfort measures is higher than reported, possibly due to poor documentation and/or lack of awareness that interventions, such as holding a child or nursing an infant during the procedure, are comfort measures.

Similar to previous initiatives, we successfully used QI methods to increase the use of topical anesthetics for venous access procedures.^{5,6,22,24,25} Like these other initiatives, we anchored our work in evidenced-based practice, provided need-based education, used a multidisciplinary team with champions, provided individual feedback, and implemented order set modifications. Although other institutions have used system-wide protocols, a venous access clinical pathway is unique to our project. Other interventions specific to our QI initiative included increased awareness of performance with data sharing at daily nursing huddles and modifications to the nursing documentation flow sheet for procedural documentation. All three of these novel interventions contributed to the reaching of our aim.

Our goal was to reduce unnecessary pain experienced by pediatric patients admitted to the hospital by improving the venous access system to include topical anesthetics as a standard component of venous access procedures.

A significant resource expenditure for this project was time and the changes required in workflow with added steps for pain management for venous access procedures and additional documentation by nursing. Modifications to the EHR, specifically the nursing flowsheet, were challenging due to the time required to make the changes and competing priorities for the information technology team.

Improvements in the inpatient setting were the first step towards decreasing pain for pediatric patients through improved venous access procedures. These improvements are planned to spread to other areas, including the ED, PICU, perioperative, and ambulatory settings.

LIMITATIONS

The interventions and results of this project may not be generalizable to all settings that care for hospitalized children, as this study was conducted in a children's hospital staffed with pediatric nurses and child life specialists. Additionally, our project focused only on the inpatient unit and did not include the PICU, ED, perioperative areas, outpatient laboratories, infusion centers, or ambulatory clinics. One major limitation of our study is that the data are from the EHR and rely on accurate and complete nursing documentation. As a result, the data only includes patients with PIVs successfully placed and does not account for multiple attempts that did not result in achieving PIV access. It also does not include venous access attempts for blood draws. In addition, 4% lidocaine was more commonly documented in the medication administration record, whereas vapocoolant spray was not. Education on the importance of accurate documentation, which was incorporated into onboarding for new nurses and regular nursing education, and the modifications to the nursing flowsheets helped improve the accuracy of procedural documentation.

CONCLUSIONS

Using the Model for Improvement to drive systems and culture change, we increased awareness of the importance of pain prevention for needle procedures. We improved patient-centered care through increased communication and collaboration between nurses, providers, and families surrounding venous access planning. Future improvement work will focus on sustainability efforts, decreasing the gap between night and daytime topical anesthetic use and increasing topical anesthetic utilization for specific populations, including those less than one year of age and with complex healthcare needs. Additionally, assessing differences in topical anesthetic use between race and ethnicity would be important to help inform and improve equitable care. Future balancing measures could be nurse satisfaction and the number of venous access attempts. This

venous access work provides a framework and model for decreasing unnecessary pain during painful procedures, with the potential to spread to other healthcare settings and painful procedures.

DISCLOSURE

All other authors have no financial interest to declare in relation to the content of this article.

Preliminary data were presented at the Pediatric Hospital Medicine Virtual Conference 2020, EPAS 2020, and the Institute for Healthcare Improvement Scientific Symposium 2019.

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