A Quality Initiative to Decrease Time Until Analgesic for Fracture-associated Pain in the Pediatric Emergency Department

Justin Davis, MD, FAAP*; Kristin Kappler, BSN, RN†; Skye Stoker, BSN, RN†

INTRODUCTION
Pain is the most common chief complaint in the pediatric emergency department (PED), and long bone fractures are among the most common causes of pain in this setting.1 Unfortunately, pain is often treated suboptimally in the PED setting, especially the timeliness of analgesic delivery.2

In the PED at The University of Mississippi Medical Center (UMMC), the average monthly median time to the first dose of analgesic for fracture-associated pain during the 12 months before this initiative was 66 minutes (range 45–89 minutes and national average 60 minutes). This first dose delay was a significant obstacle to the effective treatment of fracture-associated pain in the PED.

Other PEDs have reported efforts to improve the timeliness and effectiveness of analgesic delivery for long bone fractures. Iyer et al3 developed an “orthopedic evaluation process” with a team protocol similar to a trauma team activation. Liu and Madhok4’s QI initiative involved nursing education, addressing barriers to intranasal fentanyl, and data feedback to physicians. Schacherer et al5 developed a clinical pathway for the delivery of intranasal fentanyl. Given these results, we believed that similar initiatives could improve analgesic delivery timeliness in our department. Also, we hoped that our specific interventions could serve as a model for future quality goals in our PED, such as the treatment of other painful conditions.

Therefore, our global aim was to improve the treatment of fracture-associated pain in the PED at the UMMC. The SMART aim of this quality improvement (QI) initiative was to decrease the median time to the first dose of analgesic for fracture-associated pain in our PED to 36 minutes or less by July 1, 2015.
METHODS

Context
The PED is a 23-room unit located within Batson Children’s Hospital at UMMC that, as part of a tertiary care referral facility serving the State of Mississippi primarily. It had 46,000 emergency department visits in the fiscal year 2015. Of these visits, approximately 1,200 were for long bone fractures. The PED is staffed by attending physicians (pediatric emergency medicine, emergency medicine, and pediatrics), advanced practice providers, and residents (pediatrics and emergency medicine training programs). Pharmacist coverage is shared with other parts of the hospital and is provided from outside the department’s physical space. The treating provider must order analgesic medications, and the provider determines the specific medication used and the dose and route of delivery. Before this initiative, all delivery routes (oral, intranasal, and intravenous) were commonly used to treat fracture-associated pain in the PED.

For this QI initiative, we targeted children 2–18 of age presenting to the PED who were diagnosed with a long bone fracture and received oral, IV, or intranasal analgesics at any time during their PED visit. We excluded children with a documented refusal of pain medication (approximately 25% of children with long bone fractures in our PED) or receipt of pain medication before arrival (approximately 50% of children with long bone fractures in our PED). We did not exclude children based on pain score, method of arrival, or disposition from the PED.

Improvement Team
We created a team led by 2 PED nursing leaders, including PED nurses, a PED physician, and a Pediatrician with expertise in QI methods. We identified barriers to quality during initial team meetings that were potential causes of delay in analgesic delivery in our PED. As shown in Figure 1, we identified 5 barrier categories: department culture, triage processes, staff communication, analgesic ordering, and analgesic delivery.

Planning of Interventions
We obtained baseline data from April 2014 to April 2015 (see Measures below) from the electronic health records (2020 Epic Systems Corporation, Verona, Wis.). We brainstormed potential interventions based on our previously identified barriers to quality. We prioritized interventions that the team believed would be feasible and impactful. Once developed, we implemented 4 interventions in successive “plan, do, study, act” rapid cycles over consecutive months.

Intervention #1 consisted of multiple educational sessions with PED nursing staff members on all shifts over 1 month, focusing on triage procedures for patients with a chief complaint of pain. During the sessions, we emphasized the following practice priorities:

1. Assignment of a triage acuity level of 2 (critical) for patients with pain scores > 6.
2. Assignment of a triage acuity level of 2 (critical) for patients with bone deformities.
3. Assignment of a triage acuity level of 3 (emergent) for most other patients with extremity injuries.
4. Direct verbal communication from the triage staff member to the receiving nurse and provider regarding the arrival of triage acuity level 2 (critical) patients with extremity injuries.

Also, we created a “quality board” for display in the PED break room to communicate about the quality goal and share the latest outcomes data. The overall goal of intervention #1 was to address the triage process, communication, and cultural barriers we identified. The “quality board” was expanded and remained in use after this project, as seen in Figure 2.

Intervention #2 involved 2 components. First, we implemented a “Pull to Full” patient flow model in the department, where patients would be immediately placed into an available examination room within 1 of 3 “Pods.” “Pods” are separate care areas in our PED with dedicated nursing staffing. “Pull to Full” occurs before completing the triage process, which is completed in the patient’s exam room. Second, a nursing “Pod” leader assignment was created. The nursing pod leader was asked to help facilitate “Pull to Full” and the practice priorities from intervention #1. Although intervention #2 was not necessarily unique to patients with extremity injuries, our goal was to address the barrier of triage and room placement delays.

For intervention #3, we moved the “quality board” to a prominent area in the main unit instead of the break room to allow public visibility and greater staff visibility. This intervention aimed to support cultural barriers to quality by improving communication regarding quality goals and outcomes.

During intervention #4, we conducted follow-up staff meetings to discuss outlier cases and feedback from staff. During the follow-up period, these meetings continued monthly and have since been incorporated into a daily “huddle” that occurs at the start of each shift. Our goal with this intervention was to sustain the effects of the prior interventions.

Measures
We defined the outcome measure as the monthly median time from PED arrival until the first analgesic dose for fracture-associated pain. This metric is the Center for Medicare and Medicaid Services (CMS) OP-21 reporting measure. The CMS OP-21 utilizes the exclusion and inclusion criteria described in the context above. CMS OP-21 can be rendered less meaningful when there is incomplete documentation of outside medications, incomplete documentation of patient refusal, or a delay in diagnosing the long bone fracture. The measure also does not capture data regarding the ongoing management of fracture-associated pain during the remainder of
Despite its limitations, this outcome measure was in widespread use at the time of our initiative. Therefore, it provided a means to obtain reliable baseline and follow-up data and comparison data to other institutions. The national average for the CMS OP-21 reporting measure at the time of the initiative was 60 minutes, and the 90th percentile was 36 minutes among similar reporting institutions. Achieving the 90th percentile was the rationale for our SMART aim.

**Analysis**

We used statistical process control charts in Microsoft Excel to track the outcome measure monthly and each month’s sample size. We established a baseline mean with upper (UCL) and lower control limits (LCL) (±3 SDs) for the outcome measure based on 12 months of data before intervention #1 (April 2014 to March 2015). We used the general rules of special cause variation to identify change (ie, 8 consecutive data points above or below the mean).

**Ethical Considerations**

Each QI team member completed a self-certification form through the institution’s Human Research Office, certifying that the project was a QI initiative and not human-subjects research. We did not obtain external funding for this initiative.

**RESULTS**

As shown in Figure 3, baseline data showed that the monthly median time to delivery of the first dose of analgesic (CMS OP-21) for children with long bone fractures averaged 66.3 minutes (range 45.0–89.0, SD ±12.5, LCL 28.8, UCL 103.8) during the 12-month baseline period, April 2014 through March 2015. The x-axis labels in Figure 3 contain each month’s number of patients. We implemented interventions 1–4 over consecutive months from April through July of 2015.

Monthly median times improved during the 3-month intervention period, reaching a low of 33.5 minutes in July of 2015 immediately after the last intervention. The monthly median time averaged 48.5 minutes (range 33.5–80.0 minutes, SD ± 13.5, LCL 8.0, UCL 89.0) during the 12 months after the first intervention (Fig. 3). There were 2 months during the postintervention period during which median times were higher than otherwise experienced and higher than the preintervention average of all monthly median times: 80.0 minutes in February 2016 and 72.0 minutes in April 2016.
DISCUSSION

Summary
The SMART aim of our QI initiative was to decrease the median time to the first dose of analgesic for fracture-associated pain in our PED to 36 minutes or less by July 1, 2015. Although our median time achieved the SMART aim for 1 month (July 2015), we observed that median times did not achieve our SMART aim during the remainder of the follow-up period. However, we did observe a sustained improvement in monthly median times during
the follow-up period (average 48.5 minutes) compared to the baseline period (average 66.3 minutes).

**Interpretation**

Multiple factors affected our success. Based on PED staff members’ feedback, the practice priorities of intervention #1 and the throughput initiatives of intervention #2 received excellent staff buy-in. Staff members also appreciated how communication efforts and the “quality board” were seamlessly incorporated into the workflow. On the other hand, there are several possible reasons why we did not maintain the same level of improvement throughout the follow-up period. Although we continued to use the quality board, continued to emphasize practice priorities, and provided ongoing feedback regarding quality goals during staff “hoots,” it is possible that these reminders and feedback became less effective over time.

Furthermore, some of the initiatives were also intended to facilitate other PED quality goals, possibly diluting their effect on this project’s SMART aim. Besides, staffing turnover was high during the follow-up period, as it commonly is in the PED. Finally, the POD leader assignment did not work well for us and was discontinued in August 2015

There are a few potential explanations for the 2 months during the follow-up period with higher than expected median times. First, February and April have relatively high overall patient volume in our PED, with relatively fewer visits for extremity fractures when compared with overall volume. Children may spend a more significant time waiting for an available exam room during these busier periods, likely reducing the effect of our “Pull-to-Full” intervention. Notably, February and April also showed high median times during the baseline data period.

Ultimately, we believe that there are multiple ways to improve the timeliness and effectiveness of analgesic delivery for long bone fracture-related pain in the PED and that initiatives similar to ours can be effective. As mentioned previously, published examples of successful efforts in other PED’s include a team activation process, education and data feedback, and a clinical pathway for delivering intranasal fentanyl. We chose a different approach to our interventions based on the local barriers to quality that we identified and, in particular, because protocol orders are logistically challenging in our context.

Looking forward, we still use the “quality board” and have expanded it to include other quality and safety goals and a mechanism for soliciting staff feedback and ideas. New staff receive training regarding quality and safety goals for our PED. We identified other performance improvement goals, including an ongoing QI initiative to treat pain due to Vaso-Occlusive Crises among children with Sickle Cell Disease.

**Limitations**

This initiative should be interpreted in the context of its limitations. The CMS OP-21 measure we chose as our outcome has limitations (as described in measures above) and, of note, was removed from the CMS Hospital Outpatient Quality Reporting Program for 2018. Also, we also did not plan any process and balancing measures. Our department’s future projects have included access to outcome measures for each patient and process measures such as length of stay metrics, staff surveys, triage acuity levels, and pain scores. Finally, although the most significant improvement occurred immediately following intervention #1, we did not design this project to compare the relative effectiveness of each intervention. This decision may limit the ability to apply our findings to other contexts.

**CONCLUDING SUMMARY**

After a series of four rapid-cycle plan, do, study, act interventions involving staff education and feedback, communication, and patient flow, the monthly median time until the first dose of analgesic for patients with long bone fractures decreased in the PED. The interventions that we developed require ongoing reinforcement and monitoring to maintain the observed performance improvement.

**DISCLOSURE**

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

**REFERENCES**

1. Cordell WH, Keene KK, Giles BK, et al. The high prevalence of pain in emergency medical care. Am J Emerg Med. 2002;20:165–169.

2. Todd KH, Ducharme J, Choiniere M, et al; PEMI Study Group. Pain in the emergency department: results of the pain and emergency medicine initiative (PEMI) multicenter study. J Pain. 2007;8:460–466.

3. Iyer SB, Schubert CJ, Schoettker PF, et al. Use of quality-improvement methods to improve the timeliness of analgesic delivery. Pediatrics. 2011;127:e210–e225.

4. Madhok M, Liu M. Improvement Pain Management for Long Bone Fractures in the ED through Peer Review and Feedback: A Children’s Hospital Emergency Department QI Initiative. Available at: https://www.childrensmn.org/images. Accessed April 1, 2020.

5. Schacherer NM, Erikson Ramirez D, Frazier SB, et al. Expediting delivery of pain medication for long-bone fractures using an intranasal fentanyl clinical pathway. Pediatr Emerg Care. 2015;31:560–563.

6. National Quality Measures Clearinghouse. Emergency department (ED): median time from ED arrival to time of initial oral or parenteral pain medication administration for ED patients with a principal diagnosis of long bone fracture. Available at: https://www.qualitymeasures.ahrq.gov. Accessed February 2016.

7. Centers for Medicare and Medicaid Services. Fact-Sheet: CMS Issues Hospital Outpatient Prospective Payment System and Ambulatory Surgical Center Payment System and Quality Reporting Program Changes for 2018 (CMS-1678-FC). Available at: https://www.cms.gov/newsroom/fact-sheets/cms-issues-hospital-outpatient-prospective-payment-system-and-ambulatory-surgical-center-payment; November 1st, 2017. Accessed July 1, 2019.