

# Simple Measures to Reduce Opioid Prescriptions Following Pediatric Spinal Fusion Surgery: A Multidisciplinary Quality Improvement Project

Andrew Winsauer, BS<sup>1,2</sup>; Charu Sharma, MHA, MS<sup>1</sup>; Stacie Bukowsky, MS, RPh<sup>1</sup>; Sandi Greenberg, RN<sup>1</sup>; Craig Birch, MD<sup>1,2</sup>; Brandon Ramo, MD<sup>1,2</sup>

<sup>1</sup>Scottish Rite for Children, Dallas, TX; <sup>2</sup>University of Texas Southwestern Medical Center, Dallas, TX

## **Abstract:**

**Background:** The opioid epidemic is one of the biggest challenges facing modern healthcare. Among the adolescent and young adult populations, opioid overdose is one of the leading causes of death.

**Local Problem:** Within pediatric orthopaedics, spinal fusion is a common procedure making up 7% of the surgical volume at our institution. Spinal fusion also has high postoperative opioid prescribing rates. Review of baseline data showed that there was wide variability in prescribing habits. The goal of this quality initiative was to reduce and standardize postoperative opioid prescribing following spinal fusion procedures.

**Methods:** Data, including opiate-prescribing habits and a patient survey to assess patient and parent satisfaction with pain control, was collected retrospectively in the pre-intervention phase for 99 consecutive adolescent and juvenile idiopathic scoliosis patients undergoing spinal fusion surgery. This was followed with two PDSA cycles following implementation of a new protocol during which prospective surveys were administered to a total of 273 patients. Physician prescribing data was collected for 150 patients during the sustain phase.

**Interventions:** A multi-pronged approach was utilized consisting of the following aspects: 1) Instruction to orthopaedic trainees to limit opioid prescriptions to 45 and 40 for PDSA cycles 1 and 2, respectively, 2) A pharmacy-led education program with an opioid tapering handout given to families and encouragement of usage of non-opioid pain control, and 3) A call to the prescribing physician from pharmacy if the prescribed dosage was greater than the maximum allowed.

**Results:** There was a significant reduction in opioid prescriptions from a preintervention mean of 48.5 doses to a PDSA 1 mean of 39.0, PDSA 2 mean of 37.5, and a sustain phase mean of 36.4 ( $p=0.000$ ). This represented an estimated reduction of 22.8% over the course of the study. During this time, there was no significant change in patient and parent reported postoperative pain.

**Conclusions:** Through simple measures, our institution was able to significantly reduce total opioid prescriptions following spinal fusion surgeries while maintaining good pain control.

## Introduction

The opioid epidemic in the United States is a significant and well-publicized public health crisis. Unfortunately, this issue is not unique to adults and has high morbidity and mortality rates in the pediatric population as well. From 1997 to 2012, the annual incidence of hospitalizations for opioid poisonings in children 1–19 rose by 165%.<sup>1</sup> The adolescent population, in particular, is heavily affected with a 176% increase in hospitalizations during the same period of time for those aged 15–9.<sup>1</sup> In 2016, 12.4% of deaths among those aged 15–24 were attributable to opioids.<sup>2</sup> Among high school seniors, nearly 13% reported previous nonmedical use of prescription opioids (NMUPO).<sup>3</sup> The most common sources of narcotics for NMUPO are from the patient's own leftover prescription, or the leftover prescription of a friend or family member.<sup>4</sup> It is readily apparent that a key strategy needed to fight the opioid epidemic is to reduce the number of unused narcotics that have the potential for diversion to dangerous nonmedical usage.

Orthopaedic surgeons rank third when it comes to opioid prescriptions per provider, behind only pain management specialists and physical medicine and rehabilitation, with each provider writing approximately 440 prescriptions per year on average. In total, nearly 6% of opioid prescriptions are written by orthopaedic surgeons.<sup>5</sup> In a study on opioid medications following five common adult orthopaedic procedures, it was found that 61% of patients reported unused opioid medication.<sup>6</sup> Within pediatrics, a study investigating opioid trends in injured children after discharge from a Level 1 Pediatric Trauma center found that nearly 84% of those filling a prescription had leftover doses. Perhaps even more alarming was that nearly all of those with leftover doses reported not disposing of them, with almost half reporting no plan for disposal.<sup>7</sup>

While opioids administered in the healthcare setting have a large impact on the opioid epidemic, they still remain one of, if not the most effective tools in controlling postoperative pain. Several different strategies have been proposed to mitigate the negative

impact healthcare providers have on the opioid epidemic including provider and patient education as well as improvements in prescribing patterns.<sup>8</sup> The goal of our quality improvement project was to systematically reduce the number of narcotics prescribed to our pediatric patients undergoing spinal fusion for adolescent idiopathic scoliosis (AIS) or juvenile idiopathic scoliosis (JIS) while maintaining good or adequate patient and parent perceived-pain control. Thus, our primary aim was to use Plan-Do-Study-Act (PDSA) cycles in order to find a “sweet spot” that effectively controls patient pain in this homogenous patient population while reducing unused narcotics that can be diverted to nonmedical use both by the patient and the community as a whole.

## Methods

Patients with AIS or JIS undergoing Posterior Spinal Fusion (PSF) from May 1, 2017 to December 31, 2020, were screened for inclusion in this study. This specific patient population was chosen as they represent a homogenous group that receives a relatively high quantity of narcotics postoperatively due to the nature of the procedure. PSF was performed by one of seven spinal surgeons at a single tertiary care center.

Data was collected in four phases: pre-intervention (May 1, 2017–November 30, 2017), PDSA cycle 1 (June 1, 2018–January 23, 2019), PDSA cycle 2 (January 24, 2019–December 31, 2019), and a “sustain phase” (January 1, 2020–December 31, 2020). Data collected for all four phases included provider prescribing habits and refill rates. Postoperative survey responses were collected from patient families retrospectively for the pre-intervention cohort and prospectively during PDSA cycles 1 and 2.

Baseline data was collected during the pre-intervention phase via a retrospective review of 99 consecutive AIS patients to examine variation in opiate-prescribing habits amongst our spine surgeons, and a simple eight-question survey (see Appendix 1) was administered to assess patient and parent satisfaction with pain control

retrospectively at a time point 1–12 months after surgery for this baseline population. With this data, we determined a proper maximum dosing limit of 45 doses at the time of discharge.

As part of PDSA cycle 1, we implemented a multi-pronged approach consisting of the following aspects: 1) A brief education program for orthopaedic trainees—orthopaedic residents and fellows were instructed by the faculty PI to prescribe a maximum limit of 45 doses of narcotic at the time of discharge, and the trainees were encouraged to consult the patient’s attending surgeon for guidance if they planned to prescribe more than 45 doses. 2) Pharmacist-led education for families—with the PI attending and nursing input, the pharmacy team created a one-page handout (see Appendix 2) for a prescribed plan to wean off of narcotics over 10 days and appropriately utilize non-narcotic medications such as ibuprofen, Tylenol, and occasionally benzodiazepines. The pharmacist would go over this weaning plan with families at time of discharge/medication pick up at our facility. 3) The inpatient pharmacy team was tasked with calling the orthopaedic trainee to confirm desired dosing if the prescription was generated for more than 45 doses prior to filling the prescription as an additional process checkpoint. The prescribing of non-narcotic medication was encouraged but not strictly controlled. Orthopaedic trainees were encouraged to prescribe NSAIDs, Tylenol and occasionally benzodiazepines at discharge but without volume control. For PDSA cycle 1, the same 8-question survey was administered prospectively to 95 patients after protocol implementation via Redcap database survey and a nursing phone call as a backup for survey non-responders at the 14-day post-surgery mark.

Based on the conclusions from PDSA cycle 1, a second PDSA cycle was undertaken with the only major change being a lowering of the maximum recommended doses from 45 to 40 doses of narcotic per patient. The patient/family education sheet to teach dose tapering was altered concordantly based on 40 doses rather than 45. Due to staffing needs, the nursing phone call was dropped during this PDSA cycle.

At the end of 2019, surveys were halted as was formal intermittent data analysis, and we entered a maintenance phase to determine if the interventions applied in PDSA cycles 1 and 2 would be sustained without further intervention by the quality team. The only intervention employed during this time was an email sent to orthopaedic trainees (q6 months for residents and q12 months for fellows) at the beginning of their rotation informing them about the maximum opiate prescribing limits for these patients and sharing with them the findings of the previous interim analyses. The calendar year 2020 served as our “sustain phase.”

#### *Measure 1. Number of Narcotic Doses Prescribed*

Statistical Process Control Chart (X-bar) was used to measure variation in the number of narcotic doses prescribed at the time of discharge. Control chart rules were applied to identify shift in the centerline (mean), and upper and lower control limits (UCL and LCL). Also, Nonparametric Mann-Whitney test was used to compare median of narcotic doses dispensed during the first three phases of this QI project.

#### *Measure 2. Prescribing Habits of Providers*

Interval plot was used to measure and compare prescribing habits of seven providers during pre-intervention phase, PDSA cycle 1 and PDSA cycle 2. Also, Nonparametric Mann-Whitney test was run for each provider to compare their prescribing habits during pre-intervention phase and post-intervention phase.

#### *Measure 3. Narcotic Refill Rates*

Help from the pharmacy department was enlisted to track refills that were fulfilled at our institution. Additionally, patients were surveyed on whether or not they received a refill on narcotics.

#### *Measure 4. Patient Survey Analysis*

Redcap was utilized to conduct patient surveys to measure patient/parent satisfaction with pain management post-discharge.

Bar graphs and histograms were used to summarize data from patient surveys. These graphs also helped in comparing the response pattern of patients during pre-intervention phase, PDSA cycle 1 and PDSA cycle 2. Marginal plots were used to study relationship between response pattern and number of narcotic dispensed that helped in the development of PDSA cycles.

#### *Measure 5. Disposal of Leftover Narcotics*

Qualitative data from the survey was collected and summarized to understand the narcotic disposal habit of parents.

This report follows guidelines outlined in the Standards for QUality Improvement Reporting Excellence (SQUIRE 2.0).<sup>9</sup>

### **Ethical Considerations**

This QI project focused on reducing the overall number and intra-provider variability of opioid prescriptions following PSF in the AIS and JIS patient populations.

No Institution Review Board approval was required for this project according to our institutional policies on QI projects.

### **Results**

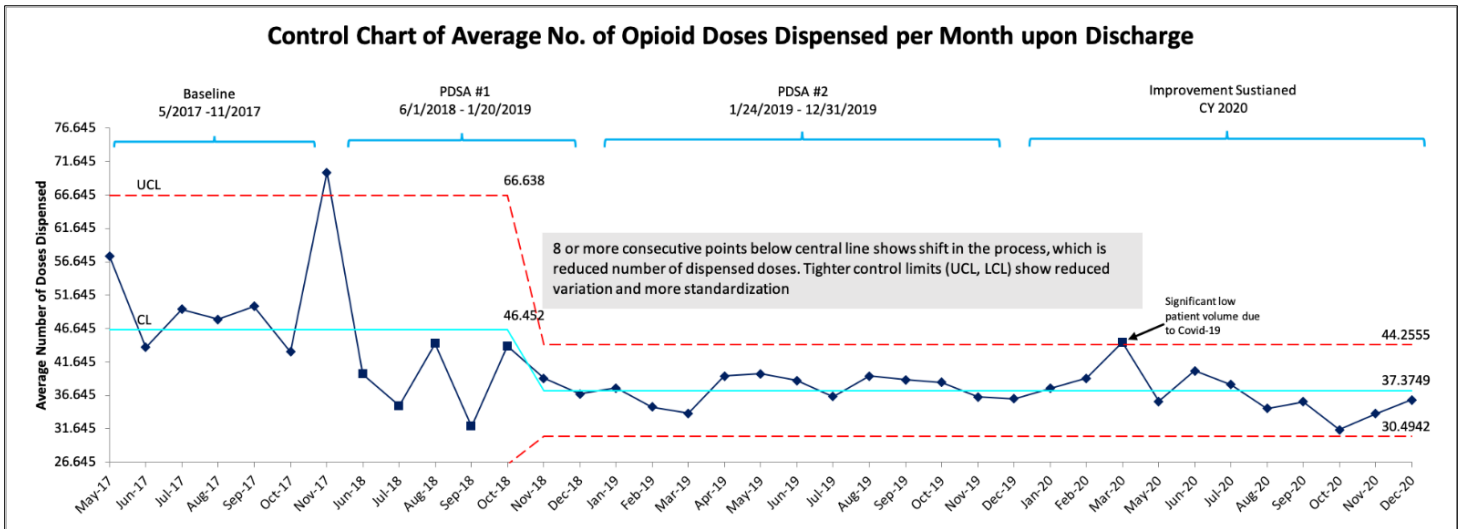
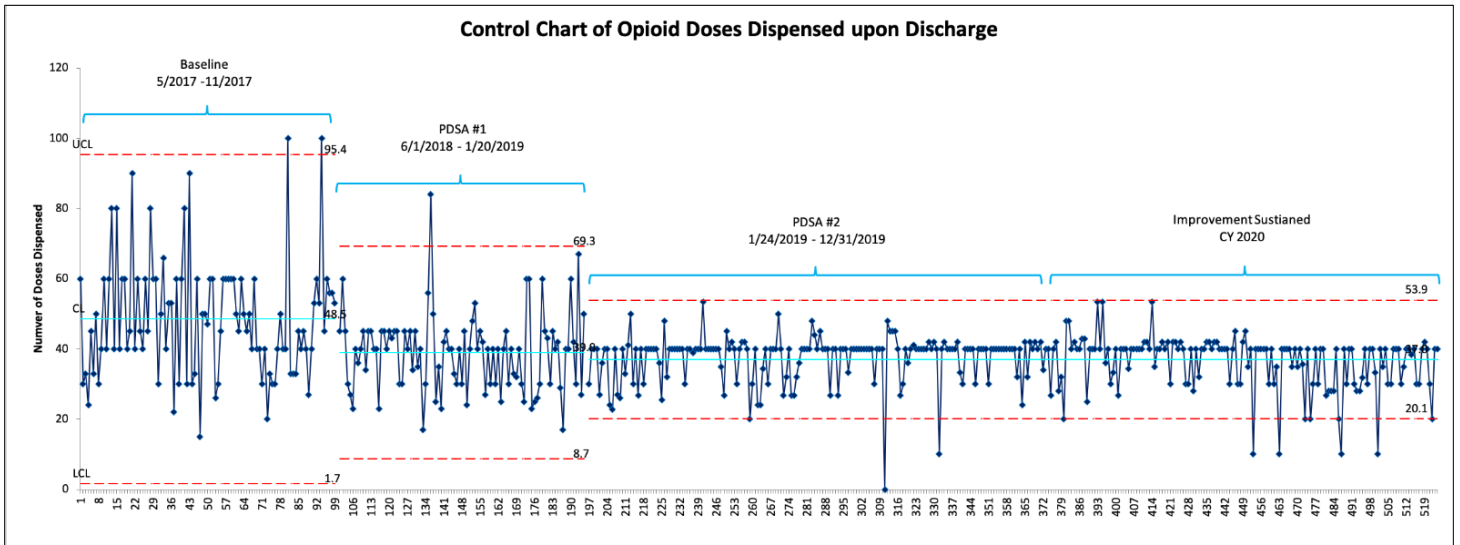
Between May 2017 and December 31, 2020, there were 522 PSF procedures performed at our institution within the AIS patient population. Ninety-nine of these were performed during the pre-intervention phase (May–November 2017), 95 during PDSA cycle 1 (June 1, 2018–January 20, 2018), 178 during PDSA cycle 2 (January 24–December 31, 2019), and 150 during the “sustain phase” (January 1, 2020–December 31, 2020). Response rates to the survey sent out at 14 days postoperatively were 27.3% for the pre-intervention phase, 72.6% for PDSA cycle 1, and 38.8% for PDSA cycle 2. Surveys were not conducted during the sustain phase.

Mean number of doses prescribed as well as standard deviations were significantly higher in the pre-

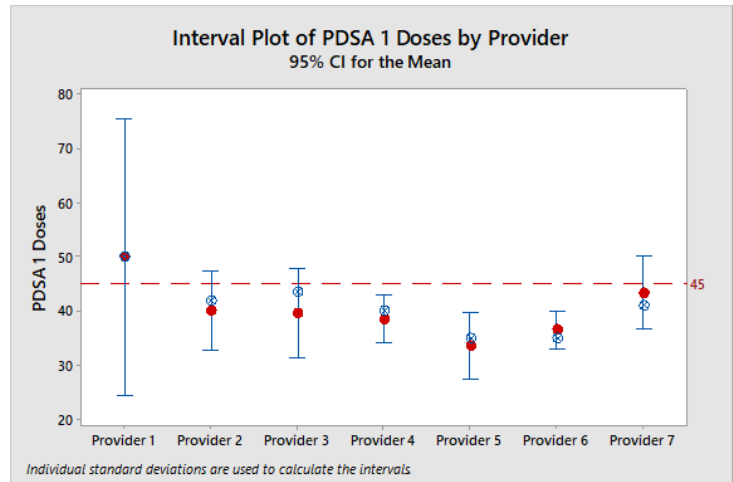
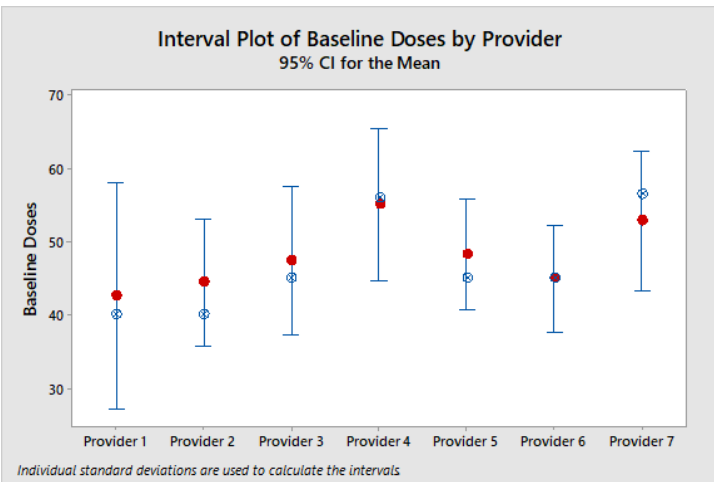
<b>Individual Provider Median Doses Prescribed</b>			
	<b>Median Baseline Dose</b>	<b>Median Sustain Phase Dose</b>	<b>P-Value</b>
Provider 1	40 (5)	40 (24)	0.373
Provider 2	40 (9)	40 (24)	0.156
Provider 3	45 (16)	40 (31)	0.005
Provider 4	56 (15)	40 (25)	0.001
Provider 5	45 (17)	40 (6)	0.442
Provider 6	45 (21)	37 (8)	0.081
Provider 7	56.5 (16)	40 (5)	0.060
<b>OVERALL</b>	45 (99)	40 (123)	0.000

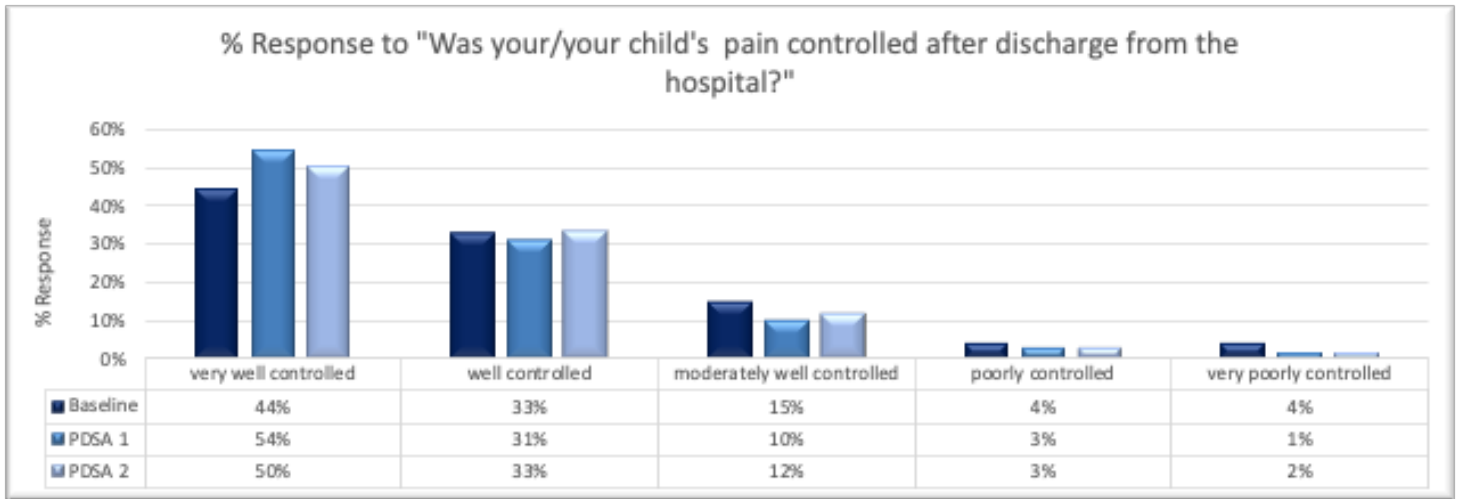
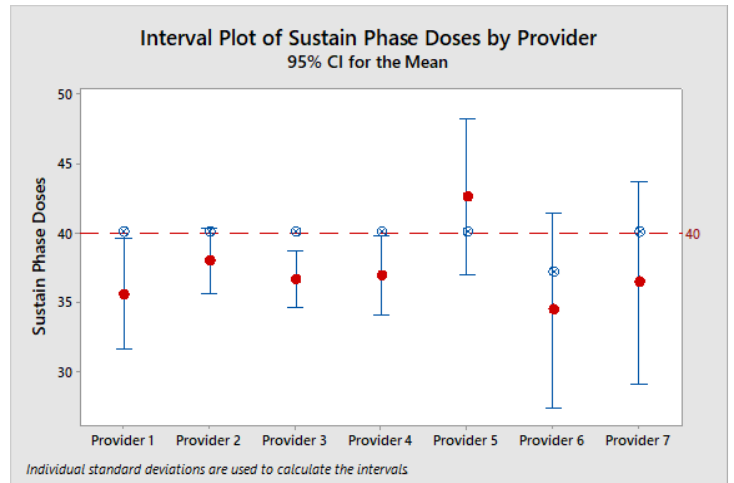
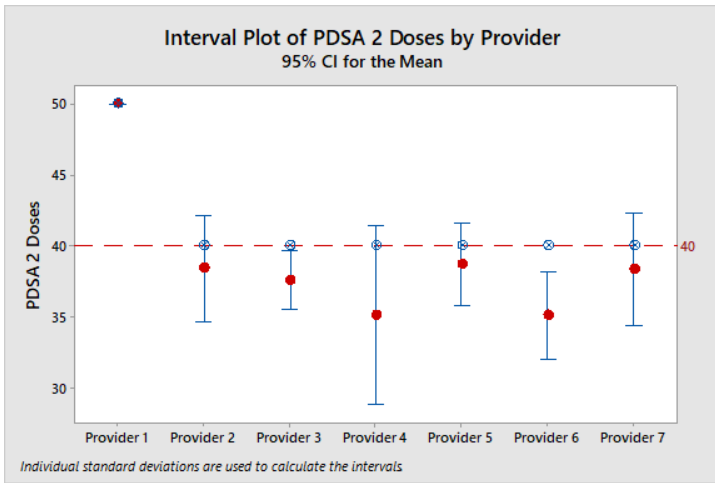
intervention phase (mean 48.5, standard deviation 16.6) than for PDSA cycle 1 (mean 39.0, standard deviation 11.1), PDSA cycle 2 (mean 37.5, standard deviation 6.68), and the sustain phase (mean 36.4, standard deviation 7.64) ( $p=0.000$ ). Two of the seven surgeons at our institution achieved statistically significant reductions in median narcotics prescribed per discharge. Overall, there was a significant reduction in median doses prescribed when comparing the baseline phase (45 doses) to the sustain phase (40 doses) ( $p=0.000$ ).

As seen in the control charts below, a desired downward trend was noted throughout the study. There was also a shift in the distribution of outliers throughout the study from more high outliers in the baseline phase to an increase in low outliers post intervention. Additionally, the variation in prescribing decreased and results were sustained after formal interventions ceased.



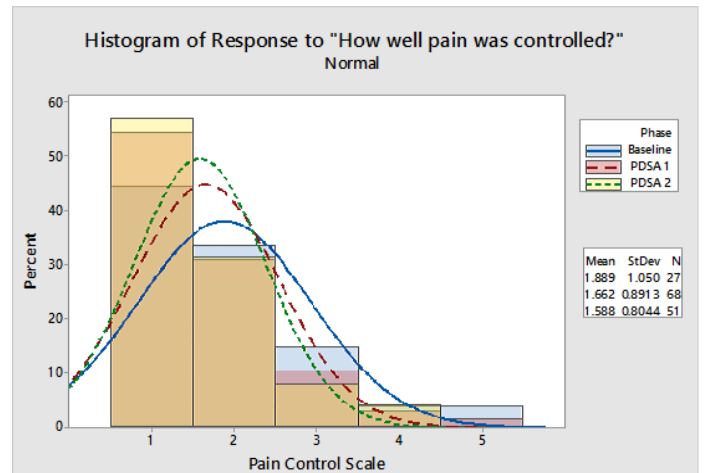
In addition to achieving overall reductions in narcotic prescriptions, there was also a decrease in intra-provider prescribing variability.



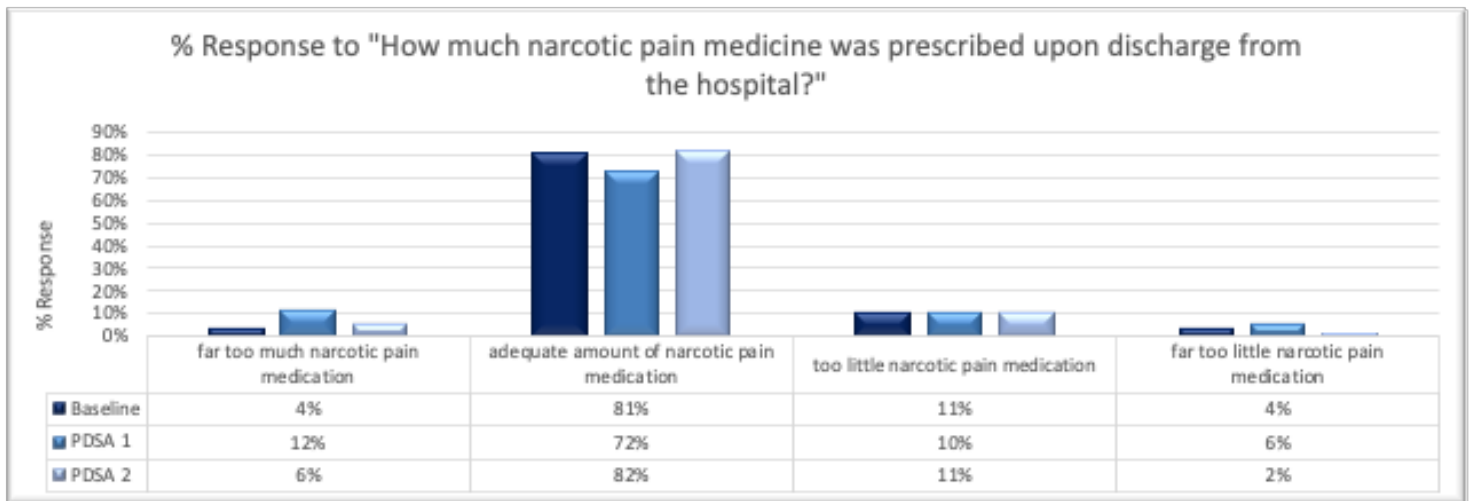


In the pre-intervention phase, 44% of patients reported their pain being “very well-controlled,” 33% “well-controlled,” 15% “moderately well-controlled,” 4% “poorly controlled,” and 4% “very poorly controlled.” In PDSA 1, 54% of patients reported their pain being “very well-controlled,” 31% “well-controlled,” 10% “moderately well-controlled,” 3% “poorly controlled,” and 1% “very poorly controlled.” In PDSA 2, 50% of patients reported their pain being “very well-controlled,” 33% “well-controlled,” 12% “moderately well-controlled,” 3% “poorly controlled,” and 2% “very poorly controlled.” Thus, after the interventions, less patients are describing their pain as “poorly controlled” or “very poorly controlled,” although this was not statistically significant ( $p=0.574$ ).

Patients were also asked whether they felt they were prescribed too much or too little narcotic pain



medication upon discharge from the hospital. More patients reported they were prescribed “far too much narcotic pain medication” in both PDSA 1 and PDSA 2 when compared to baseline.

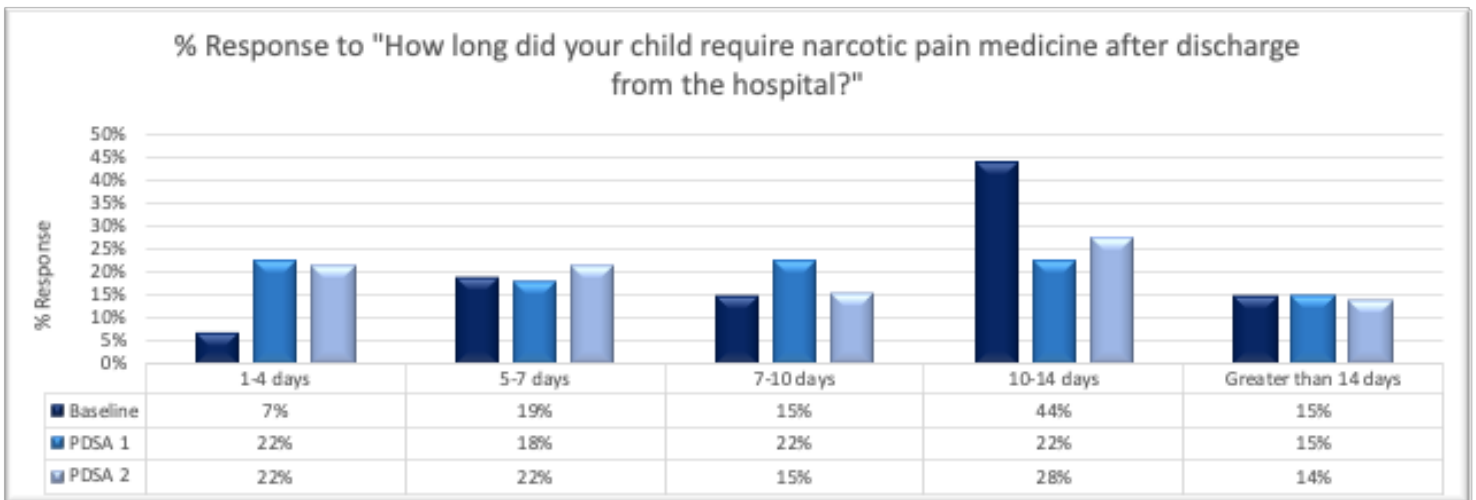


For both pre-intervention and post-intervention, the majority of patients used over-the-counter pain medication in addition to narcotics to assist with pain control. In the pre-intervention phase, 78% used over-the-counter pain medication. In PDSA 1 and 2, 88% and 86% of patients used over-the-counter pain medication, respectively.

The amount of time using opioids decreased after the PDSA cycles. Specifically, fewer patients reported using narcotics for more than 10 days when compared to baseline. At baseline, 59% of patients used narcotics for more than 10 days, and this number decreased to 37% for PDSA cycle 1 and 42% for PDSA cycle 2 (p=0.292).

Four percent of baseline survey respondents ascribed to receiving a refill which increased slightly to 13% for PDSA 1 and 13% for PDSA 2.

In regard to leftover medication, of patients who felt they were prescribed too much narcotics, the pre-intervention phase had 58% of patients having leftover narcotics. Sixty-four percent and 67% of patients in PDSA 1 and 2 had leftover narcotics, respectively. Additionally, compared to a baseline percentage of 0%, 9% of patients in PDSA 1 were unaware of where their leftover medication was stored, and 13% of patients in PDSA cycle 2 were unaware of where their leftover medication was stored.



After the implementation of the new protocol, 15,843 total doses were prescribed for AIS patients being discharged post PSF surgery. Using the pre-intervention average dosing of 48.54 doses per patient, we estimated an expected total dosage of 20,532. This represents an estimated decrease of 4689 doses of narcotics over the course of the study or a 22.8% reduction.

## Discussion

Through our QI initiative consisting of a brief education program for prescribing physicians on maximum dosing limits and pharmacist-led education for families, our facility successfully reduced post-discharge opioid prescribing after PSF in the AIS and JIS populations from a mean of 48.5 doses prior to intervention to 36.4 during the sustain phase ( $p=0.000$ ). Additionally, the opioid prescribing process became more standardized with a decrease in intra-provider prescribing variability. Despite the significant decrease in narcotic prescriptions, pain as reported by both patients and their parents remained nearly unchanged and may have even slightly improved. Notably, the simplicity of this study is one of its major advantages. Relatively few recourses were needed to make a substantial reduction in the number of opioids being prescribed. Additionally, its simplicity will make it easier for other institutions to adopt similar protocols.

Other comparable studies within the orthopaedic community have had similar success. Lindgren et al. conducted a QI initiative for PSF in the AIS and Scheuermann's Kyphosis populations in which they achieved a significant reduction in both opioid prescriptions as well as benzodiazepine prescriptions after a patient education program and a standardized pain program.<sup>10</sup> They achieved a 38% median reduction in opioid prescriptions with a post-intervention median of 50 doses, compared to our 11.1% median reduction and post-intervention median of 40 doses. The greater percent reduction that they achieved could be explained by higher pre-intervention prescribing habits, leaving more room for improvement. Like our study, they found no negative impact on patient perceived pain control.

While their study observed fewer patients over a shorter period of time, they explicitly monitored benzodiazepine prescription and usage which was not controlled for in our study. Interestingly, despite the decrease in opioid prescriptions, patients used an even lower percentage of their prescription, with patients using only 34% compared to 51% at baseline.<sup>10</sup> This suggests the possibility of even further reductions in opioid prescriptions without sacrificing pain control. Other QI initiatives within pediatric orthopaedics, including in supracondylar humerus fractures and lower extremity trauma, have been similarly effective.<sup>11,12</sup>

Data related to prescriptions, dosing, and refills was obtained for all patients through the electronic medical record. Information regarding pain control was gathered through patient and parent responses to surveys. During the three phases of data collection, there was a survey response of 27.3%, 72.6%, and 38.8% for Baseline, PDSA 1, and PDSA 2, respectively. During PDSA 1, we utilized a nursing phone call to email non-responders in an effort to increase response rate. Patient survey response decreased during PDSA 2 due to the fact that we dropped the nursing phone call because of labor needs. While a higher response rate for Baseline and PDSA cycle 2 would have been ideal, we still believe that the response rates were high enough to be representative, as multiple studies have found that in certain settings, response rates as low as 20% can yield reliable data.<sup>13-15</sup>

While the opioid epidemic is obviously problematic in today's society, narcotics are still arguably the most effective option in terms of postoperative pain management for major orthopaedic surgical procedures. It is important to continue to prioritize each individual patient when implementing new system-wide policies aimed at reducing opioid prescriptions. The ideal endpoint would be to prescribe the lowest number of opioids possible while still maintaining effective pain control. During PDSA 1, we aimed to limit maximum opioid discharge doses to 45. This effort was successful, and during PDSA 2 we further limited maximum doses

to 40. Compared to baseline, there appeared to be a small but statistically insignificant improvement in patient and parent perceived pain control during both PDSA cycles. This maintenance or even possible improvement in pain control was surprising given the decreased amount of pain medication prescribed. One hypothesized reason for this was our pharmacist-led patient education program. This is consistent with other studies that showed improvements in postoperative pain and decreased postoperative opioid usage following preoperative patient education programs.<sup>16,17</sup>

Additionally, although not strictly controlled, patients were encouraged to utilize over-the-counter analgesics for their postoperative pain management. Survey responses showed a nearly 10% increase in usage of over-the-counter pain medication from baseline during PDSA 1 and 2. Multimodal pain management regimens have been shown in previous studies to decrease opioid utilization.<sup>18</sup> Other strategies that have been shown to decrease postoperative pain in the pediatric population include intraoperative bupivacaine injections and Child Life Specialist consults, which are routinely utilized by our facility.<sup>12,19</sup>

Excess opioid medication can have a negative impact within the home of the child to whom it was prescribed and their families. Nearly 17% of adolescents participating in NMUPO obtained their opioids from their own leftover prescriptions.<sup>4</sup> Curbing this easily accessible source of medication is an important step in preventing opioid abuse and addiction. Medication that is not properly disposed of can also be accidentally ingested by younger children. Among children less than the age of 6, opioids are the most commonly implicated prescription solid medication class in emergency department visits for unsupervised pediatric medication exposure.<sup>20</sup> In the adult orthopaedic spine literature, a recent study conducted by Hills et al. found that longer duration of opioid use postoperatively was associated with worse one-year outcomes.<sup>21</sup> Further research is needed to validate these findings within the pediatric population, but this could be another potential downside of opioid over-prescription.

We also utilized prescription refill rate as a surrogate marker of pain control. A greatly increased refill rate would suggest that too few opioids were being prescribed and would also place an added burden on the prescribing physician. On the contrary, a refill rate approaching 0% could indicate that too many opioids were prescribed. Our refill rate increased slightly from 4% at baseline to 13% in both PDSA 1 and PDSA 2. While to our knowledge there is no literature discussing the optimal refill rate for postoperative opioids, we felt this was an acceptable refill rate. This is reported by survey response as we could not control if patients received refills outside of our electronic medical record.

In our baseline cohort of patients who felt like they were prescribed too many narcotics, 58% had leftover medication. This number increased to 64% and 67% during PDSA 1 and PDSA 2, respectively. The observed increase could perhaps be due to patient education, which in a previous study has been shown to decrease postoperative opioid use in adults following general surgery procedures.<sup>16</sup> Of particular concern was the increase in patients who had leftover medication and were unaware of where the medication was stored. In our baseline cohort, 0% were unaware of where the leftover medication was stored, and this increased to 9% and 13%. This suggests further emphasis needs to be placed on the importance of keeping leftover medication in a secure location before eventual proper disposal. Based on feedback from families on the survey, we were able to advocate that our in-house hospital pharmacy needed to establish a program for accepting unused narcotics to be returned. This was implemented in 2020 with appropriate safety measures and has become a resource for our patients to properly dispose of excess narcotics, which was an unplanned improvement.

Beyond just improving the care of each individual patient, our QI initiative has the potential to make a large difference in the community as a whole. Since implementing our intervention, we estimated a reduction of 4689 doses of narcotics. This reduction was seen for a single surgery (PSF) at a single institution over the

course of only 3 1/2 years. Several studies have shown a positive association between opioids prescribed per year and deaths due to opioid overdose per year, so reducing any unneeded prescriptions is an extremely important strategy in fighting the opioid epidemic.<sup>22,23</sup>

While one of the biggest strengths of this study is its simplicity and ease of implementation, this is also an inherent weakness. We did not strictly control the prescription of other medications such as muscle relaxants, benzodiazepines, or NSAIDs. Any of these could have had an effect in the slight improvement of patient-reported pain control. This study was performed in an academic setting, where residents and fellows do much of the discharging. Thus, our results are not necessarily generalizable to other types of practices.

## Conclusion

The opioid epidemic is a well-known public health crisis in dire need of creative solutions. Orthopaedic surgeons rank fourth when it comes to total number of opioid prescriptions, behind only primary care providers, internists, and dentists which give a strong opportunity for improvement within this specialty.<sup>24</sup> However, from 2014 to 2018, orthopaedic surgeons actually had a significant decrease in opioid prescriptions of 16%.<sup>25</sup> This is a strong step in the right direction, but there is still much work to be done. Following our QI initiative, we had a significant decrease in opioid prescribing and variability following PSF in the AIS and JIS populations while maintaining adequate pain control. This was done in a relatively straightforward manner and could be easily reproduced by other institutions. Data from the sustain phase, during which the only interventions were a single email sent to orthopaedic trainees and distribution of the opioid tapering tool to patients, showed that our progress was maintained even after formal interventions by the quality team were terminated. After the success of this project, our next step is to expand to every pediatric orthopaedic procedure performed at our institution utilizing the POSNA QSVI committee endorsed narcotic prescribing pathway which offers guidelines for narcotic

prescriptions' dosing based on orthopaedic procedures falling into minor, moderate, and major orthopaedic procedures plus spinal procedures.<sup>26</sup> We will then perform PDSA cycles to further refine these dosing guidelines, as we have already reduced narcotic prescribing for PSF below the proposed rate of the POSNA endorsed guidelines.

## Additional Links

- POSNA Post-Operative Opioid prescription guidelines:  
<https://posna.org/POSNA/media/Documents/QSVI/QSVI-PostOp-Prescription-Guidelines.pdf>
- POSNA Academy: Opioids and Children  
[https://www.posnacadey.org/media/Opioids%20and%20Children/1\\_bn2de04u](https://www.posnacadey.org/media/Opioids%20and%20Children/1_bn2de04u)

## References

1. Gaither JR, Leventhal JM, Ryan SA, Camenga DR. National Trends in Hospitalizations for Opioid Poisonings Among Children and Adolescents, 1997 to 2012. *JAMA Pediatr.* 2016;170(12):1195-201.
2. Gomes T, Tadrous M, Mamdani MM, Paterson JM, Juurlink DN. The Burden of Opioid-Related Mortality in the United States. *JAMA Netw Open.* 2018;1(2):e180217.
3. McCabe SE, West BT, Teter CJ, Boyd CJ. Medical and nonmedical use of prescription opioids among high school seniors in the United States. *Arch Pediatr Adolesc Med.* 2012;166(9):797-802.
4. McCabe SE, Veliz P, Wilens TE, West BT, Schepis TS, Ford JA, et al. Sources of Nonmedical Prescription Drug Misuse Among US High School Seniors: Differences in Motives and Substance Use Behaviors. *J Am Acad Child Adolesc Psychiatry.* 2019;58(7):681-91.
5. Guy GP, Jr., Zhang K. Opioid Prescribing by Specialty and Volume in the U.S. *Am J Prev Med.* 2018;55(5):e153-e5.
6. Sabatino MJ, Kunkel ST, Ramkumar DB, Keeney BJ, Jevsevar DS. Excess Opioid Medication and Variation in Prescribing Patterns Following Common Orthopaedic Procedures. *J Bone Joint Surg Am.* 2018;100(3):180-8.
7. Delamerced A, Zonfrillo MR, Monteiro K, Watson-Smith D, Wills HE. Factors affecting opioid management

- for injured children after hospital discharge. *J Pediatr Surg.* 2021;56(3):506-11.
8. Raney EM, van Bosse HJP, Shea KG, Abzug JM, Schwend RM. Current State of the Opioid Epidemic as it Pertains to Pediatric Orthopaedics From the Advocacy Committee of the Pediatric Orthopaedic Society of North America. *J Pediatr Orthop.* 2018;38(5):e238-e44.
9. Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, Stevens D. SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. *BMJ Qual Saf.* 2016;25(12):986-92.
10. Lindgren AM, Bennett R, Yaszay B, Newton PO, Upasani VV. Quality improvement in post-operative opioid and benzodiazepine regimen in adolescent patients after posterior spinal fusion. *Spine Deform.* 2020;8(3):441-5.
11. Winslow L, Holstine J, Samora JB. Reducing the Use of Opioids for Pediatric Patients with Supracondylar Humerus Fractures. *Jt Comm J Qual Patient Saf.* 2020;46(10):581-7.
12. Weiner J, Zeno R, Thrane SE, Browning KK. Decreasing Opioid Use in Pediatric Lower Extremity Trauma: A Quality Improvement Project. *J Pediatr Health Care.* 2020;34(5):446-52.
13. Curtin R, Presser S, Singer E. The effects of response rate changes on the index of consumer sentiment. *Public Opin Q.* 2000;64(4):413-28.
14. Keeter S, Kennedy C, Dimock M, Best J, Craighill P. Gauging the Impact of Growing Nonresponse on Estimates from a National RDD Telephone Survey. *Public Opinion Quarterly.* 2006;70(5):759-79.
15. Visser PS, Krosnick JA, Marquette J, Curtin M. Mail Surveys For Election Forecasting?: An Evaluation of the Columbus Dispatch Poll. *Public Opinion Quarterly.* 1996;60(2):181-227.
16. Khorfan R, Shallcross ML, Yu B, Sanchez N, Parilla S, Coughlin JM, et al. Preoperative patient education and patient preparedness are associated with less postoperative use of opioids. *Surgery.* 2020;167(5):852-8.
17. O'Donnell KF. Preoperative pain management education: a quality improvement project. *J Perianesth Nurs.* 2015;30(3):221-7.
18. Frizzell KH, Cavanaugh PK, Herman MJ. Pediatric Perioperative Pain Management. *Orthop Clin North Am.* 2017;48(4):467-80.
19. Kim K, Armstrong D, Hennrikus W. Methods to reduce opioid use during surgical treatment of pediatric supracondylar fractures—a pilot study. *Injury.* 2020.
20. Lovegrove MC, Weidle NJ, Budnitz DS. Trends in Emergency Department Visits for Unsupervised Pediatric Medication Exposures, 2004-2013. *Pediatrics.* 2015;136(4):e821-9.
21. Hills JM, Carlile CR, Archer KR, Wick JB, Butler M, Daryoush J, et al. Duration and Dosage of Opioids After Spine Surgery: Implications on Outcomes at 1 Year. *Spine.* 2020;45(15):1081-8.
22. National Academies of Sciences E, Medicine, Health, Medicine D, Board on Health Sciences P, Committee on Pain M, et al. In: Phillips JK, Ford MA, Bonnie RJ, editors. *Pain Management and the Opioid Epidemic: Balancing Societal and Individual Benefits and Risks of Prescription Opioid Use.* Washington (DC): National Academies Press (US). Copyright 2017 by the National Academy of Sciences. All rights reserved.; 2017.
23. Manchikanti L, Helm S, 2nd, Fellows B, Janata JW, Pampati V, Grider JS, et al. Opioid epidemic in the United States. *Pain Physician.* 2012;15(3 Suppl):Es9-38.
24. Volkow ND, McLellan TA, Cotto JH, Karithanom M, Weiss SR. Characteristics of opioid prescriptions in 2009. *JAMA.* 2011;305(13):1299-301.
25. Acuna AJ, Jella TK, Samuel LT, Cwalina TB, Kim TS, Kamath AF. A Work in Progress: National Opioid Prescription Reductions Across Orthopaedic Subspecialties in a Contemporary Medicare Sample of 5,026,911 Claims. *J Am Acad Orthop Surg Glob Res Rev.* 2021;5(5).
26. America POSoN. PostOp Pain Management Prescription Guidelines [Available from: <https://posna.org/POSNA/media/Documents/QSVI/QSVI-PostOp-Prescription-Guidelines.pdf>].

# APPENDIX 1

## AIS Narcotic Prescribing Survey

### Introduction:

On behalf of Texas Scottish Rite Hospital for Children, we appreciate your help in filling out this brief survey about pain control after scoliosis surgery. Our goal is to make sure that we are treating our patients' pain in an effective and responsible way to make their recovery as easy as possible. Your information is confidential, protected and will not be released to any outside parties.

1. Was your/your child's pain controlled after discharge from the hospital?
  - a. 1- very poorly controlled
  - b. 2- poorly controlled
  - c. 3- moderately well controlled
  - d. 4- well controlled
  - e. 5- very well controlled
2. How much narcotic pain medicine (e.g. oxycodone, hydrocodone) was prescribed upon discharge from the hospital
  - a. 1- far too little narcotic pain medication
  - b. 2- too little narcotic pain medication
  - c. 3- adequate amount of narcotic pain medication
  - d. 4- too much narcotic pain medication
  - e. 5- far too much narcotic pain medication
3. Did you use additional over the counter medications (e.g. ibuprofen, acetaminophen) to assist with pain control?
  - a. Yes
  - b. No
4. How long did your child require narcotic pain medication after discharge from the hospital?
  - a. 1-4 days
  - b. 5-7 days
  - c. 7-10 days
  - d. 10-14 days
  - e. Greater than 14 days
5. If you feel you were not given enough narcotic pain medication, did you get a refill of narcotic pain medication?
  - a. Yes
  - b. No
6. If you feel you were given too much narcotic pain medication, did you keep the remaining doses of medication?
  - a. Yes
  - b. No
7. If yes, are you aware of the current location of the medication?
  - a. Yes
  - b. No
8. If you do not still have the remaining medication, how did you dispose of the medication?
  - a. Free response

## How to Taper Off Your Opioid (Narcotic) Pain Medicine

After surgery, your child may be given an opioid medicine for pain. Opioid medicines are much stronger pain medicines than over-the-counter medicines. They won't eliminate all pain but will make it easier to tolerate. Pain should improve slowly over time.

As the pain gets better, you will need to wean your child off the opioid pain medicine. This is important because this type of medicine can be addictive. This means slowly reducing the amount you give your child until he or she is not taking it anymore. Your child should continue to take the other pain medicines that have been prescribed, such as ibuprofen.

### What is the best way to taper off the opioid medicine?

The following schedule will be helpful in reducing the number of doses you give your child over a ten-day period. Writing the doses down will be helpful to keep track of the doses you give.

- **Days 1-5** You may give 1 dose every 4 hours, up to 6 doses per day.
- **Day 6** You may give 1 dose every 4 hours during the daytime and bedtime, skipping the overnight dose, up to 5 doses per day.
- **Day 7** You may give 1 dose every 6 hours, up to 4 doses per day.
- **Day 8** You may give 1 dose every 8 hours, up to 3 doses per day.
- **Day 9** You may give 1 dose every 12 hours, morning and bedtime, up to 2 doses per day.
- **Day 10** You may give 1 dose per day if needed, at bedtime.

### What if this taper schedule doesn't fit my child's needs?

You may need to give less opioid pain medicine than the above schedule:

- **If** your child is not experiencing a lot of pain.
- **If** your child is too sleepy to sit up, eat, or go to the restroom when taking the medication.
- **If** your child has been diagnosed with sleep apnea (short, repeated stops in breathing during sleep)

**IF** you have any trouble reducing your child's pain medicines, please contact your doctor or pharmacist for help.

**IF** your child needs more doses of medicine than listed above, please call your doctor's office.

Opioid medicines are not usually addictive if taken correctly for pain. However, they can lead to addiction if you do not manage them carefully. It is very important to wean your child off these medicines as soon as possible.

For the safety of your family and visitors, please discard all unused opioid medicine doses as explained on the enclosed *Medicine Disposal Information* sheet.