Individual QI projects from single institutions

OPEN

Reducing Postoperative Length of Stay for Idiopathic Scoliosis Patients using Quality Improvement Methodology

Crystal Seilhamer, MSN, APRN, FNP-C, CNOR; Kelly Miller, MS, APRN, PNP-C*; Jessica Holstine, MBOE, LSSBB†*

ABSTRACT

INTRODUCTION: Approximately 1%–3% of the US population is diagnosed with scoliosis. In addition, 80% of those diagnosed have idiopathic scoliosis, with about 10% requiring surgical intervention. This Quality Improvement initiative aimed to reduce the length of stay (LOS) after posterior spinal fusion for these patients. According to the Pediatric Health Information System, our institution had a poorer performance, with an actual LOS greater than or equal to the expected LOS compared with peer institutions. **METHODS:** The aim was to increase the percentage of idiopathic scoliosis patients with a procedure to discharge LOS of less than or equal to 4 days after posterior spinal fusion from 39.13% to 90%. Interventions included implementing a new pain management protocol, a daily checklist, education on expectations of postoperative pain, and updated order sets. **RESULTS:** Interventions improved patients discharged in less than 4 days from 39.13% to 93.48% ($P \leq 0.001$), reducing the average postprocedure LOS from 4.93 to 2.59 ($P \leq 0.001$) days. A key process measure tracked was the percentage of patients off the patient-control analgesia pump by postoperative day 2, which increased from 13% to 97.75% ($P \leq 0.001$). These improvements did not affect the balancing measure of readmissions or Emergency Department visits for pain. **CONCLUSIONS:** By implementing a more standardized pathway, including a patient-focused daily checklist for providers and families, we established expectations for LOS and pain. This checklist and updates to the pain management protocol successfully reduced the length of stay in idiopathic scoliosis patients after posterior spinal fusion. *(Pediatr Qual Saf 2023;8:e672; doi: 10.1097/pq9.0000000000000672; Published online August 7, 2023.)*

INTRODUCTION

Scoliosis is a deformity of the spine noted by abnormal curvature. A normal spine is straight in the coronal plane, but when scoliosis occurs, the spine curves in a C or S shape. Approximately 1–3% of the US population is diagnosed with scoliosis.[1] Eighty percent of those patients are diagnosed with idiopathic scoliosis, meaning no identifiable cause.[2] Observation and conservative management can treat most patients with idiopathic scoliosis; however, approximately 10% require surgical intervention.[1]

The most common surgery recommended is known as a posterior spinal fusion. This procedure is a reasonably complex surgery where instrumentation corrects the deformity and prevents the curvature from progressing. Bone graft material, synthetic or allogenic, and autograft, is used during surgery to create a fusion mass along the vertebrae, allowing the spine to heal in its corrected position. Traditionally, patients undergoing posterior spinal fusions tend to have longer lengths of stay (LOS) than other elective orthopedic surgeries. Universal surgical techniques (eg, placing pedicle screws and correcting deformities) increase standardization, which can lead to a decreased LOS.[3]

Before this QI initiative, our institution ranked 15 out of 16 amongst our Pediatric Health Information System (Children's Hospital Association, Washington D.C.) peer group, with only 47% of our cases with an actual LOS compared with the expected LOS.[4] Previous studies have reported lengths of stay in similar populations as approximately 3–5 days.[5–8] The scope of our effort focused on the LOS between the spinal fusion procedure and discharge. At our institution, the LOS for patients with idiopathic

*From the *Center for Comprehensive Spine Care, Department of Orthopedics, Nationwide Children's Hospital, Columbus, Ohio; and †Center for Clinical Excellence, Nationwide Children's Hospital, Columbus, Ohio.*

**Corresponding author. Address: Jessica B. Holstine, MBOE, LSSBB, Center for Clinical Excellence, Nationwide Children's Hospital, 700 Children's Drive Columbus, OH 43205.*
Email: jessica.holstine@nationwidechildrens.org

To cite: Seilhamer C, Miller K, Holstine J. Reducing Postoperative Length of Stay for Idiopathic Scoliosis Patients using Quality Improvement Methodology. Pediatr Qual Saf 2023;8:e672.

Received for publication February 3, 2023; Accepted June 16, 2023.

Published online August 7, 2023

DOI: 10.1097/pq9.0000000000000672

scoliosis was nearly 5 days. Longer LOS can increase the risk of postoperative complications and comorbidities.[9] To better align our LOS with the peer benchmarks and improve clinical outcomes, a quality improvement (QI) project was initiated. The QI effort aimed to increase the percentage of idiopathic scoliosis patients with a LOS less than or equal to 4 days after posterior spinal fusion from 39.13% to 90%.

METHODS

Context

Our orthopedic department is part of a large, tertiary-care medical center. We have a Center for Comprehensive Spine Care where we strive to provide the best patient care in-line with industry standards and evidence-based practice. Our institution performs an average of 70 posterior spinal fusion procedures for idiopathic scoliosis patients annually. Many disciplines manage each patient, including, but not limited to the pain team, orthopedics, physical therapy, inpatient nursing, occupational therapy, discharge planning, and child life. Although all of these disciplines are beneficial and necessary for the comprehensive treatment of each patient, our spine team recognized we did not have a standard of care that guided the length of stay (LOS). More standardized pathways have proven to reduce the LOS.[10] The electronic medical record system used is Epic (Epic Systems, Verona, Wis.)

Key Drivers and Interventions

Our team consisted of multiple orthopedic surgeons, the inpatient spine patient care coordinator (a nurse practitioner, NP), the spine program coordinator (NP), pain team members (an anesthesiologist and NP), a QI strategist, and other consultants from our institution. Team leaders also networked with providers from the University of Michigan and Children's Healthcare of Atlanta[11] and reviewed additional literature[12,13] to learn from others' successful protocols, which improved LOS. Our QI team developed key drivers and interventions utilizing process mapping and impact/effort analyses, as shown in the key driver diagram (Fig. 1). Every team member worked collaboratively and contributed expertise to each appropriate intervention.

Staff Expectations of Pain Control

Interventions for this effort began by realigning staff pain control expectations, including the orthopedic spine team, pain team, registered nurses on the inpatient unit, and others who care for or educate patients and families throughout their spinal fusion journey. Project leaders emailed all groups with spinal fusion surgery information and provided education about expected pain levels at discharge using the Wong-Baker FACES scale.[14] The pain scale includes patients rating their pain level from 0 to 10. A pain rating of <5 is acceptable for discharge.

Another intervention was developing a spine patient care coordinator NP position to manage each patient's perioperative pathway. This pathway starts with a preoperative visit at least 30 days before surgery to educate patients and families and to assess a patient's physical status. During this visit, the spine patient care coordinator educates patients and families about what to expect during their hospital stay and reviews the daily checklist below (Fig. 4). This education helps set realistic expectations for hospital admission. The spine patient care coordinator also collaborates with all other disciplines caring for the patient to follow agreed-upon pain control guidelines and expectations. Our team developed and implemented this position in August 2020.

Best Practice Policy Development/Pain Medication Administration

One main contributing factor to an extended LOS was when patients were on a patient-controlled analgesia (PCA) pump. Baseline data revealed that our spinal fusion patients averaged 3.4 days connected to the PCA pump (Fig. 2). Therefore, we collaborated with the pain team and spine surgeons and referenced industry best practices to develop a new pain management protocol (Fig. 3), which underwent successful Plan-Do-Study-Act (PDSA) cycles following the model for improvement[15] and was ultimately implemented in March 2018. The full protocol (Figure 3) is listed below, and a few highlights of this bundle that proved successful are:

- Transitioning from basal to demand-only dosing of the PCA pump immediately postoperative through the postoperative day (POD) 1 with a lockout of 10–12 minutes.
- Adding oral oxycodone to the patient's regimen on the afternoon of POD 1.
- Discontinuing PCA pump on POD 2.
- Using ketamine and gabapentin.
    - Due to a national shortage of ketamine, we used gabapentin in the pre- and postoperative period in July 2018, which reduced the LOS. When ketamine was again available, we stopped the gabapentin and began using ketamine, but immediately our average LOS increased. Therefore, we halted ketamine and established gabapentin as the bundle standard.
- Adding intravenous (IV) ketorolac in the intraoperative and postoperative periods. We transitioned to ibuprofen once the patient tolerated oral intake.
- Using lidocaine infusion in the intraoperative and postoperative period.
- Preventing/managing nausea: Utilizing preoperative scopolamine patch and aprepitant.

We also looked at mobility restrictions for our spine surgery patients. When viewing LOS pathways at other institutions, it was evident that getting patients up and moving

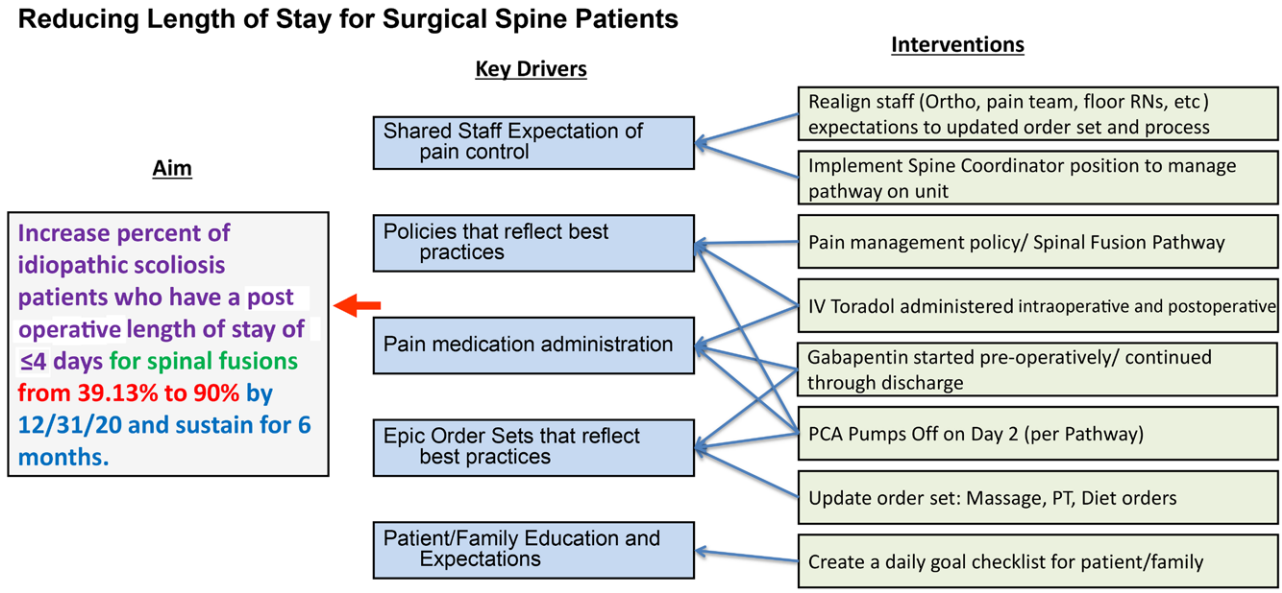

Fig. 1. Key driver diagram demonstrating the QI initiative's aim, key drivers and interventions.

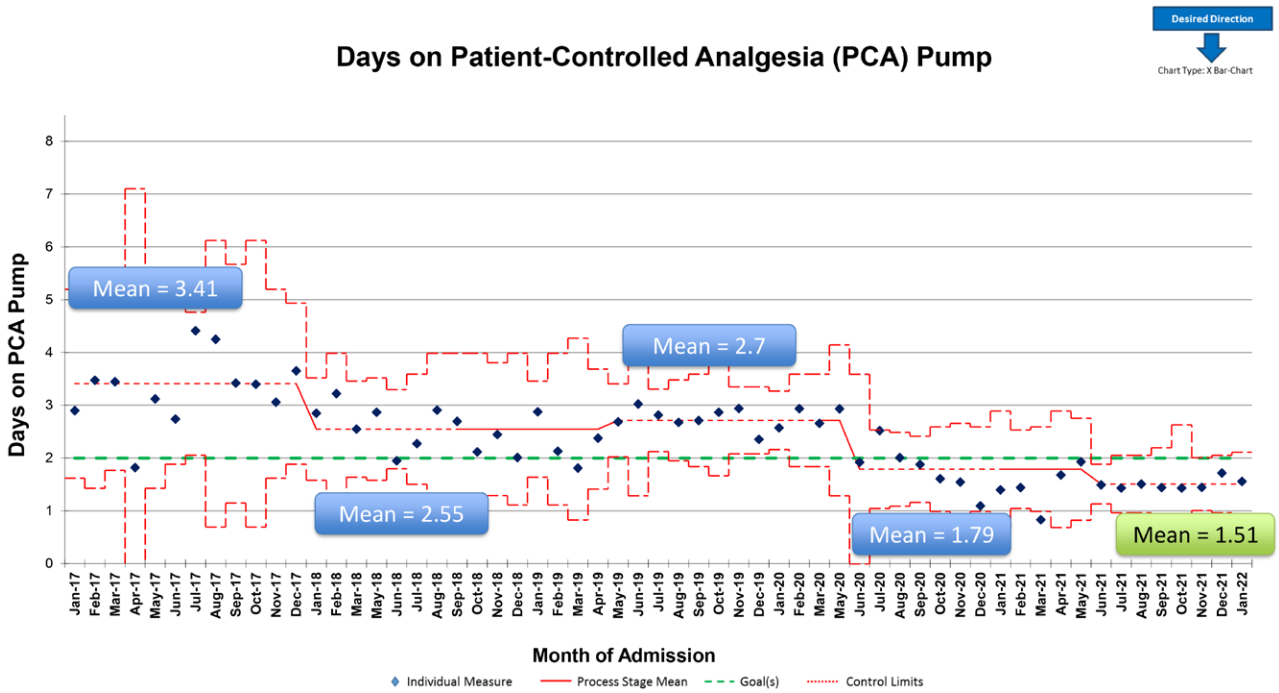

Fig. 2. X-bar chart indicating a decrease in patient days on a PCA pump after a spinal fusion procedure.

quicker after surgery would lead to a shorter LOS. Therefore, we collaborated with physical therapy and began placing orders for patients to get up and sit on the side of the bed or in a chair with physical therapy on the evening of POD 0 instead of waiting until the morning of POD 1. Further advancement to ambulation is then allowed on POD 1 as tolerated. In addition, a massage therapy consult was added to the protocol to further assist with pain management.

We updated our standard diet advancement guidelines to allow patients to begin a clear liquid diet on POD 0 instead of waiting until the morning of POD 1. In addition to diet advancement, we started chewing gum 3 times daily to stimulate the gastric system beginning on POD 0.[16] We continue to utilize a standardized bowel regimen to prevent common gastrointestinal complications.[17,18]

Epic Order Sets

We updated our Epic order sets in May 2018 to reflect the best practice changes we had implemented. These

Pain Management Protocol

Population: Idiopathic Spinal Fusion, Growing Rod insertion, Vertical Expandable Prosthetic Titanium Rib (VEPTR) insertion and MAGEC® rod insertion

Prior to Admission

- Obtain baseline blood urea nitrogen (BUN)/creatinine and hemoglobin

Day of surgery (preoperative)

- Aromatherapy instruction in Surgery Unit or Post-Anesthesia Care Unit (PACU)
- Scopolamine patch 1.5 mg for 72-hour duration
- Gabapentin
  - ≥ 50 kg: 600 mg PO
  - < 50 kg: 7.5 mg/kg
- Aprepitant PO to prevent postoperative nausea and vomiting (capsule or liquid suspension)
  - ≥ 40 kg: 40 mg PO
  - < 40 kg: 1 mg/kg PO

Intra-operative

- Desflurane titrated to keep bispectral index at 50–60; intermittent midazolam as needed
- Methadone 0.1 mg/kg after anesthetic induction
- Opioid infusions
  - Sufentanil 0.1-0.5 µg/kg/hour or remifentanil 0.1-0.5 µg/kg/min adjusted to keep the mean arterial pressure at 55-65 mm Hg per the request of the surgeon
- Clevidipine 1-5 µg/kg/min as needed to keep mean arterial pressure (MAP) within range if opioid infusion is at maximum
- Lidocaine 1 mg/kg then 1 mg/kg/hour (continue to PACU and postoperatively) NO EKG needed as on EKG monitor with starting lidocaine in OR
- Adjuncts at the discretion of the attending anesthesiologist
  - Esmolol 10-25 µg/kg/min
- Prevention of postoperative nausea and vomiting
  - Ondansetron 0.15 mg/kg to a maximum of 4 mg
  - Dexamethasone 0.15 mg/kg to a maximum of 10 mg
- Dexmedetomidine (0.3-0.5 µg/kg) bolus dose after tracheal extubation
- Intravenous acetaminophen (15 mg/kg to a maximum of 1 g) at end of case (discuss with surgeon)
- Intravenous ketorolac (0.5 mg/kg to a maximum of 30 mg) at the end of the case (discuss with surgeon)

PACU/Postoperative Day 0

- Gabapentin until discharge from the hospital
  - ≥ 50 kg: 300 mg TID
  - < 50 kg: 5 mg/kg TID
  - For patients with complex medical history, discuss gabapentin with Pain Service Attending
- Demand only Patient Controlled Analgesia (PCA)
  - Morphine PCA
    - < 50 kg: 0.02 mg/kg dose, 15-minute lockout
    - > 50 kg: 1 mg dose/ 10-minute lockout
  - Hydromorphone PCA
    - < 50 kg: 0.004 mg/kg dose/ 10-minute lockout
    - > 50 kg: 0.2 mg dose/ 10-minute lockout
- Naloxone infusion 0.25 µg/kg/hour can increase by 0.25 mcg as needed up to 1 mcg/kg/hr max
- Continue lidocaine infusion 1-3 mg/kg/hour
- Scheduled intravenous ketorolac

Fig. 3. Newly implemented spinal fusion pain management protocol.

order sets guide providers to be compliant in following the new protocol. The changes included pain medication updates, mobility restrictions, and diet advancement adjustments. By aligning the order sets with the updated protocols, we increased provider compliance with the established guidelines, reducing LOS in this patient population.

Patient/Family Education and Expectations

To align patients' and families' expectations during spinal fusion postoperative care, we created a daily checklist for spinal fusion (Fig. 4). Families receive the checklist at their preoperative appointment and during their inpatient stay. They can use this checklist to follow along with daily care, hold the clinical team accountable to the guidelines

- 0.5 mg/kg (maximum 15 mg) every 6 hours for 8 doses (alternating with intravenous (IV) acetaminophen, can increase to maximum of 30 mg if needed on POD # 1 or 2)
- Transition to scheduled oral ibuprofen (10 mg/kg) after 8 doses

- IV acetaminophen
  - 15 mg/kg (maximum 1000 mg) every 6 hours for 8 doses
  - Transition to oral acetaminophen after 8 doses
- Diazepam if needed (0.05 mg/kg or if ≥ 40 kg, 2 mg every 6 hours as needed) IV if not tolerating PO
- Aromatherapy order – peppermint inhaler stick or another alternative

Postoperative Day 1

- Dexamethasone 0.15 mg/kg to a maximum of 10 mg (one dose)
- Scheduled aprepitant
  - ≥40 kg: 20 mg PO
  - <40 kg: 0.5 mg/kg PO
  - Available in capsule or liquid suspension
- Complementary and alternative medicine therapies — ordered by primary service
  - Massage therapy consult
  - Hypnosis and guided imagery
  - Gum chewing
  - Aromatherapy
- Physical therapy and child life consults – ordered by Orthopedic service
- Scheduled oxycodone (0.1 mg/kg to a maximum of 5 mg) PO every 4 hours starting in the morning. Adjust dose based on opioid requirement
- Continue PCA pump at current dose and lockout

Postoperative Day 2

- Discontinue PCA pump infusion in the morning
  - Start as needed IV opioid (morphine) every 2 hours
- Discontinue lidocaine infusion
- Continue scheduled oxycodone
- Continue scheduled acetaminophen and ketorolac/ibuprofen
- Orthopedic service will manage bowel regimen
- Pain service will sign off on the afternoon of POD 2 if the patient is doing well
- Pain service will manage nausea until they sign off
- Orthopedic service will order BUN/creatinine postoperatively if urinary output is a concern starting POD 3
- Gabapentin discontinued at discharge

Fig. 3. Continued.

and anticipate the next steps in their care. This checklist underwent multiple PDSA cycles throughout protocol development, and the expected LOS decreased.

Measures and Analysis

For the outcome metric, we monitored the percentage of patients in the target population discharged in less than or equal to 4 days from the end of the spinal fusion procedure to discharge. In addition, we measured and tracked actual LOS between the procedure's end and the hospital discharge time. Process metrics included the patient's time on a PCA pump and PDSA-related measures, including the average LOS based on the medications given preoperatively and postoperatively. We used a p-chart for the percent of patients meeting the 4-day LOS and an x-bar chart to measure the average LOS in days. Finally, to ensure that patients were not enduring unmanaged pain because of a shorter LOS, the balancing metric tracked the volume of patients returning to the hospital (ED visit or readmission) due to pain after a posterior spinal fusion procedure.

Ethical Issues

This QI project focused on the perioperative care of pediatric surgical patients with idiopathic scoliosis. Our institutional guidelines on QI work on human subjects did not require IRB approval. Quality improvement team members accessed medical records as part of routine job functions.

RESULTS

Three hundred fifty-six patients with idiopathic scoliosis underwent posterior spinal fusion during the 61-month study period. Before any intervention, only 39.13% of the population met the target of 4 days from the procedure to discharge, with an average LOS of 4.93 days (Fig. 5,6). Throughout the project, we achieved multiple statistically significant shifts[19] (determined using statistical process control charts and 2-sample *t* tests) in the average LOS from the baseline of 4.93 days, ultimately achieving an average LOS of 2.59 days ($P \leq 0.001$)

(Fig. 6). The initial shift to 4.26 days ($P = 0.047$) occurred after implementing a new pain management protocol in March 2018. Implementing gabapentin in the pre- and postoperative periods alongside the new pain management protocol likely caused an additional shift to 3.77 days ($P = 0.005$). The final shift to an average LOS of 2.59 days ($P \leq 0.001$) occurred after adding the Spine Patient Care Coordinator and updating the protocol (Fig. 6). These interventions collectively led to a reduction in the LOS for this patient population. Ultimately, our outcome measure of the percent of patients with LOS ≤ 4 days increased from 39.13% to 93.48% ($P \leq 0.001$) (Fig. 5).

In identifying key process indicators involved with our outcome measure, the leading key process indicator for success was whether the patients were off the PCA pump on postoperative day (POD) 2. At the project's inception, only 13.64% of the patient population were removed from PCA pumps on POD 2, with an average time on PCA pumps of 3.41 days. We knew that if most patients were still receiving IV pain medications on POD 3, achieving a discharge aligned with our goal would be unattainable. Patients would need to be transitioned to oral pain medications much earlier than previously done. After implementing the pain management protocol, which included pre-/postoperative gabapentin, 40.74% of patients were off pain pumps on POD 2 with an average time of 2.55 days. The percentage moved in an undesirable direction to 18.97% when the surgical teams started using ketamine and stopped using gabapentin in May 2019. However, with the updates to the pain management protocol, including the re-introduction of gabapentin, and the addition of the inpatient spine NP in the Fall of 2020, the mean shifted back up and sustained 97.75% of patients off PCA pumps on POD 2 with an average of 1.79 days on the PCA pump. As a balancing measure, we measured readmissions related to postoperative pain in our target population. We did not find any statistically significant increase in readmissions or ED visits during the duration of this project.

DISCUSSION

This QI initiative focused on decreasing the postprocedure LOS of pediatric spinal fusion patients with idiopathic scoliosis. Over the last 3 years, we collaboratively worked with our pain team, orthopedics spine team, and

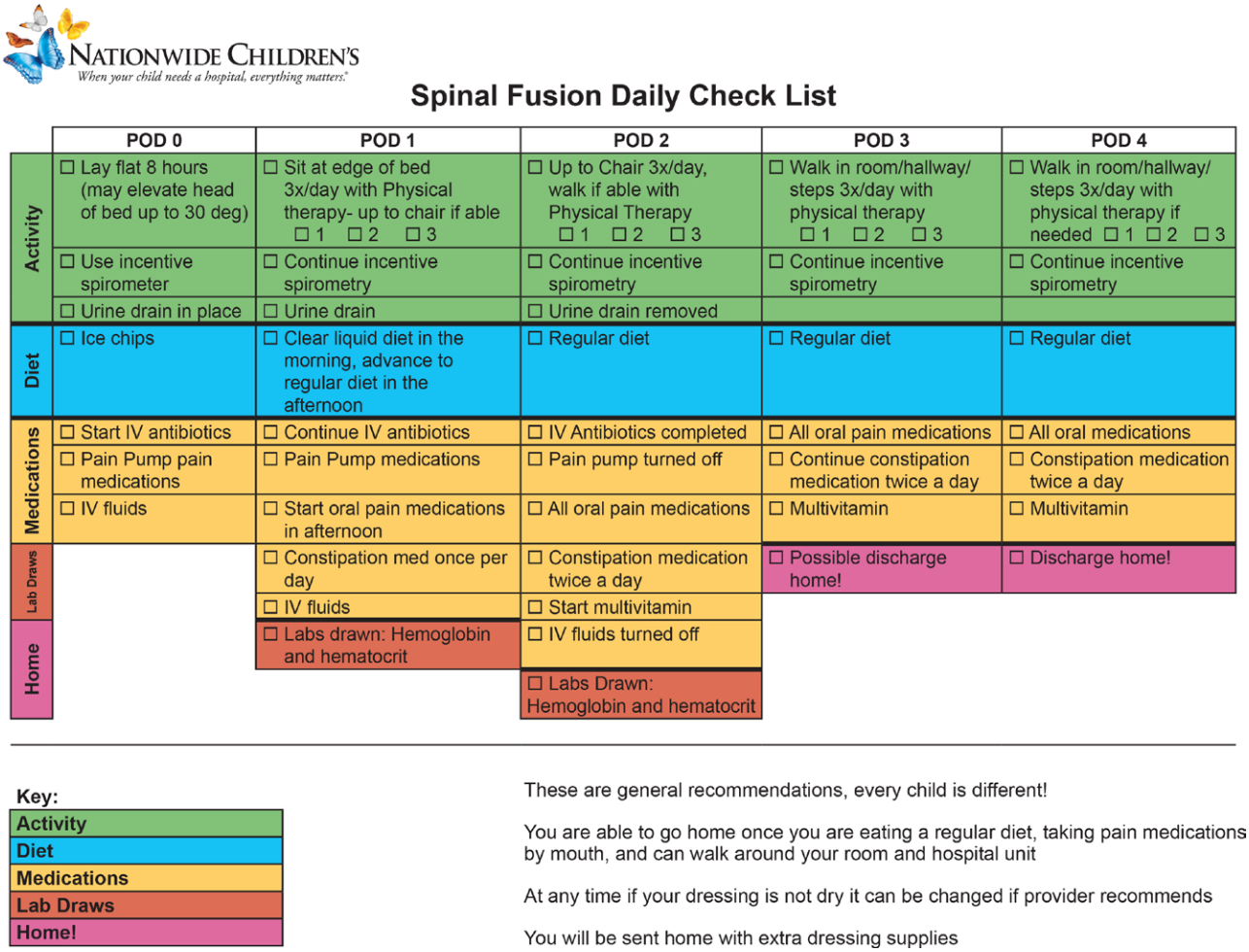

Fig. 4. Spinal fusion daily checklist developed for patients and families.

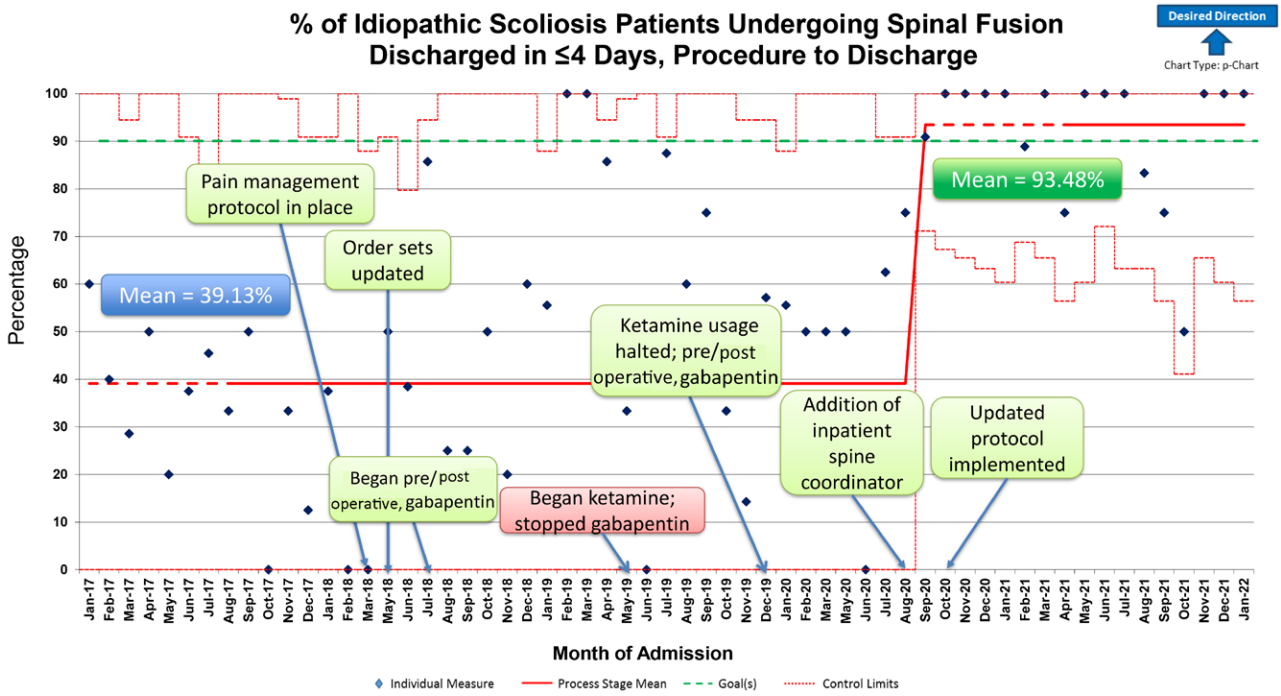

Fig. 5. P-chart showing the percentage of idiopathic spinal fusion patients discharged in less than or equal to 4 days after the procedure.

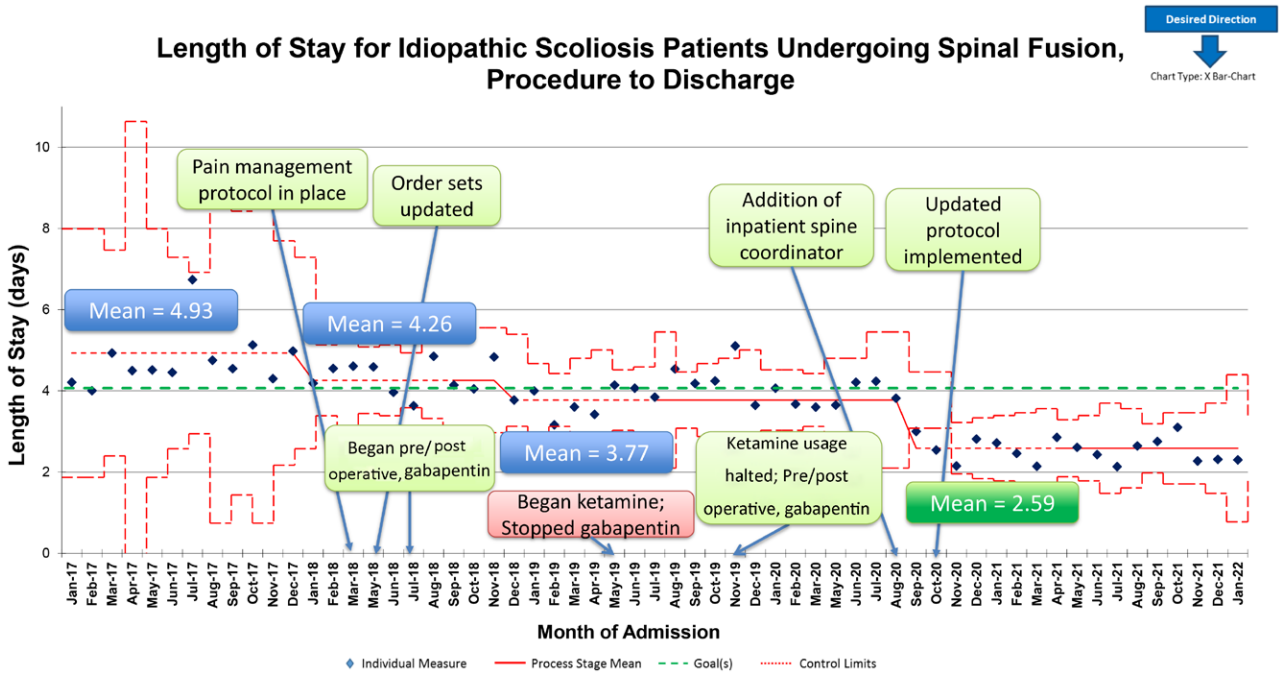

Fig. 6. X-bar chart indicating the length of stay (LOS) for idiopathic spinal fusion patients between procedure and discharge.

inpatient care team members to develop an LOS protocol that included changes in pain management and improvements to the mobility and dietary advancement pathway. As a result, we now approach each patient's spine surgery and admission through a focused lens that follows a pathway to reduce LOS while appropriately managing pain for this population of spinal fusion patients.

Our target population included patients with idiopathic scoliosis who underwent an initial posterior spinal fusion by orthopedic surgeons between January 2017 and January 2022. The project team also chose to include patients with idiopathic early onset scoliosis who underwent initial insertion of growing rods as a part of the same clinical pathway. Excluded from this study were

patients with neuromuscular scoliosis, as comorbidities can complicate their treatment course and require multidisciplinary care from other subspecialties throughout the healthcare system. In addition, we excluded patients with syndromic scoliosis, scoliosis associated with other medical conditions, kyphosis, spondylolisthesis, or patients who had a fusion completed by another service, such as Neurosurgery. Also excluded were patients who underwent growing modality lengthening and revision surgeries.

Many spine institutions worldwide have developed effective LOS pathways to send patients home sooner. Reducing LOS by more than 2 days for each patient can significantly impact a hospital's infrastructure in the finance and workforce realms and the overall cost to the individual families. In addition, reducing LOS minimizes resources which, when allocated elsewhere, reduces the overall burden on the healthcare system. Due to the significant reduction in LOS with the implemented interventions, we have since updated the checklist to remove POD 4, with expected discharge on POD 3.

One project limitation is the need to individualize each patient's treatment plan when circumstances arise. For example, social situations that impact discharge planning can negatively impact LOS outcome measures. We found that extensive preoperative planning is crucial to limit the possibility of unexpected situations arising. For unanticipated aspects of a patient's care, such as response to pain medication, the patient's overall well-being always takes priority over meeting the items on the discharge checklist.

Another limitation is patients and families feel "pushed" toward discharge as we follow the checklist. Families have expressed concern as we use the "ready for discharge" language. They voice that our attention is sometimes on the discharge day, not their perceived medical needs. We have taken these concerns seriously and now explain that our generalized expectations can differ for every patient throughout the perioperative process.

CONCLUSIONS

In conclusion, we successfully reduced the LOS after posterior spinal fusion for patients with idiopathic scoliosis and have sustained this reduction throughout our spine program. In addition, we have received positive feedback regarding increased communication and expectations from patients, families, and inpatient and outpatient staff. With protocols and interventions in place, all care team members have the resources to continue successfully implementing this work.

With the knowledge obtained through this project, we assess how to apply these same principles to patients with other types of scoliosis and kyphosis. Although standardizing a pathway for patients with comorbidities has proven challenging, we hope to tailor this project's interventions to other patient populations and continue to reduce LOS.

ACKNOWLEDGMENTS

We acknowledge the following persons for their assistance with the study: Allan Beebe, MD, Reid Chambers, DO, Allen Kadado, MD, Jan Klamar, MD, Walter Samora, MD, Nationwide Children's Hospital Pain Team.

DISCLOSURE

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

REFERENCES

1. Menger RP, Sin AH. *Adolescent and Idiopathic Scoliosis*. In: StatPearls. Treasure Island (Fla.); 2022.
2. Scoliosis Research Society. "Scoliosis: What is Scoliosis?" www.srs.org/patients-and-families/conditions-and-treatments/parents/scoliosis. Accessed June 26, 2023.
3. Yoshihara H, Paulino C, Yoneoka D. Predictors of increased hospital stay in adolescent idiopathic scoliosis patients undergoing posterior spinal fusion: analysis of national database. *Spine Deform*. 2018;6:226–230.
4. Association CsH. *Pediatric Health Information Systems Database*. In: Association CsH, ed.
5. Yoshihara H, Yoneoka D. National trends in spinal fusion for pediatric patients with idiopathic scoliosis: demographics, blood transfusions, and in-hospital outcomes. *Spine (Phila Pa 1976)*. 2014;39:1144–1150.
6. Erickson MA, Morrato EH, Campagna EJ, et al. Variability in spinal surgery outcomes among children's hospitals in the United States. *J Pediatr Orthop*. 2013;33:80–90.
7. Fletcher ND, Andras LM, Lazarus DE, et al. Use of a novel pathway for early discharge was associated with a 48% shorter length of stay after posterior spinal fusion for adolescent idiopathic scoliosis. *J Pediatr Orthop*. 2017;37:92–97.
8. Gornitzky AL, Flynn JM, Muhly WT, et al. A rapid recovery pathway for adolescent idiopathic scoliosis that improves pain control and reduces time to inpatient recovery after posterior spinal fusion. *Spine Deform*. 2016;4:288–295.
9. Lagoe RJ, Johnson PE, Murphy MP. Inpatient hospital complications and lengths of stay: a short report. *BMC Res Notes*. 2011;4:135.
10. Shaughnessy EE, Sturm P, Sitzman TJ. Feasibility of episode-based bundled payment for a pediatric surgical condition: posterior spinal fusion. *Pediatr Qual Saf*. 2017;2:e028.
11. Fletcher ND, Ruska T, Austin TM, et al. Postoperative dexamethasone following posterior spinal fusion for adolescent idiopathic scoliosis. *J Bone Joint Surg Am*. 2020;102:1807–1813.
12. Muhly WT, Sankar WN, Ryan K, et al. Rapid recovery pathway after spinal fusion for idiopathic scoliosis. *Pediatrics*. 2016;137:e20151568.
13. Thomson K, Pestieau SR, Patel JJ, et al. Perioperative surgical home in pediatric settings: preliminary results. *Anesth Analg*. 2016;123:1193–1200.
14. Wong DL, Baker CM. Smiling faces as anchor for pain intensity scales. *Pain*. 2001;89:295–300.
15. Langley GJ. *The Improvement Guide: A Practical Approach to Enhancing Organizational Performance*. 2nd ed. San Francisco, Calif.: Jossey-Bass; 2009.
16. Jennings JK, Doyle JS, Gilbert SR, et al. The use of chewing gum post-operatively in pediatric scoliosis patients facilitates an earlier return to normal bowel function. *Spine Deform*. 2015;3:263–266.
17. Seilhamer C, Di Lorenzo C, Holstine J, et al. Creating a bowel management plan for pediatric orthopaedic spine surgery patients. *Spine Deform*. 2021;9:365–371.
18. Ye J, Myung K, Packiasabapathy S, et al. Methadone-based multimodal analgesia provides the best-in-class acute surgical pain control and functional outcomes with lower opioid use following major posterior fusion surgery in adolescents with idiopathic scoliosis. *Pediatr Qual Saf*. 2020;5:e336.
19. Provost LP, Murray S. *The health care data guide: learning from data for improvement*. John Wiley & Sons; 2011.