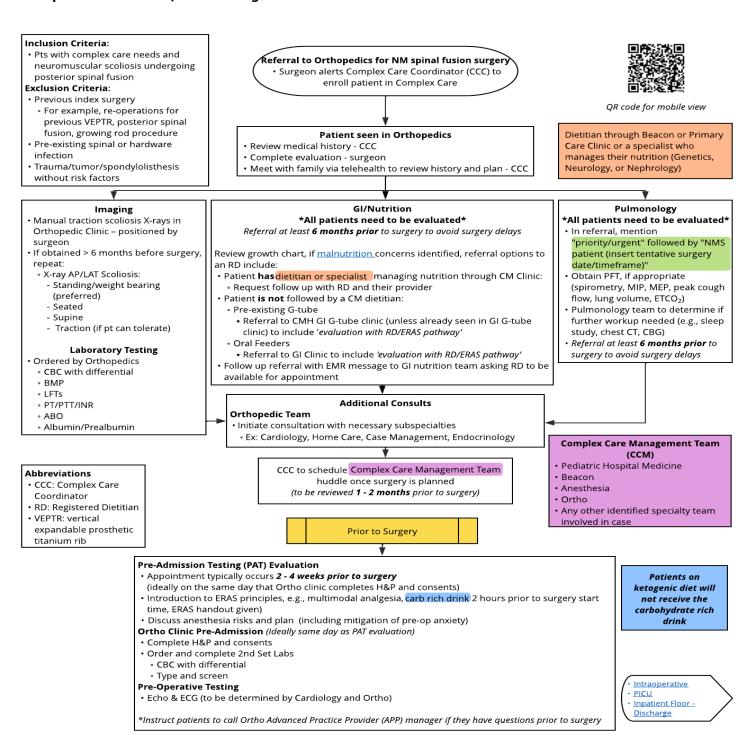
Date Finalized: February 2025

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Neuromuscular Spinal Fusion Enhanced Recovery After Surgery Pathway Synopsis

NM Spine: Assessment/Referral Algorithm



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NM Spine: Intraoperative Algorithm

Inclusion Criteria:

· Patients with neuromuscular scoliosis undergoing posterior spinal fusion

Exclusion Criteria:

- · Previous index surgery
- · Pre-existing spinal or hardware infection
- Trauma/tumor/spondylolisthesis without risk factors

Equipment

- · Infusion pumps
- · Hotline with blood tubing
- · Prone pillow
- Bite blocks
- · Tegaderm/ointment for eye protection
- · Esophageal temp probe

Maintenance of TIVA

- Propofol gtt: 50 150 mcg/kg/min High dose may decrease NM signals
- · Remifentanil gtt: 0.2 0.5 mcg/kg/min

- · Sufentanil gtt: 0.2 1 mcg/kg/min
- Avoidance of inhaled anesthetics
- Avoidance of dexmedetomidine gtt

PONV Prophylaxis

- Dexamethasone 0.1 mg/kg IV (Max 8 mg)
- · Ondansetron 0.15 mg/kg IV (Max 8 mg)

Antibiotics No MRSA history:

· Cefepime 50 mg/kg IV (Max 2 G)

MRSA history:

 Clindamycin 10 mg/kg IV- if susceptible (Max 900 mg) PLUS cefepime 50 mg/kg (Max 2 G)

OR

• Vancomycin15 mg/kg IV **PLUS** cefepime 50 mg/kg IV (Max 2 G)

Coagulation

- Tranexamic acid (TXA)
 - · Loading Dose: 30 mg/kg (Max 2 G)
 - Infusion: 10 mg/kg/hour

Muscle Relaxants

• Surgeons may ask for NMB to be given for exposure following completion of baseline neuro-monitoring

End of Case

- Upon completion of final neuro-monitoring
- · May discontinue ketamine gtt
- If preferred, may discontinue propofol infusion and start inhalation anesthetic
- · Continue TXA until closing of skin
- Administer ondansetron, ketorolac, & acetaminophen if have not already

Assessment/Referral

Preoperative Care in SDS

- Clear carbohydrate-rich drink up to 2 hours before surgery
- Document ingestion of clear carb drink Obtain UCG for patient > 10 years
- · Consider IV placement in SDS
- Anxiolysis: per anesthesia team

Case Setup & Induction

Vascular Access

- · Ultrasound (US) in room to capture image; order anesthesia
- 2-3 large bore IVs (avoid antecubital location if possible)
- Obtain T&S with IV placement (and cortisol if needed) Low threshold for CVC placement (preferred by PICU)
- Discuss with surgeon
- Arterial line

Intraoperative Care

Multimodal Analgesia

- · Methadone 0.1 mg/kg IV (Max 8 mg) at start of case
- · Ketamine gtt: 5 mcg/kg/min
- · Acetaminophen: 12.5 mg/kg IV (Max 1000 mg)
- Administered at beginning of case and q6 hrs
- Ketorolac 0.5 mg/kg IV (Max 15 mg)
- Administered at end of case (confirm with surgeon)
- Consider avoiding long-acting opioids (morphine and hydromorphone), may give fentanyl boluses PRN
- Surgeon may inject local anesthetic at incision site

MAP Management

- · Have phenylephrine or dopamine gtt in line
- · Ephedrine prn
- MAP goals vary by phase of surgery

Fluid Management/Blood Transfusion

Utilize cell saver

Temperature Management

 Maintain normothermia (36º to 38º C) utilizing upper & lower Bair Hugger

Emergence

Transport Considerations

- · If going to PICU, transport directly to PICU intubated for bedside handoff (PICU & surgeon preference)
 - Consider continuing propofol gtt and/or starting demedetomidine gtt for transport
 - If NOT planning to transport intubated, discuss with surgeon

Transfer to PICU

OR code for mobile view

Prior to surgery patient/family meets

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- · Pre-op nurse
- Anesthesiologist
- Child Life Specialists

Patients on ketogenic diet will not receive the carbohydrate rich drink

Induction

- · Consider the avoidance of non-depolarizing neuromuscular blocking agents (NMBA) for intubation
- · May give succinylcholine if appropriate

Phases of Surgery & Mean Atrial Pressure (MAP) Goals

Always Confirm w/ Surgery

- Phase 1: Decortication of vertebral laminae, destruction of facet joints and removal of spinous processes
- Phase 2: Placement of pedicle screws MAP goal ~65 mmHg (If < 10 yrs old,
- normal age based MAP)
- Phase 3: Distraction of spinal cord
- MAP goal 75 85 mmHg (If < 10 yrs old increase to 25% above normal)

Change or Loss of Neuromuscular Signals

- · Make sure surgeon stops operating
- Verify change or loss w/ neuro-monitoring team and ask for characterization (change vs loss; diffuse vs focal)
- Verify correct probe placements and patient positioning
- Increase MAP
- Age > 15: 85 95 mmHg
- · Age 10 14: 80 90 mmHg
- Age 5 9: 75 85 mmHg
- · Age 1 4: 70 80 mmHg
- · Hypoventilate > 45 mmHg · Confirm current medications, including
- infusions Optimize ABG and O² carrying capacity (transfuse as needed)
- · Consider lidocaine IV 1 2 mg/kg to treat possible vasospasm
- Prepare for possible wake-up test
- · Coordinate postop plans w/ surgeon

PICU Inpatient Floor - Discharge

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NM Spine: PICU Algorithm

Inclusion Criteria:

Neuromuscular scoliosis patients undergoing posterior spinal fusion

Exclusion Criteria:

- · Previous index surgery
- · Pre-existing spinal or hardware infection
- Trauma/tumor/spondylolisthesis without risk factors

PICU

Upon Arrival

• Extubate - when appropriate

Considerations (defer to primary care team):

- · Extubate to BPAP if patient was on PAP therapy pre-surgery
- Extubate to BPAP if complications in surgery or severe weakness
- Obtain labs and vitals ABG, iCal, Lactic acid, CBC, BMP, PT/INR, PTT, Fibrinogen
- Ortho APP to perform med reconciliation

Key ERAS Principles:

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- Keep patient/family/team focused on early discharge
- · Advance diet, minimize IV fluids
- Multimodal analgesia: minimize opioids, transition to orals quickly
- · Encourage time out of bed
- Remove invasive lines (E.g., Foley)

PCA Orders & Consider APS Consult

- Hydromorphone PCA (provide demand only if patient received methadone or IT morphine)
- Start in PACU & to be discontinued on POD 1
- Ketorolac IV 0.5 mg/kg (Max 15 mg) q6 hrs scheduled
 - · Alternate with acetaminophen q3 hrs
 - Transition to PO ibuprofen 10 mg/kg (Max 800 mg) q6 hrs on POD 1
- Acetaminophen IV 12.5 mg/kg (Max 750 mg) q6 hrs
- Transition to PO acetaminophen 12.5 mg/kg (Max 750 mg) q6 hrs on POD 1
- Diazepam IV or PO 0.05 0.1 mg/kg (Max 5 mg) q 4 6 hrs PRN or scheduled
- · If poor pain trajectory anticipated or if pain escalation is required, may consider addition of the following:
- · Low dose ketamine infusion
- · Dexmedetomidine infusion or clonidine IV dosing followed by patch placement
- Other pain adjuncts as needed
- Surgery to order Dexamethasone IV 0.1 mg/kg (Max 8 mg) q8 hrs x 3 doses

Exparel injected during surgery?

Patients on ketogenic diet:

Avoid IV acetaminophen and IV

dexamethasone.

Patients with known

hypertension or Addison's

disease:

Avoid IV dexamethasone

Accelerated Pain Pathway *Goal to transition to PO Pain Meds on POD 0*

- No PCA
- Ketorolac IV 0.5 mg/kg (Max 15 mg) q6 hrs scheduled for 3 doses
 - · Alternate with acetaminophen q3 hrs
 - Transition to PO ibuprofen 10 mg/kg (Max 800 mg) q6 hrs on POD 1
- Acetaminophen IV 12.5 mg/kg (Max 750 mg) q6 hrs
- Transition to PO acetaminophen 12.5 mg/kg (Max 750 mg) q6 hrs on POD 1
- Oxycodone PO 0.1 mg/kg (Max 7.5 mg) q4 hrs prn
- Hydromorphone IV 5 mcg/kg (Max 500 mcg) q3 hrs for breakthrough pain or not tolerating PO

OR

- Morphine IV 0.05 mg/kg (Max 4 mg) q 2 hrs prn for breakthrough pain or not tolerating PO
- Diazepam IV or PO 0.05 0.1 mg/kg (Max 5 mg) q 4-6 hrs
- Dexamethasone IV 0.1 mg/kg (Max 8 mg) q8 hrs x 3

Perioperative Antibiotics No hx of MRSA · Cefepime 50 mg/kg IV

(Max 2 G) q8 hrs x 3 doses

MRSA (active or hx of)

- · Clindamycin 10 mg/kg IV q6 hrs x 3 doses (Max 600 mg) **PLUS** cefepime 50 mg/kg (Max 2 G)
- x 3 doses

OR

 Vancomycin 15 mg/kg IV q12 hrs PLUS cefepime 50 mg/kg IV (Max 2 G) x 3 doses

Physical Activity Activity

Once airway and pulmonary status are stabilized, encourage up to the wheelchair TID

Physical Therapy

· Consult once pt is stabilized

Pulmonary Care

- Review preoperative complex ortho plan
- Follow pulmonary sick plan: · Pulmonary airway clearance
 - a4 hrs (if no pulmonary airway clearance plan/sick plan in chart, use incentive spirometry or intrapulmonary percussive therapy q4 hrs
- · Resume VEST when appropriate
- Consult pulmonary if problems weaning respiratory support

Diet Advance feeds as tolerated

- Initiate bowel regimen
- Docusate/Senna QHS on POD 0
- Miralax BID on morning of POD1
- Famotidine BID unless on home GI prophylaxis
- Ondansetron prn for nausea/vomiting
- 0.1 mg/kg/dose (Max 4 mg)

Lines, Labs, & Vitals

- Foley Catheter
- · Consider removing on POD1

Vital Signs

- Vitals: q2 hrs for 24 hrs
- Motor: q1 hrs X 4, q2 hrs X 4 hrs (x4), q8 hrs after
- Neurovascular: q2 hrs X 4, q4 hrs after

Labs

- POD1 am CBC, BMP, coags
- Prevena (negative pressure wound therapy) incisional vac with bulb drain
- POD 2 drain to be removed by Ortho



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Transfer Considerations to Inpatient Team

- Stable respiratory support (nasal cannula and weaning and/or home NIV), g4 hrs treatments or less frequent
- Pain tolerated on current regimen
- · Hemodynamic stability: 6 hours off vasoactive infusions

Assessment - Referral Intraoperative

Inpatient Floor - Discharge

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NM Spine: Inpatient Floor to Discharge Algorithm

Inclusion Criteria:

 Neuromuscular scoliosis patients undergoing posterior spinal fusion

Exclusion Criteria:

- · Previous index surgery
- · Pre-existing spinal or hardware infection
- Trauma/tumor/spondylolisthesis without risk factors

Post Operative - Henson Hall

Consider consult for social work or case management for continued inpatient and outpatient support

Key ERAS Principles:

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- Keep patient/family/team focused on early discharge
- · Advance diet, minimize IV fluids
- Multimodal analgesia: minimize opioids, transition to orals quickly
- Encourage time out of bed
- Remove invasive lines (E.g., Foley)

PCA Orders & APS Consult

- Hydromorphone PCA (provide demand only if patient received methadone or IT morphine)
- ${\scriptstyle \bullet}$ Start in PACU & to be discontinued on POD 1
- Ketorolac IV 0.5 mg/kg (Max 15 mg) q6 hrs scheduled
 - · Alternate with acetaminophen q3 hrs
- Transition to PO ibuprofen 10 mg/kg (Max 800 mg) q6 hrs on POD 1
- Acetaminophen IV 12.5 mg/kg (Max 750 mg) q6 hrs
 - Transition to PO acetaminophen 12.5 mg/kg (Max 750 mg) q6 hrs on POD 1
- Diazepam IV or PO 0.05-0.1 mg/kg (Max 5 mg) q 4-6 hrs PRN or scheduled
- If poor pain trajectory anticipated or if pain escalation is required, may consider addition of the following:
- Low dose ketamine infusion
- Dexmedetomidine infusion or clonidine IV dosing followed by patch placement
- · Other pain adjuncts as needed
- Surgery to order Dexamethasone IV 0.1 mg/kg (Max 8 mg) q8 hrs x 3 doses immediately post-op

No—Exparel injected during surgery? Yes→

Patients on ketogenic diet:

Avoid IV acetaminophen and IV dexamethasone.

Patients with known hypertension or Addison's disease: Avoid IV dexamethasone

Patient is off pathway if surgical complications identified

*Provide appropriate supportive care Otherwise proceed with ERAS pathway

Accelerated Pain Pathway *Goal to transition to PO Pain Meds on POD 0*

- No PCA
- Ketorolac IV 0.5 mg/kg (Max 15 mg) q6 hrs scheduled for 3 doses
 - Alternate with acetaminophen q3 hrs
 - Transition to PO ibuprofen 10 mg/kg (Max 800 mg) q6 hrs on POD 1
- Acetaminophen IV 12.5 mg/kg (Max 750 mg) q6 hrs
 - Transition to PO acetaminophen 12.5 mg/kg (Max 750 mg) q6 hrs on POD 1
- Oxycodone PO 0.1 mg/kg (Max 7.5 mg) q4 hrs prn
- Hydromorphone IV 5 mcg/kg (Max 500 mcg) q3 hrs for breakthrough pain or not tolerating PO

OR

- Morphine IV 0.05 mg/kg (Max 4 mg) q 2 hrs prn for breakthrough pain or not tolerating PO
- Diazepam IV or PO 0.05-0.1 mg/kg (Max 5 mg) q 4-6 hrs prn
- Dexamethasone IV 0.1 mg/kg (Max 8 mg) q8 hrs x 3 doses immediately post-op

Lines, Labs, & Vitals

- Foley Catheter and PICC line
 Remove as soon as possible
- Vital Signs
 - Vitals/Motor/Neurovascular q4 hrs X 24 hrs, then per provider discretion

Labs

No routine labs scheduled

Physical Activity Activity

 Encourage out of bed to wheelchair

Physical Therapy

 Consult, if not already done in PICU

Pulmonary Care

- Review preoperative complex care ortho plan
- Provide pulmonary airway clearance QID (if no pulmonary airway clearance/sick plan, use IS or IPV QID)
- Switch airway clearance to BID or home 'well plan' when back to baseline respiratory support
- **Resume** VEST when appropriate
- Consult pulmonary if problems weaning respiratory support or needing increased O₂ flow

Diet

- Encourage return to preoperative nutritional intake advance as tolerated
- Initiate bowel regimen
- Docusate/Senna QHS on POD 0 or 1
- Miralax BID on morning of POD 1
- Famotidine BID unless on home GI prophylaxis
- Ondansetron prn for nausea/vomiting
- 0.1 mg/kg/dose (Max 4 mg)

Abbreviations

IS: Incentive spirometry IPV:

Intrapulmonary percussive therapy

Discharge Readiness

Discharge Goal POD2 vs POD3

Discharge Requirements

- Stable respiratory status per home routine
- Tolerating preoperative nutritional intake
- Transitioned to oral/PG pain medication with good pain control
- Transition to home Prevena vacuum canister
- Cleared by PT safe transfers and appropriate DME

Discharge Teaching

- Post-op care instructions reviewed by team with family
- If constipation remains at time of discharge, consider Miralax and senna for home



QR code for



Discharge home

Follow-up appointment scheduled with surgeon 6 weeks postop

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NM Spine: Assessment/Referral Algorithm
NM Spine: Intraoperative Algorithm
NM Spine: PICU Algorithm
NM Spine: Inpatient Floor to Discharge Algorithm4
Objective of ERAS Pathway6
Background
Target Users
Target Population
Core Principles of ERAS
ERAS Management Recommendations:
Additional Questions Posed by the ERAS Committee
Key Metrics To Be Monitored:
Value Implications
Potential Organizational Barriers and Facilitators
Power Plans
ERAS Pathway Preparation
Neuromuscular Spine ERAS Committee Members and Representation
ERAS Development Funding
Approval Process
Implementation & Follow-Up
Disclaimer
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6

Objective of ERAS Pathway

To minimize the variation of care for the neuromuscular spine patient undergoing spinal fusion surgery and improve patient outcomes. The Neuromuscular Spinal Fusion Enhanced Recovery After Surgery (ERAS) Pathway assists the multidisciplinary team with a standardized approach to care before, during, and after surgery to achieve optimal patient outcomes.

Background

Surgical correction is the most effective treatment for severe neuromuscular scoliosis; however, it is not without complications (Antolovich et al., 2022; Simpson et al., 2022). The children who require this surgery are medically complex, often presenting with multiple comorbidities such as decreased pulmonary function, inadequate nutritional status, decreased mobility, and cognitive difficulties (Antolovich et al., 2022; Miller et al., 2020). These factors contribute to a higher risk of perioperative complications such as pneumonia, respiratory failure, surgical blood loss, and wound infections, which can result in longer hospital stays (Miller et al., 2020; Simpson et al., 2022). A multidisciplinary care approach throughout all stages of surgical care will help mitigate potential complications and promote optimal outcomes for these children (Beery et al., 2020; Zhang et al., 2024). The Neuromuscular Spinal Fusion ERAS Pathway, a multimodal perioperative care approach, aims to enhance surgical outcomes and expedite recovery. ERAS protocols encompass preoperative, intraoperative, and postoperative strategies such as optimized pain management, early mobilization, and nutritional support. These evidence-based practices improve patient and family satisfaction, reduce hospital stays, and promote quicker returns to daily activities (Liu, 2017; Rafeeqi & Pearson, 2021; Roberts et al., 2020). The Neuromuscular Spinal Fusion ERAS committee seeks to implement a comprehensive care management protocol to optimize pre-surgery health and minimize complications like surgical site infections (SSI), prolonged opioid use, and extended mechanical ventilation.

Target Users

- Anesthesiologists, Orthopedic Surgeons, Intensivists, Hospitalists, Gastroenterologists, Pulmonologists, Fellows, Residents
- Advanced Care Nurses, Physician Assistants
- Dieticians
- Nurses
- Physical Therapists

Target Population

Inclusion Criteria

Patients with neuromuscular scoliosis undergoing posterior spinal fusion

Exclusion Criteria

- Previous index surgery
 - Re-operations for previous vertical expandable prosthetic titanium rib (VEPTR)
 - Posterior spinal fusion
 - Growing rod procedure
- Pre-existing spinal or hardware infection
- Trauma/tumor/spondylolisthesis without risk factors

Core Principles of ERAS

- · Preoperative education of patients and their families with an introduction to ERAS
- Reduced pre-operative fasting, with clear liquid oral carbohydrate loading until 2 hours prior to surgery
- Goal-directed strict intraoperative intravenous fluid therapy guidelines to avoid hypo-or hypervolemia
- Avoidance of pre-operative mechanical bowel preparation
- Avoidance of routine nasogastric tube use
- Minimizing long-acting opioid analgesia in favor of regional anesthesia with epidural and/or local anesthesia for intra-operative and postoperative pain control when appropriate and using alternative non-opioid medications when appropriate (e.g., non-steroidal anti-inflammatories or acetaminophen)
- Early post-operative mobilization

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ERAS Management Recommendations:

Pre-Operative Care

- This ERAS protocol begins well before the surgical date with a referral and assessment in Orthopedic Surgery.
 Once surgery is recommended, the complex care coordinator begins the process of pre-surgery consults and presents the concept of ERAS to the patient/family. The ERAS protocol is also reviewed and reinforced preoperatively.
- At the initial surgical appointment, the patient and family are provided with educational items on preoperative diet restrictions, risks of anesthesia, and pain management.
- Some of the core concepts of ERAS, including the emphasis on early post-operative oral intake and a multimodal pain management approach, are also discussed. Expectation management is crucial in the preoperative phase. A handout, approved by CM's Health Literacy Committee, is given to the family before departing their pre-surgery appointment.
- Patients and families are provided with contacts for the complex care coordinator to answer any questions they may have before the procedure.
- On the morning of surgery, the patient drinks or is provided carbohydrate-rich clear fluids via a G-tube up to two hours before the procedure start time.

Intra-Operative Care

The principal goals during the intraoperative care of these patients are:

- Multimodal approach to pain management
 - Local anesthetic injection to be determined by the surgeon
 - o Minimize the use of long-acting opioids
- Mean arterial pressure (MAP) management during the three phases of surgery
- Postoperative nausea and vomiting prophylaxis with dexamethasone and ondansetron
- Fluid management goal of clinical euvolemia
- Provide antibiotics based on MRSA history
- Maintain normothermia throughout the entire procedure
- The standard will be for the patient to go to the PICU intubated

Post-Operative Care

The principal goals during the postoperative care of these patients in the PICU are:

- Upon arrival to the PICU, extubate once the patient meets the criteria and obtain labs and vitals
- Advance feeds as tolerated
- Consider removing the Foley catheter on postoperative day one
- Prevent/treat postoperative nausea and vomiting with dexamethasone and ondansetron as needed
- Multimodal pain control: Minimize opioids and transition to oral or G-tube-administered medications as soon as possible.
- Pulmonary hygiene: Review preoperative complex care plan for adjustments to medication
- Physical therapy (PT): Consult once airway and pulmonary status are stabilized
- Administer perioperative antibiotics per protocol
- Remove wound drain postoperative day two (by Ortho)

The principal goals during the postoperative care of these patients once stabilized and moved to inpatient floor are:

- Transition to oral or G-tube-administered pain medications with good pain control
- Encourage PO/PG intake for nutrition and advance as tolerated
- Initiate bowel regimen
- Stabilize respiratory status
- Establish appropriate durable medical equipment (DME) is in place for home
- Meets criteria for safe transfers per PT

Additional Questions Posed by the ERAS Committee

No clinical questions were posed for this review.

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Key Metrics To Be Monitored:

Pre-Op	Intra-Op	Post-Op	
Carbohydrate-rich drink	IV acetaminophen	Extubate as early as possible	
Anxiolysis (Midazolam IV)	PONV prophylaxis	Ondansetron	
	ABX prior to incision (based on MRSA history)	Perioperative antibiotics	
	Methadone	Prevena wound therapy	
	Ketamine	Length of stay	
	Ketorolac	Safe transfers	
	Long-acting opioids		
	Normothermia		
	Mean Arterial Pressure (MAP) management		
	Coagulation		
	Neuromuscular block		

Value Implications

The following potential improvements may reduce healthcare facility costs and resource utilization and reduce healthcare costs and non-monetary costs (e.g., missed school/work, loss of wages, stress) for patients and families.

- Decreased inpatient length of stay
- Decreased unwarranted variation in care
- Improved communication between patients and the care team throughout the perioperative period
- Improved post-operative pain control

Potential Organizational Barriers and Facilitators

Potential Barriers

- Variability of acceptable level of risk among providers
- Challenges with follow-up faced by some families

Potential Facilitators

- Collaborative engagement across care continuum settings during ERAS development
- High rate of use of ERAS
- Streamlined patient and parent/caregiver education throughout the surgical experience

Power Plans

There are no Power Plans associated with this ERAS pathway

Associated Policies

There are no associated policies with this ERAS pathway

Education Materials

- ERAS overview handout
 - o Intended to be a general handout encompassing the key concepts and plan for an ERAS pathway
 - Found on the CM external website for each ERAS pathway
 - Available in English and Spanish

ERAS Pathway Preparation

This ERAS pathway was prepared by the Department of Evidence Based Practice (EBP) in collaboration with the Neuromuscular Spinal Fusion ERAS committee composed of content experts at Children's Mercy Kansas City. If a conflict of interest is identified, the conflict will be disclosed next to the committee member's name.

Neuromuscular Spine ERAS Committee Members and Representation

- Aaron Shaw, DO, FAAOS | Orthopaedic Surgery | Committee Co-Chair
- Trent Sims, DO, MS | Anesthesiology | Committee Co-Chair
- Michael Benvenuti, MD | Orthopaedic Surgery | Committee Member
- John Anderson, MD | Orthopaedic Surgery | Committee Member

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- Nichole Doyle, MD | Anesthesiology | Committee Member
- Emily Weisberg, MD | Anesthesiology | Committee Member
- Tara Benton, MD, MSCI | Pediatric Critical Care Medicine | Committee Member
- Cara Holton, MD | Pediatric Critical Care Medicine | Committee Member
- Leah Jones, MD | Hospital Medicine | Committee Member
- Emily Goodwin, MD, FAAP | Beacon Program | Committee Member
- Samira Naime, MD | Pulmonology | Committee Member
- Aileen Frances Har, MD | Gastroenterology | Committee Member
- Heather Sambol, RN, APRN | Anesthesiology | Committee Member
- Anne Stuedemann, MSN, RN, CPNP | Orthopaedic Surgery | Committee Member
- Katie Shedd, MSPAS, PA-C | Orthopaedic Surgery | Committee Member
- Jamie Wilkins, MS, RD, LD, CNSC | Nutrition | Committee Member

EBP Committee Members

- Todd Glenski, MD, MSHA, FASA | Anesthesiology, Evidence Based Practice
- Andrea Melanson, OTD, OTR/L | Evidence Based Practice

ERAS Development Funding

The Departments of Evidence-Based Practice, Anesthesiology, Orthopedics, Pediatric Critical Care, Hospital Medicine, Pulmonology, Gastroenterology, Nutrition, and the Beacon Program underwrote the development of this ERAS pathway.

Conflict of Interest

The contributors to the Neuromuscular Spinal Fusion ERAS pathway have no conflicts of interest to disclose related to the subject matter or materials discussed in this care process.

Approval Process

- This product was reviewed and approved by the Neuromuscular Spinal Fusion ERAS Committee, Content Expert Departments/Divisions, and the EBP Department.
- ERAS pathways are reviewed and updated as necessary every three years within the EBP Department at CMKC. Content expert teams are involved with every review and update.

Review Requested

Department/Unit	Date Obtained
Anesthesiology	January 2025
Orthopedics	January 2025
Pulmonology	January 2025
Pediatric Critical Care	January 2025
Hospital Medicine	January 2025
Gastroenterology	January 2025
Beacon Clinic	January 2025
Nutrition	January 2025
Evidence Based Practice	January 2025

Version History

Date	Comments
February 2025	Version one – (algorithms, synopsis, and patient/caregiver education)

Date for Next Review:

February 2028

Implementation & Follow-Up

• Once approved, this ERAS pathway was presented to appropriate care teams and implemented.

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• Key metrics will be assessed and shared with the appropriate care teams to determine whether changes are needed.

- Education tools for patients and families were created for pre-surgery visits to provide an overview of the ERAS pathway. Health literacy reviewed the tool.
- Education was provided to all stakeholders:
 - o Nursing units where the Neuromuscular Spinal Fusion ERAS pathway is used
 - Departments of Anesthesiology, Orthopedic Surgery, Pulmonology, Gastroenterology, Critical Care, and Hospital Medicine
 - Providers from Beacon Clinic and Nutrition
 - o Resident physicians

Disclaimer

When evidence is lacking or inconclusive, care options are provided in the supporting documents and the power plan(s) that accompany the ERAS pathway.

These ERAS pathways do not establish a standard of care to be followed in every case. It is recognized that each case is different, and those individuals involved in providing health care are expected to use their judgment in determining what is in the best interests of the patient based on the circumstances existing at the time.

It is impossible to anticipate all possible situations that may exist and to prepare ERAS pathways for each. Accordingly, these ERAS pathways should guide care with the understanding that departures from them may be required at times.

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References

- Liu, V.X., Rosas, E., Hwang, J., Cain, E., Foss-Durant, A., Clopp, M., et al. (2017). Enhanced recovery after surgery program implementation in 2 surgical populations in an integrated health care delivery system. *JAMA Surg*, 152, e171032. https://doi.org/10.1001/jamasurg.2017.1032
- Antolovich, G. C., Cooper, M. S., Johnson, M. B., Lundine, K., Yang, Y., Frayman, K., Vandeleur, M., Sutherland, I., Peachey, D., Gadish, T., Turner, B., & Harvey, A. (2022). Perioperative care of children with severe neurological impairment and neuromuscular scoliosis: A practical pathway to optimize perioperative health and guide decision making. *Journal of Clinical Medicine*, 11(22), 6769. https://doi.org/10.3390/jcm11226769
- Berry, J. G., Glaspy, T., Eagan, B., Singer, S., Glader, L., Emara, N., Cox, J., Glotzbecker, M., Crofton, C., Ward, E., Leahy, I., Salem, J., Troy, M., O'Neill, M., Johnson, C., & Ferrari, L. (2020). Pediatric complex care and surgery co-management: Preparation for spinal fusion. *Journal of Child Health Care: for Professionals Working with Children in the Hospital and Community*, 24(3), 402–410. https://doi.org/10.1177/1367493519864741
- Miller, N. H., Benefield, E., Hasting, L., Carry, P., Pan, Z. & Erickson, M. A. (2010). Evaluation of high-risk patients undergoing spinal surgery: A matched case series. *Journal of Pediatric Orthopaedics*, *30*(5), 496-502. doi: 10.1097/BPO.0b013e3181df16ac.
- Rafeeqi, T. & Pearson, E.G. (2021, July). Enhanced recovery after surgery in children. *Translational Gastroenterology* and *Hepatology*, 6, 1-9. doi: 10.21037/tgh-20-188
- Roberts, K., Brindle, M., & McLuckie, D. (2020, July). Enhanced recovery after surgery in pediatrics: A review of the literature. *British Journal of Anesthesia*, 20(7), 235–241. doi.org/10.1016/j.bjae.2020.03.004.
- Simpson, B.E., Kara, S., Wilson, A., Wolf, D., Bailey, K., MacBriar, J., Mayes, T., Russell, J., Chundi, P., & Sturm, P. (2022, March). Reducing patient length of stay after surgical correction for neuromuscular scoliosis. *Hospital Pediatrics*, 12(3), 293–302. doi:10.1542/hpeds.2021-006196
- Zhang, H., Liu, H., Zhang, X., Zhao, M., Guo, D., Bai, Y., Qi, X., Shi, H. & Li, D. (2024). Short-term outcomes of an enhanced recovery after surgery pathway for children with congenital scoliosis undergoing posterior spinal fusion: a case-control study of 70 patients. *Journal of Pediatric Orthopaedics B, 33*(3), 258-264. doi: 10.1097/BPB.00000000001105.

11

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