Spinal Fusion for Adolescent Idiopathic Scoliosis Pathway

Taryn J Hamre, DNP, APRN – Pain and Palliative Medicine
William Zempsky, MD – Pain and Palliative Medicine
Jeffrey Thomson, MD - Orthopedics
Mark Lee, MD - Orthopedics
Ana Verissimo, MD – Integrative Medicine
Kim Koenig, PT – Physical Therapy

What is a Clinical Pathway?

An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective, and consistent patient care.

Objectives of Pathway

Connecticut Children's

- Standardize inpatient post op care
- Promote early mobilization
- Decrease length of stay
- Minimize opioid related side effects
- Determine if a multimodal analgesia approach improves pain control

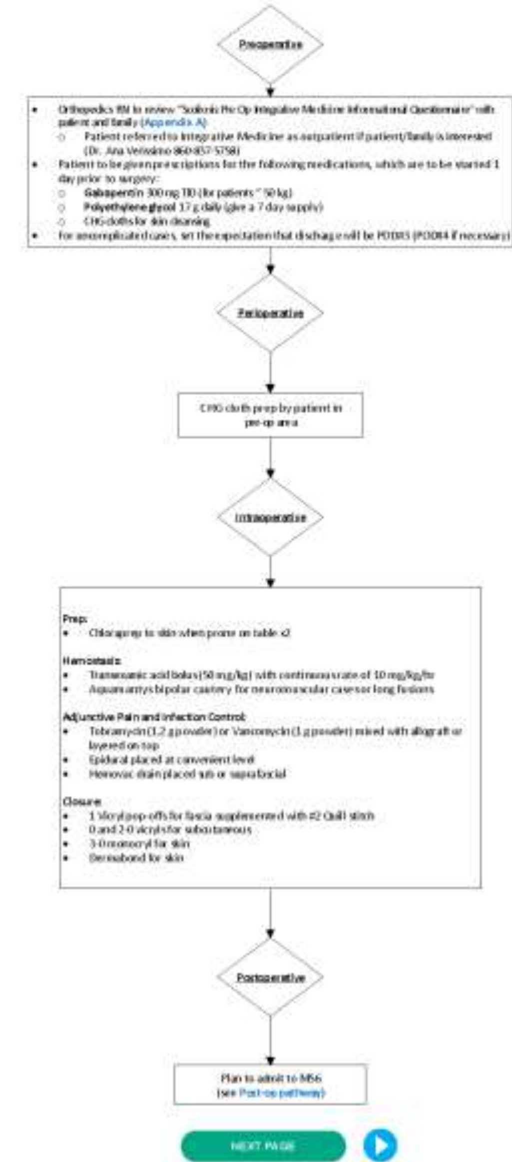
Why is This Pathway Necessary?

- Posterior spinal fusion for adolescent idiopathic scoliosis is associated with significant pain and prolonged hospitalization.
- Standardizing care for posterior spinal fusion can allow early mobilization, decreased LOS and minimize opioid related side effects
- We also wish to determine if a multimodal analgesia approach improves pain control, as such an approach has helped patients after a “Nuss procedure” (chest repair surgery) use less pain medication and generally do better postoperatively.

This is the Posterior Spinal Fusion Clinical Pathway.

The pathway is divided into pre-op, peri-op, intra-op and post-op care.

We will be reviewing each component in the following slides.



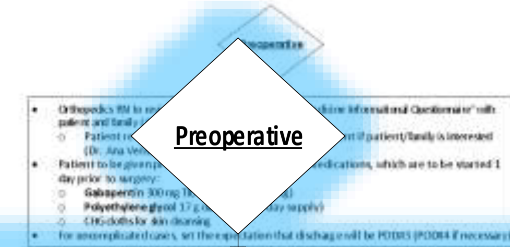
Preoperative Care

Prep for managing pain, constipation, as well as managing expectations postoperatively, is important for post-op success.

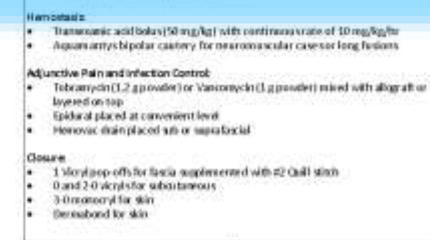
Inform the family that expected discharge will be POD 3 (or 4 if necessary).

CLINICAL PATHWAY:
Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.



- Orthopedics RN to review "Scoliosis Pre Op Integrative Medicine Informational Questionnaire" with patient and family (Appendix A)
  - Patient referred to Integrative Medicine as outpatient if patient/family is interested (Dr. Ana Verissimo 860-837-5758)
- Patient to be given prescriptions for the following medications, which are to be started 1 day prior to surgery:
  - **Gabapentin** 300 mg TID (for patients ≥ 50 kg)
  - **Polyethylene glycol** 17 g daily (give a 7 day supply)
  - CHG cloths for skin cleansing
- For uncomplicated cases, set the expectation that discharge will be POD#3 (POD#4 if necessary)



CONTACTS: TARYN J. HAMRE, DNP, APRN | WILLIAM ZEMPSKY, MD | JEFFREY THOMSON, MD | MARK LEE, MD
ANA VERISSIMO, MD | KIM KOENIG, PT

Connecticut Children's

Preoperative Care

The questionnaire should be offered to families to help identify patients who may want to participate in the study to see if relaxation strategies can have beneficial outcomes postoperatively.

It is available in appendix A.

CLINICAL PATHWAY:
Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Preoperative

- Orthopedics RN to review "Scoliosis Pre Op Integrative Medicine Informational Questionnaire" with patient and family (Appendix A)
  - Patient referred to Integrative Medicine as outpatient if patient/family is interested (Dr. Ana Verissimo 860-837-5758)
- Patient to be given prescriptions for the following medications, which are to be started 1 day prior to surgery:
  - **Gabapentin** 300 mg TID (for patients ≥ 50 kg)
  - **Polyethylene glycol** 17 g daily (give a 7 day supply)
  - CHG cloths for skin cleansing
- For uncomplicated cases, set the expectation that discharge will be POD#3 (POD#4 if necessary)

Pre-op scoliosis patient/family questions:

1. Is your child anxious about the scoliosis surgery? Yes/No

2. Does your child have 'anxious' tendencies? Yes/No

3. Does your child have back pain? Yes/No

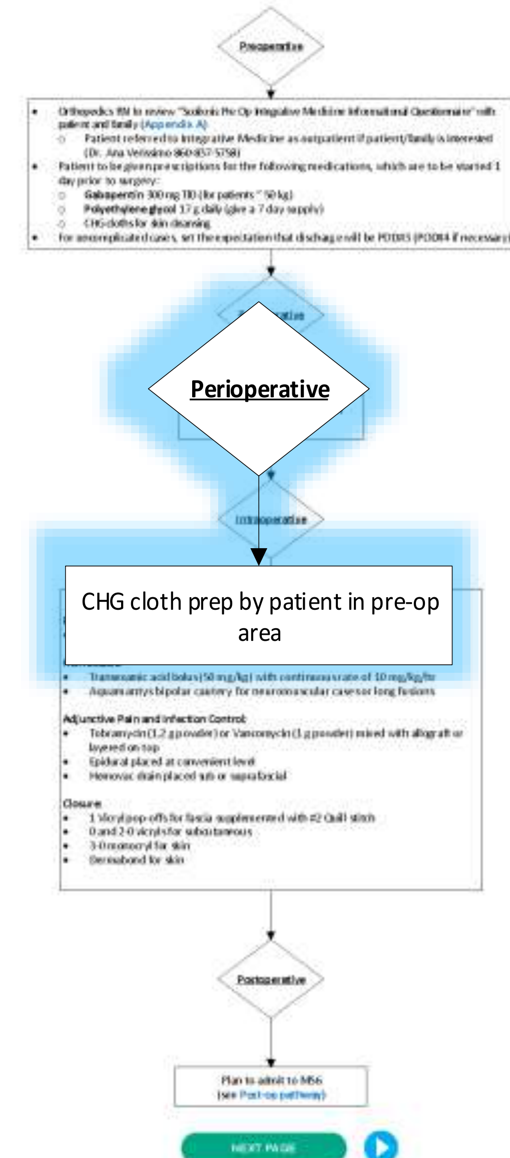
4. Can your child swallow pills? Yes/No
(your child will likely need to swallow medication including "pain" pills while in the hospital and at discharge)

CONTACTS: TARYN J. HAMRE, DNP, APRN | WILLIAM ZEMPSKY, MD | JEFFREY THOMSON, MD | MARK LEE, MD
ANA VERISSIMO, MD | KIM KOENIG, PT

Connecticut Children's

Perioperative Care

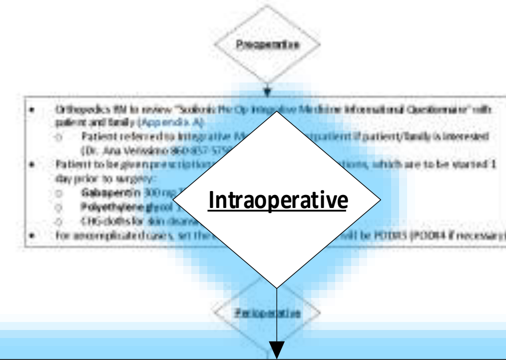
Sage Chlorhexidine Gluconate (CHG) cloths should be used to cleanse the back in the pre-op area



Intraoperative Care

Specific surgical management has been outlined here

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.



Prep:

- Chloraprep to skin when prone on table x2

Hemostasis:

- Transexamic acid bolus (50 mg/kg) with continuous rate of 10 mg/kg/hr
- Aquamantys bipolar cautery for neuromuscular cases or long fusions

Adjunctive Pain and Infection Control:

- Tobramycin (1.2 g powder) or Vancomycin (1 g powder) mixed with allograft or layered on top
- Epidural placed at convenient level
- Hemovac drain placed sub or suprafascial

Closure:

- 1 Vicryl pop-offs for fascia supplemented with #2 Quill stitch
- 0 and 2-0 vicryls for subcutaneous
- 3-0 monocryl for skin
- Dermabond for skin

Plan to admit to MS6
(see Post-op pathway)

NEXT PAGE

CONTACTS: TARYN J. HAMRE, DNP, APRN | WILLIAM ZEMPSKY, MD | JEFFREY THOMSON, MD | MARK LEE, MD
ANA VERISSIMO, MD | KIM KOENIG, PT

Connecticut Children's

Postoperative Care

Care has been outlined by topic and post op day.

CLINICAL PATHWAY:
Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT

	POD 0	POD 1	POD 2	POD 3 *goal discharge date*	POD 4-5
Medications					
Studies/ Consults					
Drains					
Activity					
Nursing					
Diet					

Discharge Criteria:

Discharge Instructions:

RETURN TO THE BEGINNING

CONTACTS: TARYN J. HAMRE, DNP, APRN | WILLIAM ZEMPSKY, MD | JEFFREY THOMSON, MD | MARK LEE, MD
ANA VERISSIMO, MD | KIM KOENIG, PT

©2019 Connecticut Children's Medical Center. All rights reserved.

Medications

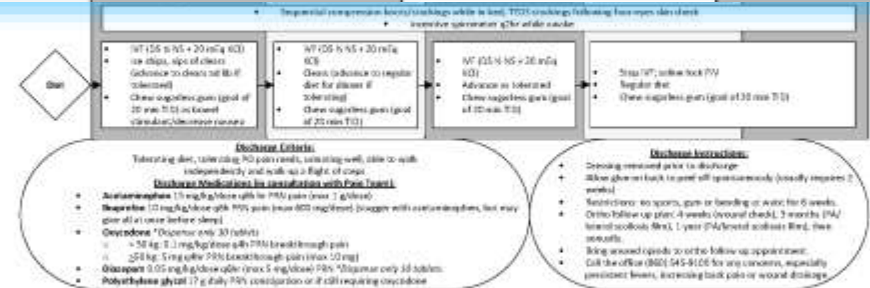
- Medications mainly focus on adequate pain control that will minimize opioid side effects while managing pain well.

Note the following:

- Gabapentin initiated preoperatively is continued throughout the hospital course until discharge
- Epidural will turn off on POD 2 at 6 AM
- The PCA should be turned off at POD 3 (or sooner) and PO oxycodone started
- Tylenol and ketorolac/motrin should be continued ATC.

CLINICAL PATHWAY:

POD 0 / POD 1	POD 2	POD 3 *goal discharge date*	POD 4-5
Pain Control: • *Epidural:* **Ropivacaine 0.1%** at 0.2 to 0.4 mg/kg/hr (0.2-0.4 ml/kg/hr) up to 14 mL/hr ○ When epidural in use, monitor for systemic toxicity: circumoral paresthesias, tinnitus, irritability, tremor, seizures, visual disturbances, metallic taste, cardiac dysrhythmias. Refer to Epidural Policy. • **IV ketorolac:** 0.5 mg/kg/dose q6hr x12 doses (max 30 mg/dose). *To alternate with acetaminophen.* • **IV acetaminophen** 15 mg/kg/dose q6hr (max 1 g/dose) for 4 doses. *To alternate with ketorolac* • **PCA** (demand only): **hydromorphone** 0.004 mg/kg (max 0.2 mg/dose) with 6 min lock out, up to 0.02 mg/ kg/hr limit (max 1 mg/hr) • **IV diazepam** 0.05 mg/kg/dose q6hr (max 5 mg/dose); hold if RR <10 or oversedation. • **IV Dexamethasone** 8 mg/dose q8h x 3 doses • **PO Gabapentin** 300 mg TID (patients ≥ 50 kg) to continue from pre-op • **EMLA** PRN for needle procedures. Antibiotic prophylaxis: • Cefazolin 1-2 grams q8hr x 24h • If allergy, Clindamycin 600 mg q8hr x 24h Antiemetics: • **IV ondansetron** 0.15 mg/kg/dose q8hr (max 8 mg/dose) • Consider 1 **scopoloamine patch** on POD1 for nausea and dizziness Bowel Management: • **PO senokot** 2 tab BID until 1 BM/day • **Polyethylene glycol** 17 g daily	6:00 AM: • Turn off epidural; if tolerated by noon, leave off (if not, turn on x24 hr) Begin: • Convert IV acetaminophen to **PO acetaminophen** q6hr (after 4th IV dose) • Convert IV diazepam to **PO diazepam** 0.05 mg/kg/dose q6hr (max 5 mg/dose); hold if RR <10 or oversedation • Convert IV ondansetron to **ondansetron ODT** PRN (if tolerating oral opioid) Continue: • **IV ketorolac** • **PO Gabapentin** • **Polyethylene glycol** • **PO senokot**	**If still on epidural, follow POD 2 meds & activity** 10:00 AM: • Turn off PCA (may do sooner if pain well controlled) • Start **PO oxycodone** ○ < 50 kg: 0.1 mg/kg/dose q4h PRN pain ○ ≥50 kg: 5 mg q4hr PRN pain (max 10 mg) • **IV hydromorphone** 0.015 mg/kg q3hr PRN breakthrough pain not alleviated by oxycodone (max 0.5 mg/dose) x24 hr Begin: • Convert IV ketorolac to **PO ibuprofen** 10 mg/kg q6hr (after 12th IV dose)(max 600 mg/dose) Continue: • **PO acetaminophen** ATC • **PO diazepam** PRN (can schedule if patient is anxious) • **PO ondansetron** PRN • **PO senokot** daily until 1 BM/day • **PO polyethylene glycol** daily • **PO gabapentin** (to be discontinued upon discharge)	



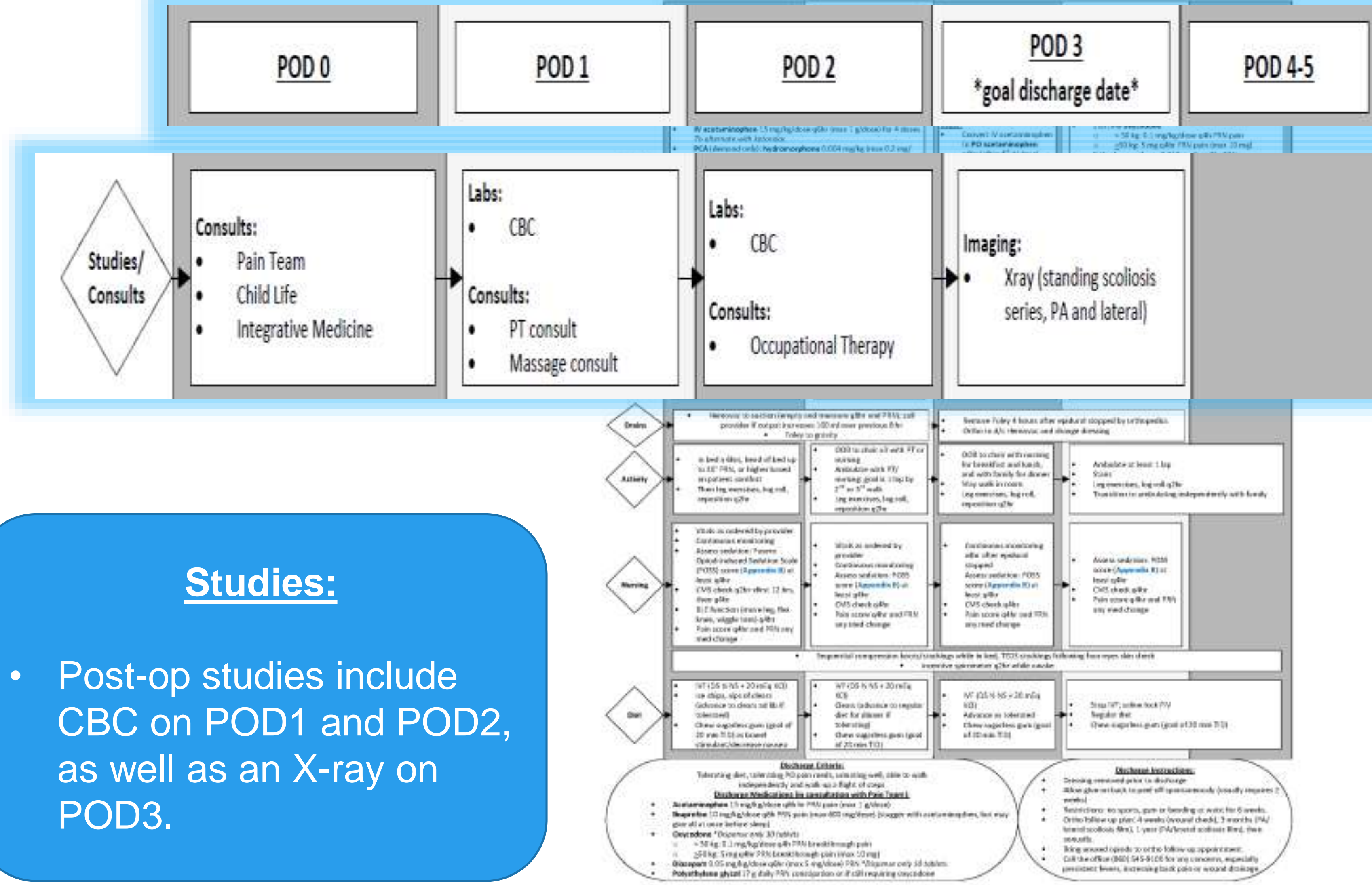
RETURN TO THE BEGINNING

CONTACTS: TARYN J. HAMRE, DNP, APRN | WILLIAM ZEMPSKY, MD | JEFFREY THOMSON, MD | MARK LEE, MD ANA VERISSIMO, MD | KIM KOENIG, PT

©2019 Connecticut Children's Medical Center. All rights reserved.

Consults:

- Consulting the pain team, child life and integrative medicine on POD0 allows for early intervention and improved outcomes
- Integrative medicine may include self-hypnosis strategies
- PT and massage will be consulted on POD1, and OT on POD2 to allow for early mobilization and functioning.



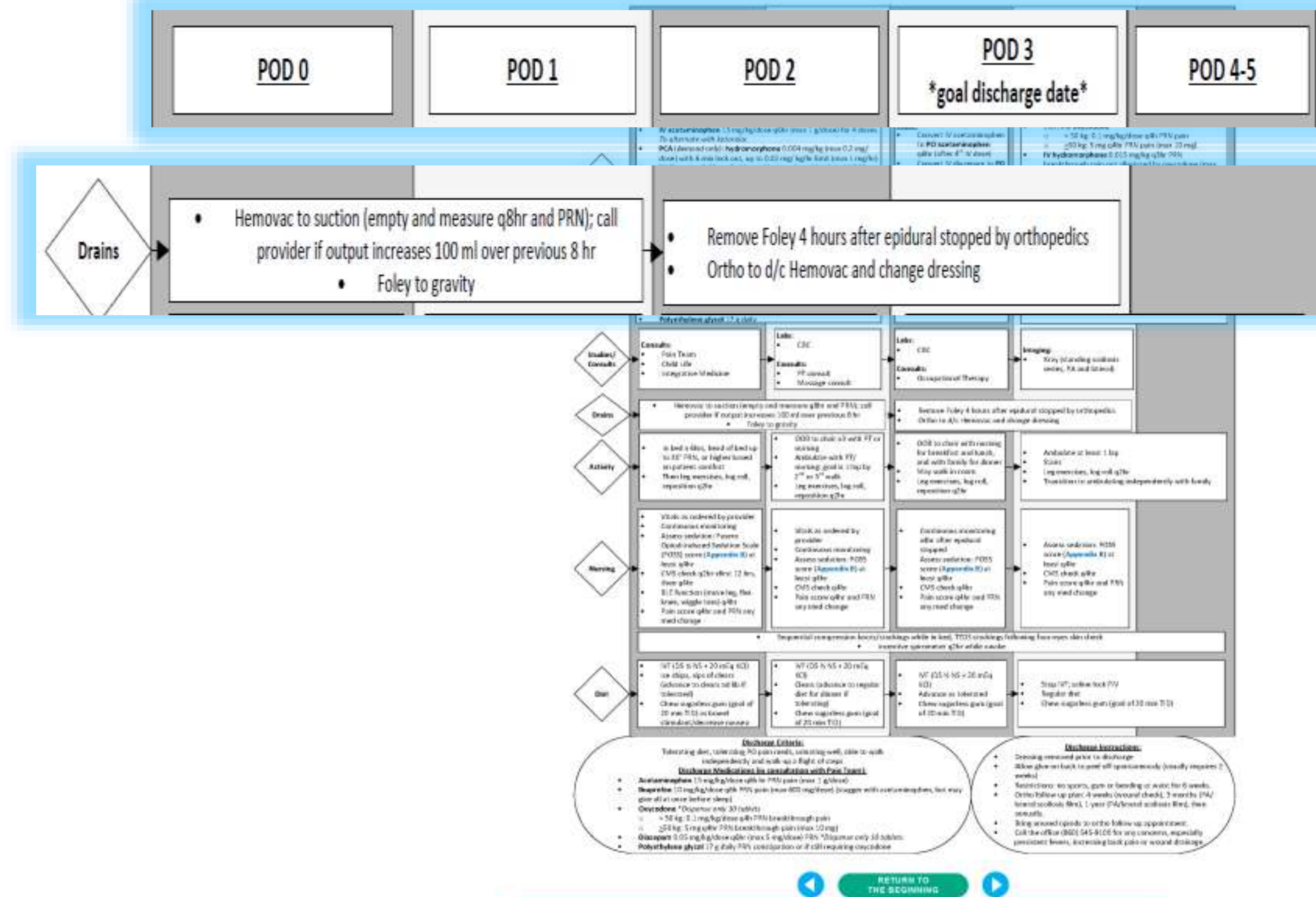
Studies:

- Post-op studies include CBC on POD1 and POD2, as well as an X-ray on POD3.

Drains:

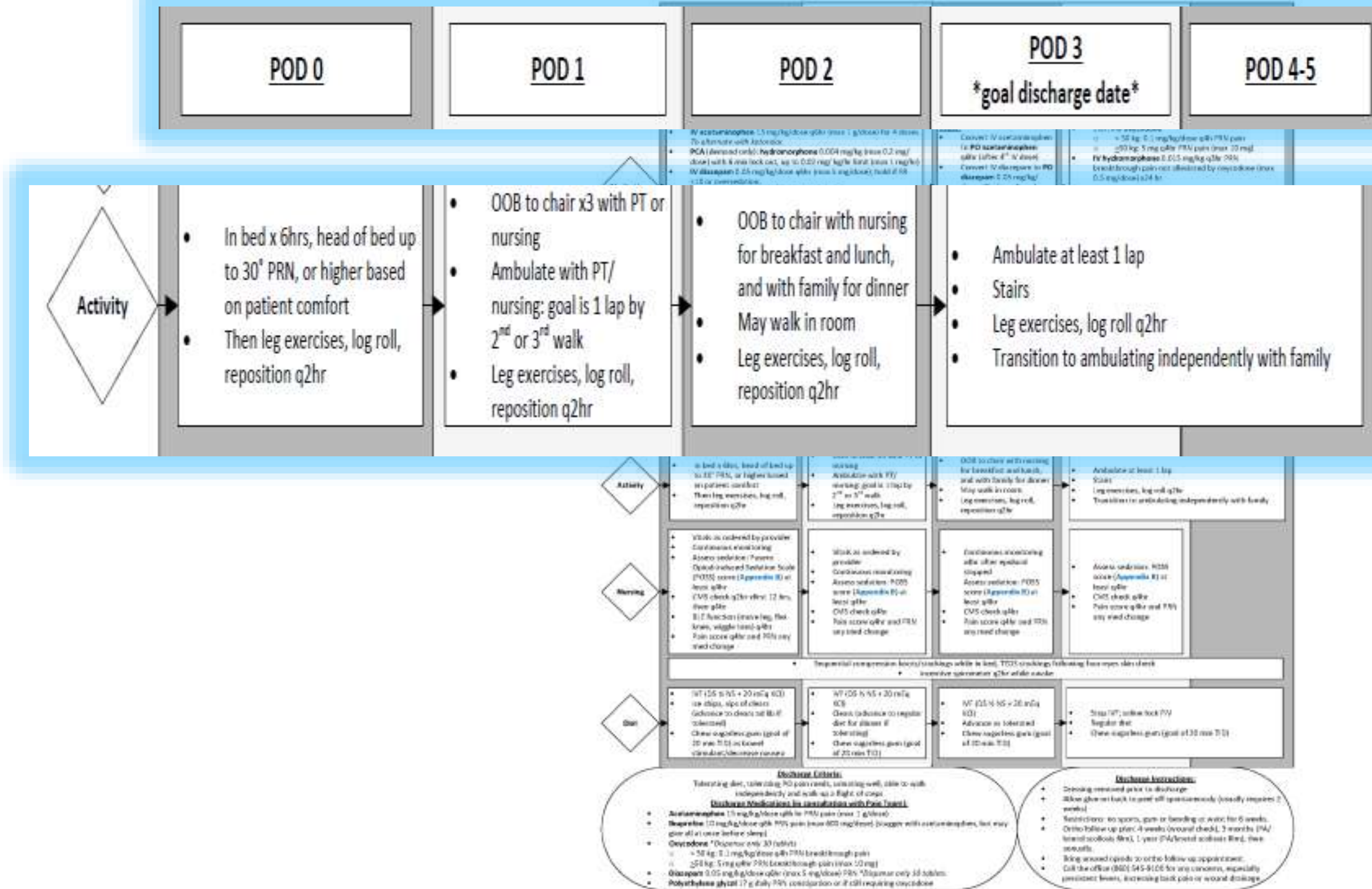
The foley and hemovac will be removed on POD 2 to help:

- promote independent mobilization with family (which will help comfort with mobility and decrease anxiety surrounding these tasks)
- increase opportunity for mobilization to decrease overall length of day
- prepare the patient on POD3



Activity:

- Early mobilization is key for improved postoperative outcomes.
- PT will assist in OOB to chair on POD 1
- Patient will then be encouraged to increase activity by POD 2 and 3.
- The goal of POD 3 (and 4 if needed) would be to ambulate independently with family.



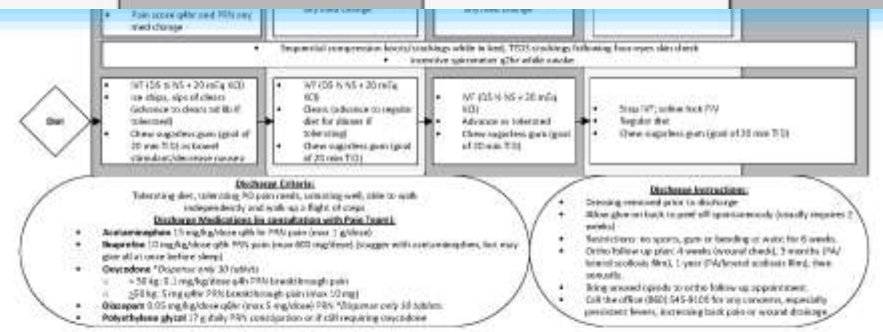
Nursing Care:

- Nursing care will focus on monitoring for side effects of opioids, CMS checks, pain monitoring and BLE functioning.
- Sequential stockings, skin checks and IS per standard postoperative care is recommended.

CLINICAL PATHWAY:
Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT

	POD 0	POD 1	POD 2	POD 3 *goal discharge date*	POD 4-5
Nursing	• Vitals as ordered by provider • Continuous monitoring • Assess sedation: Pasero Opioid-Induced Sedation Scale (POSS) score (Appendix B) at least q4hr • CMS check q2hr xfirst 12 hrs, then q4hr • BLE function (move leg, flex knee, wiggle toes) q4hr • Pain score q4hr and PRN any med change	• Vitals as ordered by provider • Continuous monitoring • Assess sedation: POSS score (Appendix B) at least q4hr • CMS check q4hr • Pain score q4hr and PRN any med change	• Continuous monitoring x4hr after epidural stopped Assess sedation: POSS score (Appendix B) at least q4hr • CMS check q4hr • Pain score q4hr and PRN any med change	• Assess sedation: POSS score (Appendix B) at least q4hr • CMS check q4hr • Pain score q4hr and PRN any med change	
	• Sequential compression boots/stockings while in bed, TEDS stockings following four-eyes skin check • Incentive spirometer q2hr while awake				



RETURN TO THE BEGINNING

CONTACTS: TARYN J. HAMRE, DNP, APRN | WILLIAM ZEMPSKY, MD | JEFFREY THOMSON, MD | MARK LEE, MD
ANA VERISSIMO, MD | KIM KOENIG, PT

Connecticut Children's

©2019 Connecticut Children's Medical Center. All rights reserved.

Nursing Care:

- Note that the Pasero Opioid-Induced Sedation Scale (POSS) score is done every 4 hours and available in appendix B.
- This is important to ensure that opioid induced side effects are avoided and kept at a minimum.

POSS Scale

(Pasero Opioid-Induced Sedation Scale)

Sedation Level	Description	Nursing Intervention
S	Sleep, easy to arouse	Acceptable, no action necessary; may, consider increasing dose if needed
1	Awake and alert	Acceptable, no action necessary; may, consider increasing dose if needed
2	Slightly drowsy, easily aroused	Acceptable, no action necessary; may, consider increasing dose if needed
3	Frequently drowsy, arousable, drifts off to sleep during conversation	**UNACCEPTABLE;** closely monitor respiratory status and sedation level; notify prescriber
4	Somnolent, minimal or no response to verbal and physical stimulation	**PAUSE OPIOID INFUSION; UNACCEPTABLE;** closely monitor respiratory status and sedation level; notify prescriber; consider narcan

*The **POSS Scale** is a validated tool used to assess sedation after every opioid administration (For example: Fentanyl, Morphine, Oxycodone)*

Instructions

1. Complete POSS score within 1 hour of every opioid administration, including ATC and prn dosing.
2. Complete POSS and pain re-assessment at the same time
3. Document the level of sedation that best describes the assessment of your patient's sedation

For Patients on a PCA/NCA or continuous infusion:

1. Assess POSS sedation level/respiratory status every 1-2 hours for the first 24 hours and with a dose change
2. After 24 hours and stable assess POSS every 4 hours with pain assessment and vital signs

In the PICU POSS is not used when the patient is intubated as long as the patient is being assessed with a validated sedation tool (For example: SBS)

connecticutchildrens.org

RETURN TO THE BEGINNING

CONTACTS: TARYN J. HAMRE, DNP, APRN | WILLIAM ZEMPSKY, MD | JEFFREY THOMSON, MD | MARK LEE, MD
ANA VERISSIMO, MD | KIM KOENIG, PT

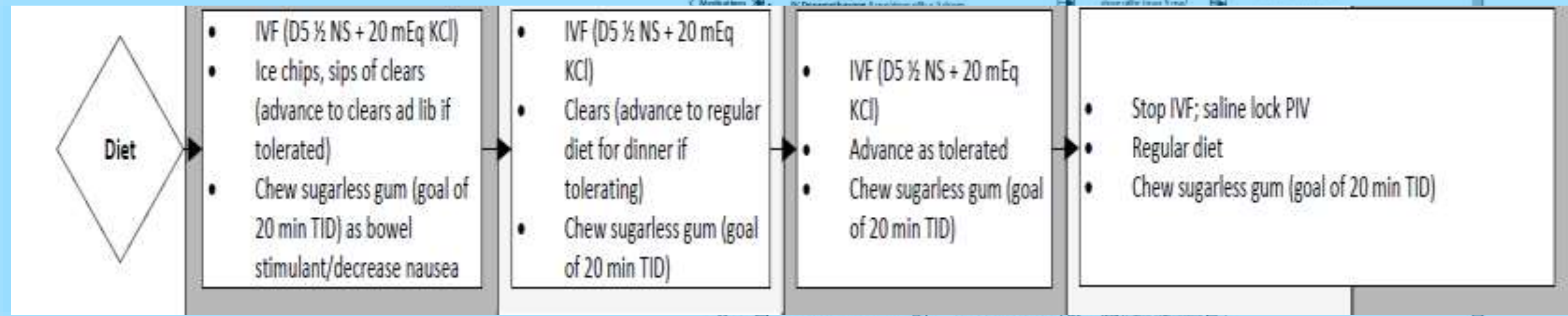
Connecticut Children's

CLINICAL PATHWAY:
Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT

Diet:

- Diet advancement is outlined
- Note chewing of sugarless gum acts as a bowel stimulant and helps decrease nausea



RETURN TO THE BEGINNING

CONTACTS: TARYN J. HAMRE, DNP, APRN | WILLIAM ZEMPSKY, MD | JEFFREY THOMSON, MD | MARK LEE, MD
ANA VERISSIMO, MD | KIM KOENIG, PT

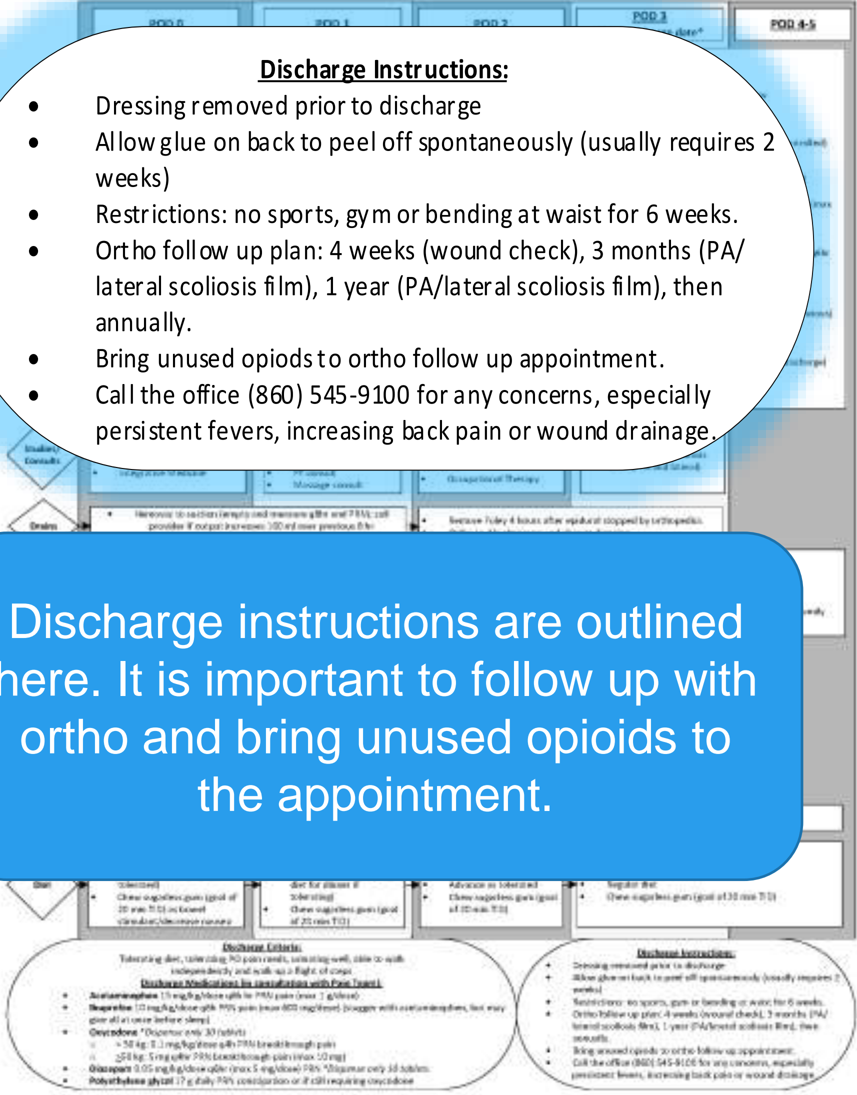
Connecticut Children's

Discharge Criteria:

Tolerating diet, tolerating PO pain meds, urinating well, able to walk independently and walk up a flight of steps

Discharge Medications (in consultation with Pain Team):

- **Acetaminophen** 15 mg/kg/dose q6h hr PRN pain (max 1 g/dose)
- **Ibuprofen** 10 mg/kg/dose q6h PRN pain (max 600 mg/dose) (stagger with acetaminophen, but may give all at once before sleep)
- **Oxycodone** **Dispense only 30 tablets*
    - < 50 kg: 0.1 mg/kg/dose q4h PRN breakthrough pain
    - ≥50 kg: 5 mg q4hr PRN breakthrough pain (max 10 mg)
- **Diazepam** 0.05 mg/kg/dose q6hr (max 5 mg/dose) PRN **Dispense only 10 tablets*
- **Polyethylene glycol** 17 g daily PRN constipation or if still requiring oxycodone



Discharge Instructions:

- Dressing removed prior to discharge
- Allow glue on back to peel off spontaneously (usually requires 2 weeks)
- Restrictions: no sports, gym or bending at waist for 6 weeks.
- Ortho follow up plan: 4 weeks (wound check), 3 months (PA/ lateral scoliosis film), 1 year (PA/lateral scoliosis film), then annually.
- Bring unused opiods to ortho follow up appointment.
- Call the office (860) 545-9100 for any concerns, especially persistent fevers, increasing back pain or wound drainage.

Discharge criteria includes urination (BM is not a necessity).

Discharge instructions are outlined here. It is important to follow up with ortho and bring unused opioids to the appointment.

Discharge medications should be given in consultation with the pain team. Note that oxycodone should only have 30 tablets give, and diazepam only 10 tablets.

Review of Key Points

- **Pain**
  - Gabapentin initiated preoperatively and continued through hospital course
  - Epidural turns off at 0600 POD 2
  - Discontinue PCA, initiate PO oxycodone 1000 POD # 2 or 3
  - Valium dose decreased from prior pathway
  - Tylenol and Toradol/Motrin ATC

- **Ortho:**
  - CHG cloths day before and morning of surgery.
  - Tranexamic acid bolus and infusion during surgery
  - Perioperative antibiotics (Ancef, Clindamycin)
  - Vancomycin/Tobramycin powder in wound
  - Hemovac drain postoperatively
  - Rapid mobilization postoperatively with physical therapy
  - Plain radiographs POD#2 or #3.

Quality Metrics

Connecticut Children's

- Length of time on opioid PCA
- Gabapentin script written prior to admission for surgery
- Length of stay (LOS)
  - Overall LOS for all patients
  - Breakdown of LOS by #vertebrae fused
- Number of post-op infections
- Length of time from functional clearance until discharge
- Opioid dose per day in morphine equivalents
- Number of pain scores above a 6/10 in a 24-hour period

Pathway Contacts

- Taryn J Hamre, DNP, APRN – Pain and Palliative Medicine
- William Zempsky, MD – Pain and Palliative Medicine
- Jeffrey Thomson, MD - Orthopedics
- Mark Lee, MD - Orthopedics
- Ana Verissimo, MD – Integrative Medicine
- Kim Koenig, PT – Physical Therapy

References

- Fletcher ND, Ruska T, Austin TM, Guisse NF, Murphy JS, Bruce RW Jr. Postoperative Dexamethasone Following Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis. *J Bone Joint Surg Am.* 2020 Oct;102(20):1807-1813.
- Gauger, VT, Voepel-Lewis TD, Burke CN,et al. Epidural Analgesia Compared With Intravenous Analgesia After Pediatric Posterior Spinal Fusion. *J Pediatr Orthop*. 2009 Sep;29(6):588–593.
- Hong RA, Gibbons KM, Li GY, Holman A, Voepel-Lewis T. A retrospective comparison of intrathecal morphine and epidural hydromorphone for analgesia following posterior spinal fusion in adolescents with idiopathic scoliosis. *Paediatr Anaesth*. 2017 Jan;27(1):91–97.
- Hong R, Gauger V, Caird MS, Burke C. Narcotic-only Epidural Infusion for Posterior Spinal Fusion Patients. *J Pediatr Orthop.* Jul-Aug 2016:36(5):526–529.
- Lavelle ED, Lavelle WF, Goodwin R, et al. Epidural Analgesia for Postoperative Pain Control After Adolescent Spinal Fusion Procedures Which Violated the Epidural Space. *J Spinal Disord Tech*. 2010 Jul;23(5):347–350.
- Manworren RCB, Anderson MN, Girard ED, et al. Postoperative Pain Outcomes after Nuss Procedures: Comparison of Epidural Analgesia, Continuous Infusion of Local Anesthetic, and Preoperative Self-Hypnosis Training. *J Laparoendosc Adv Surg Tech A.* 2018 Oct;*28*(10):1234-1242.
- Manworren R, Girard E, Verissimo K, et al. Effectiveness of Hypnosis for Post-operative Pain Management of Minimally Invasive Thorascopic Approach to Repair Pectus Excavatum: Retrospective Analysis. *J Pain.* 2014 Apr;15(4):S118.
- Muhly WT, Sankar WN, Ryan K, et al. Rapid Recovery Pathway After Spinal Fusion for Idiopathic Scoliosis. *Pediatrics*. 2016 Apr;137(4): doi: 10.1542/peds.2015-1568.
- Oetgen ME, Shirley ED, Choi PD, Sanders JO. Common Elements in Surgical Site Infection Care Bundles for Adolescent Idiopathic Scoliosis at North American Pediatric Institutions. *J Pediatr Orthop.* 2019 Aug;39(7): e514-519.
- Rao RR, Hayes M, Lewis C, et al. Mapping the Road to Recovery: Shorter Stays and Satisfied Patients in Posterior Spinal Fusion. *J Pediatr Orthop.* 2017 Dec;37(8):e536-542.
- Sheffer BW, Kelly DM, Rhodes LN, Sawyer JR. Perioperative Pain Management in Pediatric Spine Surgery. *Orthop Clin North Am*. 2017 Oct;48(4):481–486.
- Sundarathiti P, Pasutharnchat K, Jommaroeng P. Thoracic epidural-general analgesia in scoliosis surgery. *J Clin Anesth*. 2010 Sep;22(6):410–414.
- Vandenberg C, Niswander C, Carry P, et al. Compliance With a Comprehensive Antibiotic Protocol Improves Infection Incidence in Pediatric Spine Surgery. *J Pediatr Orthop.* May/Jun;38(5):287–292.

Thank You!

About Connecticut Children's Clinical Pathways Program

The Clinical Pathways Program at Connecticut Children's aims to improve the quality of care our patients receive, across both ambulatory and acute care settings. We have implemented a standardized process for clinical pathway development and maintenance to ensure meaningful improvements to patient care as well as systematic continual improvement. Development of a clinical pathway includes a multidisciplinary team, which may include doctors, advanced practitioners, nurses, pharmacists, other specialists, and even patients/families. Each clinical pathway has a flow algorithm, an educational module for end-user education, associated order set(s) in the electronic medical record, and quality metrics that are evaluated regularly to measure the pathway's effectiveness. Additionally, clinical pathways are reviewed annually and updated to ensure alignment with the most up to date evidence. These pathways serve as a guide for providers and do not replace clinical judgment.