High-Risk Spinal Fusion

ALGORITHM 1. Pre-Operative High Risk Spinal Fusion Care Path

Pt undergoing or considering undergoing major spinal or chest wall deformity procedure (e.g., spinal fusion, VEPTR insertion, or magnetic growing rod insertion)

Pre-Op Surgical Assessment (2-6 months prior to surgery)
- Surgeon, spine nurse, patient/family to attend
- Risk vs. benefit analysis, including ethical considerations
- Educate about pathway and surgical procedure
- Discuss possible sub-specialty consults/evaluations

Spine nurse conducts phone follow up with family to complete assessment (RN Spine Pre-op Call flowsheet in Epic)

Spine nurse communicates with care team to determine appropriate consults/evaluations and schedules appointments

Complete Pulmonary consult and other consults/ evaluations as clinically indicated:
- Nutrition
- Cardiology
- Sleep Study
- Others (if indicated)

Pre-op labs:
For ALL patients:
- Complete blood count (CBC)
- Type and screen
- Basic metabolic panel (BMP)
- Serum albumin
- Prealbumin
- Venous blood gas (VBG)
- 25-OH Vitamin D

ONLY IF clinically indicated:
- Serum selenium, serum zinc, and serum folate

Imaging & Tests:
- Chest radiography (CXR)
- Electrocardiogram (EKG)

Other Evaluations as clinically indicated:**
- Sleep study
- Pulmonary function test
- Echocardiogram
- Metabolic

**See pp. 4-5 of the clinical pathway for additional information about determining need for other evaluations.

High Risk Spine Clinic/Discharge Planning Meeting/Anesthesia Evaluation
- ☐ Spine nurse, hospitalist, anesthesiologist, PT, RT, dietician, case manager, & social worker to attend
- ☐ Review the Safe for Surgery Checklist in Appendix D and initiate arrangements for any other consults/tests or post-op home equipment needs
- ☐ Patient/family education

Pre-Admission (1-2 weeks prior to surgery)
- Determine surgical antibiotic prophylaxis (consult Epidemiology/Infection control physician on-call for patients who are currently on antibiotics
- Labs: MRSA/PCR
- Pre-op scoliosis imaging
- Patient/family education
- Confirm that the Safe for Surgery Checklist in Appendix D is complete

Day of Surgery
- Skin assessment
- Labs: Urine pregnancy test for 10+ and/or post-menarchal, Type and Crossmatch, and CBC if clinically indicated
- Pre-op medications: Refer to Table 1 on page 13 and Ortho IP Spinal Fusion Admission Orderset in Epic.

Inclusion Criteria
- Neuromuscular scoliosis **AND/OR** other spinal deformity with underlying chronic conditions.
- Idiopathic scoliosis with co-morbidities **OR** high degree of curvature.
- Others designated as "High Risk" by the Orthopedic Spine Surgery team.

Exclusion Criteria
- Idiopathic Scoliosis with no co-morbidities.
- Adolescent kyphosis.
- Vertical expandable prosthetic titanium rib (VEPTR) expansion.
- Spinal diagnosis related to trauma.
- Others based on clinical judgment by Orthopedic Spine Surgery team.

ALGORITHM 2. Post-Operative High Risk Spinal Fusion Care Path

Orthopedics/Anesthesia team hand off patient to the PICU

PICU manages patient according to clinical status:
- PICU manages ventilator, fluids, nutrition, and labs
- PICU and Surgical teams coordinate pain management
- Orthopedics team manages incision/dressing care, neurovascular assessment, and activity

PICU - Pulmonology Consult:
- PICU team should review pre-operative Pulmonary consult for recommendations
- PICU should consult Pulmonology within 24 hours of extubation for EVERY patient.
- If patient was on non-invasive ventilation at baseline, strongly consider Pulmonology consult PRIOR to extubating.
- Pulmonology to determine need for Respiratory Medical Equipment and begin ordering process early (if not already underway).

PICU - Nutrition and Other Consults:
- PICU team should review pre-operative nutrition recommendations and advance feeding (start via G-tube, NG tube, or oral as clinically indicated)
- PICU team should consult Nutrition Services within 24 hours.
- Other consults as indicated (e.g., Cardiology, Neurology, etc.)

PICU AND/OR Hospitalist (Yellow) Team Clinical Management
(Note: Can be done by either/both teams; NOT dependent on patient location)
- VTE prophylaxis for at risk patients in accordance with VTE Prevention Clinical Pathway. Discuss with surgeons need for enoxaparin if still at risk for VTE.
- Ez-PAP™ treatments for extubated patients
- Cold therapy as needed for pain
- **Post-op labs**: Hemoglobin monitoring, transfusion management, and other labs as indicated (see page 10 for detail on hemoglobin and transfusion criteria).
- **Post-op medications** (e.g., antibiotics, pain medications, others as clinically indicated) as shown in Table 2 (page 14) and the **Ortho IP Spinal Fusion PICU Post-Op Orderset**
- Dressing and incision care per the Surgical Site Infection (SSI) Spine Surgery Bundle
- Ensure adherence to bowel regimen and activity recommendations in green boxes to the right.

PICU Team determines that patient is medically stable for transfer to the floor per usual PICU practice

Hospitalist (Yellow) Team Clinical Management:
- Hospitalist (Yellow) team is the primary team managing the patient on the floor; Orthopedics co-manages these patients.
- Inpatient Service Specialist (ISS) should call Yellow Team to notify them of the patient's arrival on the floor.
- The Yellow Team should communicate with Pulmonology within 24 hours after arrival to the floor. If patient has had a pleural effusion and/or chest tube, Pulmonology must be consulted.
- The Yellow Team should call the Spine Nurse to co-round daily (M-F).

Patient Discharged (see criteria to the right)
- Home care based on clinical need
- Follow up in 4-6 weeks post-op

Inclusion Criteria
- Neuromuscular scoliosis **AND/OR** other spinal deformity with underlying chronic conditions.
- Idiopathic scoliosis with co-morbidities **OR** high degree of curvature.
- Others designated as "High Risk" by the Orthopedic Spine Surgery team.

Exclusion Criteria
- Idiopathic Scoliosis with no co-morbidities.
- Adolescent kyphosis.
- Vertical expandable prosthetic titanium rib (VEPTR) expansion.
- Spinal diagnosis related to trauma.
- Others based on clinical judgment by Orthopedic Spine Surgery team.

Bowel Regimen:
- See Table 2 on page 14 for Suggested Medications for the Post-Operative Period
- Senna/Docusate twice a day
- Polyethylene glycol once a day
- Fleets enema PRN

Activity:

Day of surgery- ALL patients:
- Elevate head of the bed up to 90° as tolerated
- Logroll every 2 hours and as needed.
- Physical therapy twice daily until patient is cleared

Postoperative day 1:

Intubated Patients
- Elevate head of bed up to 90 degrees as tolerated
- Logroll every 2 hours and as needed

Extubated patients: (should be up to chair within 18 hours post-extubation)
- Physical therapy to assist patient to dangle legs over edge of bed and/or get into chair

Postoperative day 2 until discharge:
- Ambulatory patients: Physical Therapy to assist patient with ambulation as tolerated
- Nonambulatory patients: Up to wheelchair using Hoyer lift and/or 1 or 2 person lifts.
- Parent/caregiver should be cleared by Physical Therapy to perform transfers
- Nursing and parent/caregiver should get patient up to wheelchair at least 3-4 times per day, even if patient has been cleared by Physical Therapy

Discharge Criteria:
- Off oxygen or returned to baseline respiratory status and/or stable
- Train caregivers on new home respiratory or other medical equipment
- Tolerating oral/enteral intake
- Voiding
- Has at least one bowel movement
- Pain well controlled with oral/enteral medications and non-pharmacological approaches to pain control (i.e., cold therapy).
- Family trained and comfortable with transfers
- Cleared by physical therapy
- Home care, nursing, PT orders are placed and arranged
- Pulmonary and/or PT equipment needs are met
- Patient or caregiver can verbalize understanding of discharge teaching instructions

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TARGET POPULATION

Inclusion Criteria

- ☐ Patients with neuromuscular scoliosis and/or other spinal deformity with underlying chronic conditions
- ☐ Idiopathic Scoliosis with comorbidities OR high degree of curvature
- ☐ Patients undergoing or considering undergoing major spinal or chest wall deformity procedure, such as spinal fusion (primary or major revision), VEPTR insertion, or magnetic growing rod insertion
- Any other patient designated as "High Risk" by the Orthopedic Spine Surgery team

Exclusion Criteria

- ☐ Idiopathic Scoliosis with no comorbidities
- ☐ Adolescent kyphosis
- ☐ Vertical expandable prosthetic titanium rib (VEPTR) expansion
- ☐ Patients with spinal diagnosis related to trauma
- ☐ The Orthopedic Spine Surgery team may exclude a patient from this pathway if their underlying disease or planned surgery does not justify an escalated level of care.

BACKGROUND

- ☐ This clinical pathway is based on the published Care Pathway for Spine Surgery (CAPSS)1 developed by CHCO.
- ☐ Patients who require major spinal procedures, such as fusions and growing spine implants, often have many co-morbidities in addition to scoliosis.
- Scoliosis surgery requires extensive planning and coordination with the Orthopedic Surgery Team, providers in other disciplines (e.g., pulmonary, hospitalist, anesthesiology, etc.), and the patient's family.
- ☐ Many elements of the process, from pre-operative evaluation and preparation to surgery to post-operative care, are time sensitive and need to have a formal workflow to ensure that all appropriate steps are completed.

Ethical Considerations

The goal of spine surgery for patients with progressive neuromuscular scoliosis is to maintain or improve quality of life. Because of the many associated risk factors in these complex patients, the option of surgical treatment needs to be considered carefully as surgery may not be the best option for every patient/family. The ethical issues surrounding these decisions are multi-faceted and complex. The purpose of this clinical pathway is to evaluate the patient medically, determine risks, and to assess the families' resources and ability to care for the patient once discharged to home. The patient (if able), the parents/caregivers, and the surgeon should all come to a consensus as to whether surgical management is the best option.

PRE-OPERATIVE CLINICAL MANAGEMENT (2-6 MONTHS PRIOR TO SURGERY)

Initial Evaluation

- ☐ Surgeons and spine team will discuss ethical considerations and risk/benefit analysis with patients/families to determine candidacy for spinal surgery.
- ☐ During initial meeting/call with patient and family in orthopedic clinic, discuss the following:
  - Education on the surgical procedure and pathway
  - Ethical issues related to surgical options
  - Unique family resources and factors impacting clinical decision-making
  - Initial assessment of consults that may be needed (cardiology, neurology, pulmonology, nutrition, etc.)
- ☐ Follow-up and complete assessment by phone
  - Complete RN Spine Pre-OP Call flowsheet, including psychosocial assessment, involvement of specialty services, past medical and surgical history, current medications, previous hospitalizations, eligibility for sleep study, and history of UTI.
  - Spine nurse will communicate with surgeon, surgeon's PA, and subspecialists to determine work up as indicated.

Consults

- ☐ Pulmonary consult is indicated for all patients.
- ☐ Nutrition assessment by registered dietician for:
  - Patients with a body mass index (BMI) less than 10% for age or greater than 85% for age
  - Patients on tube feeds or parenteral nutrition at home
  - Patients with known eating disorders, or with diagnosed gastrointestinal conditions
- ☐ Neurology consult is indicated for patients with uncontrolled seizures, severe dystonia, or if parents have questions about seizure medications
- ☐ Acute Pain Service consult is indicated for patients with baseline opioid medication use or history of chronic pain

- ☐ Cardiology as clinically indicated.

Laboratory Studies

The following labs are indicated for all patients:

- ☐ Complete Blood Count (CBC)
- ☐ Type and screen
- ☐ Basic metabolic panel (BMP)
- ☐ Serum albumin
- ☐ Prealbumin
- ☐ Venous blood gas (VBG)
- ☐ 25-OH, Vitamin D

The following labs should be conducted only if clinically indicated:

- ☐ Serum selenium, serum zinc, and serum folate

Imaging & Tests

- ☐ Chest radiography (CXR)
- ☐ EKG

Evaluations

- Sleep Study (if clinically indicated) – to be ordered by Pulmonology 2-3 months prior to surgery.
- ☐ **Pulmonary Function Tests**- for patients with a thoracic scoliosis curve greater than 70º, kyphosis greater than 70º, any planned chest wall violation during surgery, or history of poorly controlled asthma.
- ☐ **Cardiac Evaluation**
  - **For patients with a history of cardiac disease, pulmonary hypertension, or abnormal cardiovascular exam**, The spine nurses or their designee will contact the patient's cardiologist via Epic Inbox to determine whether another visit and/or EKG is indicated prior to surgery. The cardiologist will determine if an echocardiogram is needed and will place the order, arrange for any further evaluations, and make recommendations prior to surgery.
  - **Patients without a history of cardiac disease** will have a screening EKG performed. (Note: congenital scoliosis patients have a higher incidence of cardiac defects[2]. Screening EKG has a high negative predictive value and was deemed appropriate by CHCO Cardiology Department).
    1. As standard CHCO procedure, a cardiologist will review the EKG and document the final interpretation in Epic.
    2. The spine nurses or designee will review the final EKG results.
    3. EKG results will guide the next step in cardiac evaluation:

       If the EKG is normal, no further cardiac evaluation is necessary.

       If the EKG is abnormal, call One Call at 7-3999 and ask for the outpatient cardiologist on call (aka "City Team") to discuss whether an echocardiogram and/or cardiology consult is indicated.

       a. If there is no concern about the abnormal EKG, proceed with pathway.

       b. If a cardiology consult is done, the cardiologist's peri-operative recommendations will be documented in a letter sent to the PCP. If risk is identified, cardiologist will consult with cardiac anesthesiologists to determine possible need for cardiac anesthesia.

c. If the City Team determines an echocardiogram only is indicated, a spine team provider (hospitalist, surgeon or anesthesiologist) should order the echocardiogram.
   - **If the echocardiogram is normal**, a report is documented in Epic and no further cardiac workup is needed
   - **If the echocardiogram is abnormal,** the echocardiogram physician will intervene to ensure appropriate follow up and will communicate with the ordering provider.

d. Any spine team member, including the anesthesiologist, may order an echocardiogram at their discretion even if not recommended by the City Team.

e. When ordering an echocardiogram, ensure that the appropriate provider, nurse, and contact number are included in the order. These details will help the Cardiologist contact the Spine Team in case there is an abnormality.

f. For help on interpreting echocardiogram results, contact the Echocardiogram Reading Room at 720-777-4359.

High Risk Spine Clinic/Discharge Planning/Anesthesia Evaluation

- ☐ Patient/family attends **High Risk Spine/Discharge Planning Meeting/Anesthesia Evaluation**
  - The discharge planning meeting should be attended by representatives from: nursing, respiratory therapy, nutritional services, social work, physical therapy, case management, hospitalist, and anesthesia.
  - Provide families with the preoperative Spine book.
  - Initiate any other consults or diagnostic tests needed and coordinate with family (Refer to Appendix D. Safe for Surgery Checklist)
  - Physical therapy will order/contact DME company about new equipment needed postoperatively.

Parent | Caregiver Education

- ☐ Encourage a well-balanced diet during the pre-operative period. Adequate pre-operative nutrition has been associated with improved healing and decreased infection[3].

PRE-ADMISSION CLINICAL MANAGEMENT (1 - 2 WEEKS PRIOR TO SURGERY)

Preoperative visit

- ☐ Determine surgical antibiotic prophylaxis
  - Consult with **Epidemiology / Infection Control** physician on-call (via phone or email) for recommended surgical antibiotic prophylaxis for patients who are currently on antibiotics.
  - Anesthesiology Pre-Operative Clinic – only for patients who are not seen by an anesthesiologist during the Discharge Planning/High Risk Spine Clinic visit, unless requested by the family.

Laboratory Studies

- ☐ Nasal culture for methicillin-resistant Staphylococcus aureus (MRSA)* is recommended for all patients:
  - *Note current CHCO guideline is to test patients who will undergo spinal fusion and use results to guide surgical prophylaxis. Guideline does not recommend routine treatment of positive MRSA nasal swab results.
  - Preoperative testing and treatment of patients positive for MRSA has been shown to decrease the incidence of postoperative infections[4,5].

Imaging

- ☐ Scoliosis patients: two view spine and bending radiographs as ordered
- ☐ Kyphosis patients: AP lateral bolster radiographs of the thoracic spine

- ☐ Other radiographs as clinically indicated
- ☐ Traction spine film as ordered by provider
- ☐ MRI as clinically indicated

Parent | Caregiver Education

- ☐ Shower and CHG cleanse guidelines - please refer to the Surgical Site Infection Spine Surgery Target Zero Bundle
- ☐ Nil per os NPO guidelines
- ☐ Patients and caregivers should receive 1:1 preoperative teaching approximately 1 week prior to surgery.
- ☐ The surgical procedure is explained and consents are obtained by the provider.
- ☐ It is suggested that patients and caregivers receive a tour of the hospital prior to surgery.

DAY OF SURGERY CLINICAL MANAGEMENT

Assessment

- ☐ Skin assessment to examine skin integrity and presence of pressure ulcers or other concerns.

Laboratory Studies

- ☐ Urine pregnancy test: all females 10 years and older and/or post-menarchal (may be cancelled per anesthesia the morning of surgery)
- ☐ Type and crossmatch
- ☐ CBC if clinically indicated

Pre-Operative Medications

Please refer to Table 1. Suggested Medications for the Pre-Operative Period and refer to the Orderset in Epic: **Ortho IP Spinal Fusion Admission.**

Antibiotics

Please refer to Appendix A. Spine Surgery Patient Algorithm for "Expanded" Surgical Prophylaxis for guidance on antibiotic ordering

- ☐ Cefazolin 30 mg/kg (max of 2,000 mg) IV completion of antibiotic within 60 minutes of surgical incision ***OR***
- ☐ Vancomycin 15 mg/kg (max of 1,000 mg) IV completion of antibiotic within 60 minutes of incision for patients with a beta-lactam allergy, patients colonized or at high-risk for colonization with MRSA, patients over the age of 13, or post-menarchal, or with acne, or with signs of maturity such as pubic hair or breast buds
    - For patients with documented hypersensitivity to vancomycin (Red Mans Syndrome), infuse over 120 minutes and pre-medicate with IV or PO diphenhydramine (see Table 1 for dosing).

AND

- ☐ Ceftriaxone 50 mg/kg (max of 2,000 mg) IV completion of antibiotic within 60 minutes of surgical incision.
- ☐ Levofloxacin 10 mg/kg (max of 500 mg) IV completion of antibiotic within 60 minutes of surgical incision **for patients allergic to ceftriaxone**.
- ☐ Clindamycin 10 mg/kg (max of 900 mg) IV completion of antibiotic within 60 minutes of surgical incision **for patients allergic to vancomycin**.
- ☐ Vancomycin powder for topical use (see Table 1 for dosing).

Other Medications

- ☐ For patients who can swallow pills, administer the following on arrival to the pre-op area. (Please refer to Table 1. Suggested Medications for the Pre-Operative Period for further detail).
  - Gabapentin oral capsule **AND**
  - Acetaminophen oral tablet
- For patients who can't swallow pills, administer the following on arrival to the pre-op area. (Please refer to Table 1. Suggested Medications for the Pre-Operative Period for further detail).
  - Gabapentin oral solution and **IV** acetaminophen

INTRA-OPERATIVE CLINICAL MANAGEMENT

Please refer to the Anesthesiology Protocol for Spinal Fusion Surgeries for further detail.

- ☐ All patients will have a specialized Spine Anesthesiologist for their surgery
- ☐ All patients will have the following lines placed: at least 2 large bore peripheral IVs, arterial line, and central venous catheter

Medications

- ☐ Limit use of volatile anesthetic, terminate use as soon as possible
- Antibiotics- Please refer to Appendix A. Spine Surgery Patient Algorithm for "Expanded" Surgical Prophylaxis
  - Vancomycin infusion should be started after the arterial line is established
  - Other antibiotics should be administered after the patient is flipped prone
  - Redose antibiotics for blood loss and/or elapsed time per Appendix A.
- ☐ Intrathecal morphine
  - 7.5 mcg/kg (maximum dose 500 mcg)
  - If patient has documented obstructive sleep apnea (OSA), decrease dose to 5 mcg/kg (maximum dose 350 mcg)
- ☐ Total intravenous anesthetic (TIVA) with propofol (75-200 mcg/kg/min) and remifentanil (0.05-0.3 mcg/kg/min) infusions
- ☐ Ketamine infusion 0.1-0.4 mg/kg/hr
- ☐ Tranexamic Acid: 10 mg/kg bolus over 30 minutes (maximum 1 gram), then 5 mg/kg/hr
- ☐ Ketorolac 0.5 mg/kg (maximum 30 mg) at end of surgery, if approved by surgeons
- ☐ Acetaminophen re-dose (15 mg/kg) at 6 hours after initial acetaminophen dose
- ☐ Transfusion Management
  - Hemoglobin goal is > 8-9 or hematocrit > 24-27%
  - FFP, platelets, cryoprecipitate- guide use based on thromboelastogram

POST-OPERATIVE CLINICAL MANAGEMENT

Assessment | Monitoring

Initial management following transfer from Orthopedics/Anesthesia Team to the PICU:

- ☐ Upon arrival to PICU, Anesthesiology team and Surgery team give full report and handoff the patient to the PICU team.
- ☐ Admission orders to PICU done by Surgical team. Orders are reviewed and modified by PICU team as needed.
- ☐ PICU manages patient based on clinical status.
- ☐ Ventilator, fluids, nutrition, and labs- managed by PICU.
- ☐ Pain management is coordinated between the PICU and Surgical teams. Multimodal standardized pain management algorithm for spine fusion patients will be followed when appropriate. Final clinical management will be decided by the PICU team.
- ☐ Incision/dressing care, neurovascular assessment, and activity- managed by Surgical team.

Coordination of Specialty Services in the PICU:

- ☐ Pulmonology Consult:
  - PICU team should review preoperative Pulmonology consult for recommendations.
  - PICU should consult Pulmonology within 24 hours of extubation for EVERY patient.
  - If patient was on non-invasive ventilation at baseline, **strongly consider** a pulmonary consult PRIOR to extubating.
  - Determine the need for Respiratory Medical Equipment and, if the patient does not have that equipment at home, begin process of ordering early.
- ☐ Nutrition Consult:
  - PICU should consult Nutrition Service within 24 hours.
  - See preoperative nutrition recommendations and advance feeding. Start via g-tube/NG/oral as clinically indicated.
- ☐ Other Consults as indicated based on individual patient characteristics (e.g. Cardiology, Neurology, etc.)

Daily considerations that apply throughout hospital stay, both in PICU and on floor:

- ☐ Urinary catheter (foley): assess for necessity every day. Reasons to keep the foley include:
  - Patient is unable to ambulate to the bathroom
  - Patient cannot return to baseline diapering
  - Accurate measurement of urine output is needed for clinical decision-making
  - Urinary retention due to opioids
- ☐ Central line (CVC): assess for necessity every day. Reasons to keep central line include:
  - Hemodynamic instability
  - Ongoing need for frequent laboratory draws. Consider that hematocrit and sodium may be checked with finger-stick
  - Ongoing need for medication that cannot be given through peripheral IV, such as Parenteral Nutrition (PN) and lipid emulsion (assess whether patient is tolerating enteral nutrition)
  - Lack of other intravenous access or very high level of concern (provider and parent) about losing and replacing peripheral IVs
- ☐ VTE prophylaxis for at risk patients in accordance with the VTE Prevention clinical pathway. Discuss with surgeons the need for enoxaparin if still at risk for VTE.

- Ez-PAP™ treatments for extubated patients every 4 hours for 24 hours, continued 3 times/day until discharge
  - Local expert consensus supports the use of Ez-PAP™ for prevention of post-operative atelectasis. Refer to the Lung Expansion policy for more information.

- ☐ Cold therapy as needed to decrease pain. Cold therapy unit belongs to the family and should be sent with the patient to floor when transferred. Cold therapy is provided to patients for comfort and not necessarily to manage swelling or drainage
- ☐ Neurovascular checks every 2 hours for 24 hours, then every 4 hours afterward.
- ☐ Elevate head of the bed to 90 degrees as tolerated. Log roll every 2 hours. Dangle on edge of bed or transfer to chair on post-op day 1 or when extubated. Progress to ambulation and/or time in wheelchair as tolerated, minimum 3 to 4 times a day.

Transition of patient from PICU to Hospitalist (Yellow) floor team:

- ☐ PICU team determines when patient is medically stable for transfer to floor per usual PICU practice.
- ☐ Hospitalist (Yellow) team is the primary team when transferred out of PICU to the 6th floor. Ortho co-manages these patients.
  - Inpatient Service Specialist (ISS) should call Yellow Team to notify them of the patient's arrival on the floor.
  - The Yellow Team will communicate with Pulmonology with 24 hours after arrival to the floor. **If the patient has had a pleural effusion and/or chest tube, then a formal Pulmonology consult should be done.**
  - Ensure Durable Medical Equipment (DME) has been ordered.
  - Call the Spine Nurse to co-round daily on Monday-Friday.

Laboratory Studies

The following laboratory studies generally do not vary based on patient location and may be done in the PICU and/or on the floor depending on clinical indication:

- ☐ Hemoglobin monitoring (Blood bank has requested that hemoglobin be monitored. Approximate conversion from hemoglobin to hematocrit is multiplication by 3. Hgb 7 = Hct 21%, Hgb 8 = Hct 24%, etc.)
  - POD #1: All patients have hemoglobin checked
  - POD # 2: Only check hemoglobin if the hemoglobin from POD #1 is < 10
  - POD #3: Only check hemoglobin if the hemoglobin from POD #2 is < 9
- ☐ Transfusion management:
  - Criteria for transfusion of PRBCs: Hemoglobin is < 8 **AND** the patient has symptoms of tachycardia unrelated to pain, hypotension despite euvolemia, dizziness with ambulation, or oxygen requirement.
  - Blood product choice
    - Patient ≤ 25 kg: 10 ml/kg PRBCs
    - Patient > 25 kg: 1 unit PRBCs
  - If considering additional transfusion, recheck hemoglobin and refer to above criteria
- ☐ Other labs to be ordered as clinically indicated by the provider

Medications

Medications generally do not vary based on patient location and may be ordered/administered in the PICU and/or on the floor depending on clinical indication.

- ☐ Please refer to Table 2. Suggested Medications for the Post-Operative Period and refer to **Ortho IP Spinal Fusion PICU Post-op Orderset**

Antibiotics

- Antibiotic should be continued **for only 24 hours** post operatively even if drains are left in place. Please refer to Appendix A. Spine Surgery Patient Algorithm for "Expanded" Surgical Prophylaxis

Pain Medications

- ☐ Patient Controlled Analgesia (PCA) for patients per Patient controlled Analgesia (PCA) Set-up, Administration and Documentation Policy:
  - No basal rate should be ordered due to intrathecal morphine given in OR. Only demand dose should be ordered.
  - If patient unable to utilize PCA button, then order for a PCA nurse bolus only.
  - Discontinue PCA after patient has tolerated 2 doses of oral pain medications.
- ☐ Acetaminophen
  - Oral/NG/GT every 4 hours for 48 hours, then every 4 hours PRN
- ☐ Oxycodone
  - Oral/NG/GT every 4 hours scheduled for 48 hours, then every 4 hours PRN
  - First post-op dose to begin first post-op day at 0900 ("Start PRN dose 4 hours after scheduled dose.")
- ☐ Gabapentin
  - Oral/NG/GT- same dose as pre-op dose three times a day starting on the evening of the surgery day (2100) and continuing through until the evening of the second post-op day, for a total of 7 doses[6,7.]
- ☐ Ketorolac
  - IV scheduled every 6 hours beginning 0900 on the first post-operative day for 48 hours (total of 8 doses), then ibuprofen every 6 hours PRN until discharge
  - Do not give Ketorolac to patients with underlying kidney disease.
- ☐ Diazepam
  - Oral/NG/GT - Every 6 hours PRN for spasms. Use lowest effective dose.

Other Medications

- ☐ Nalbuphine every 3 hours as needed for pruritis
- ☐ Ondansetron every 6 hours for 24 hours, then every 6 hours PRN for nausea
- ☐ Scopolamine patch every 72 hours, for patients 12 years of age and older, for nausea
- ☐ Famotidine IV every 12 hours for 24 hours, then ranitidine PO twice a day for GI prophylaxis

Bowel Regimen

- ☐ Please refer to Table 2. Suggested Medications for the Post-Operative Period
- ☐ Senna/Docusate twice a day
- ☐ Polyethylene glycol once a day
- ☐ Bisacodyl (Magic Bullet) suppository QD
- ☐ Fleets enema every day PRN

Dressing and Incision Care:

- ☐ Please refer to the Surgical Site Infection (SSI): Spine Surgery Target Zero Bundle

Activity:

- ☐ Please consult orthopedic and plastic surgeons for wound care and activity orders.

DISCHARGE

Discharge Criteria:

It is suggested that the following criteria be met prior to discharge:

- ☐ Off oxygen or returned to baseline respiratory status and/or stable
- ☐ If new home respiratory equipment needs to be ordered and obtained, caregivers need to be trained and able to use any new equipment
- ☐ Tolerating oral/enteral intake
- ☐ Voiding
- ☐ Has at least one bowel movement prior to discharge
- ☐ Pain well controlled with oral/enteral medications and non-pharmacological approaches to pain control (i.e., cold therapy)
- ☐ Cleared by physical therapy
- ☐ Family trained and comfortable with transfers and use of any new equipment
- ☐ Home care, nursing, PT orders are placed and arranged
- ☐ Pulmonary and/or PT equipment needs are met
- ☐ Patient or caregiver can verbalize understanding of discharge teaching instructions

FOLLOW-UP

- ☐ Home care: Based on clinical need.
  - Nursing- RN: 2 to 3 visits over first week or two to assess nutrition, skin, respiratory status
  - CNA: as needed or available
  - Physical therapy: 2 to 3 visits to assess and train patient/caregiver on transfers and use of new equipment
- ☐ It is suggested that patient be seen 4 to 6 weeks post-operatively, and then annually from their surgical date. May be more frequent based on provider and clinical need.

TABLE 1. SUGGESTED MEDICATIONS FOR THE PRE-OPERATIVE PERIOD

Medication	Indication	Dose	Frequency	Route	Maximum Dose	Comments
ANTIBOITCS						
Cefazolin	Pre-operative antibiotic prophylaxis for MSSA	30 mg/kg	ONCE Intra-op: re-dose every 4 hours or 50% of dose with one-half blood volume loss	IV	2,000 mg	Complete infusion within 60 minutes before surgical incision
Vancomycin	Pre-operative antibiotic prophylaxis for beta-lactam allergy, MRSA positive, *P. acnes* coverage also for age > 13 years and/or postmenarchal	15 mg/kg	ONCE Intra-op: re-dose every 8 hours or 50% of dose with one-half blood volume loss	IV	1,000 mg	Pre-op dose started within 120 minutes before surgical incision and completed prior to incision. Patients with documented Red Mans Syndrome should receive diphenhydramine pre-medication and 120 minute infusion of vancomycin
Clindamycin	Pre-operative antibiotic prophylaxis for patients allergic to vancomycin	10 mg/kg	ONCE Intra-op: re-dose every 6 hours or 50% of the dose with one half blood volume loss	IV	900 mg	Complete infusion within 60 minutes of surgical incision
Ceftriaxone	Pre-operative antibiotic prophylaxis for gram negative coverage	50 mg/kg	ONCE Intra-op: re-dose 50% of the dose with one half blood volume loss	IV	2,000 mg	Complete infusion within 60 minutes of surgical incision
Levofloxacin	Pre-operative antibiotic prophylaxis for patients allergic to ceftriaxone	10 mg/kg	ONCE	IV	500 mg	Complete infusion within 60 minutes of surgical incision
Topical Vancomycin	For topical use only in the OR	Short segments: 500 mg Segments that include the thoracic OR lumbar curve: 1000 mg Segments that include the thoracic AND lumbar curve: 2000 mg	ONCE	Topical	2,000 mg	
Diphenhydramine	Vancomycin pre-medication for patients with documented Red Mans Syndrome	11-29.9 kg: 12.5 mg 30-50 kg: 25 mg >50 kg: 50 mg	ONCE	PO	50 mg	For patients who cannot swallow pills give: • Diphenhydramine oral liquid 1 mg/kg (max dose 50 mg) **OR** • IV diphenhydramine 1 mg/kg (max dose 50 mg)
PAIN MEDICATIONS						
Gabapentin	Pre-operative pain medication	Capsules: 11-21.9 kg: 5 mg/kg 22-34.9 kg: 100 mg 35- 59.9 kg: 200 mg > 60 kg: 300 mg	ONCE	PO	300 mg	For patients who cannot swallow pills give gabapentin oral solution 5 mg/kg (max dose 300 mg)
Acetaminophen	Pre-operative pain medication	Tablets: 11-16 kg: 162.5 mg	ONCE	PO	650 mg	For patients who cannot swallow pills give IV

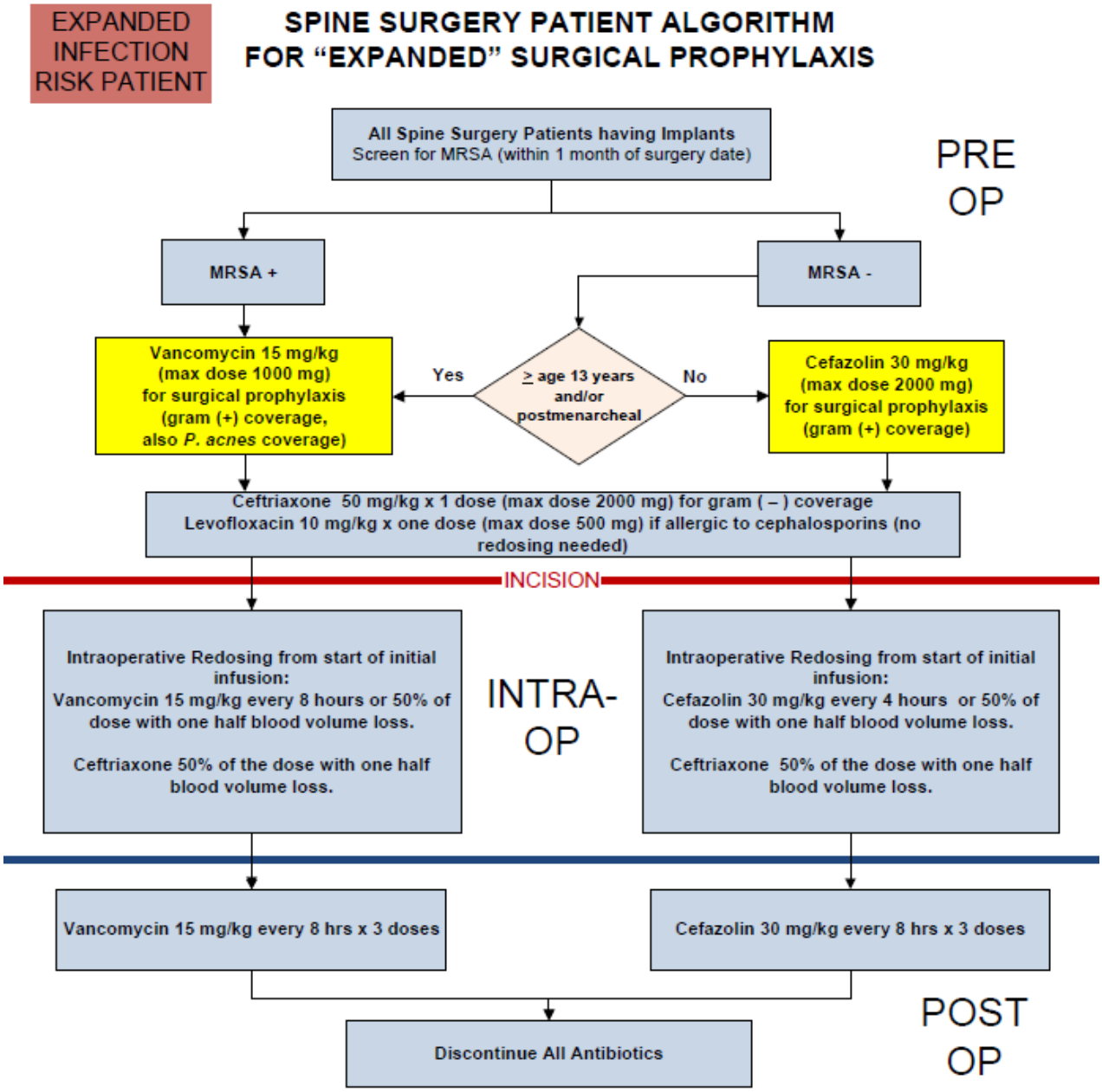
		16.1-21.5 kg: 250 mg 21.6-32.5 kg: 325 mg 32.6-43 kg: 500 mg >43 kg: 650 mg				acetaminophen 15 mg/kg (max dose 650 mg)

TABLE 2. SUGGESTED MEDICATIONS FOR THE POST-OPERATIVE PERIOD

Medication	Indication	Dose	Frequency	Route	Maximum Dose	Comments
ANTIBIOTICS						
Cefazolin	Post-operative antibiotic prophylaxis for MSSA	30 mg/kg/dose	Every 8 hours x 24 hours post-op (3 doses)	IV	2,000 mg	
Vancomycin	Post-operative antibiotic prophylaxis for beta-lactam allergy, MRSA positive, *P. acnes* coverage also for age > 13 years and/or postmenarchal	15 mg/kg/dose	Every 8 hours x 24 hours post-op (3 doses)	IV	1,000 mg	Patients with documented Red Mans Syndrome should receive diphenhydramine pre-medication and 120 minute infusion of vancomycin
Clindamycin	Post-operative antibiotic prophylaxis for patients allergic to vancomycin	10 mg/kg/dose	Every 8 hours x 24 hours post-op (3 doses)	IV	900 mg	
PAIN MEDICATIONS						
Acetaminophen	Mild pain	10-15 mg/kg/dose	Every 4 hours x 48 hours, then every 4 hours prn	Oral	650 mg	Tablet or suspension
Oxycodone	Moderate to severe pain	0.1 to 0.15 mg/kg/dose	Every 4 hours x 48 hours, then every 4 hours prn	Oral	10 mg/dose	Start on post-op day 1 at 0900. Use conservative dosing for patients with OSA (start on the low end of the dosing range)
Ketorolac	• Post-operative, around-the-clock analgesia • Patients on NPO status	0.5 mg/kg/dose	Every 6 hours x 48 hours, then ibuprofen every 6 hours prn pain	IV	30 mg/dose	Maximum duration: 48 hours. Start on post-op day 1 at 0900. Do not use in patients with underlying kidney disease
Ibuprofen	• Mild to moderate pain • Adjunct for more severe pain	10 mg/kg/dose	Every 6 hours prn	Oral	800 mg/dose	Start 6 hours after last ketorolac dose. Do not use in patients with underlying kidney disease
Diazepam	Muscle spasms	0.05 to 0.1 mg/kg/dose	Every 6 hours prn	Oral	4 mg/dose	
Gabapentin	Post-operative pain	5 mg/kg/dose	Three times a day for 7 doses	Oral	300 mg	Capsules or oral solution. Start on evening of surgery.

Nalbuphine	Opioid related pruritis	0.05 mg/kg/dose	Every 3 hours prn	IV	5 mg	
ANTIEMETICS						
Ondansetron	Post-operative nausea/vomiting (PONV)	0.1 mg/kg	Every 6 hours x 24 hours, then q6h prn	Oral or IV	4 mg/dose	May be given undiluted over 2 to 5 minutes when used as a single dose for prevention of PONV
Scopolamine patch	Post-operative nausea/vomiting (PONV)	1 patch	Every 72 hours	Transdermal	1 patch	For patients 12 years and older
ACID BLOCKERS						
Famotidine	Stress ulcer prophylaxis	<3 months: 0.5 mg/kg every 24 hours 3 months and older: 0.5 mg/kg every 12 hours	Every 12 or 24 hours x 24 hours, then ranitidine twice daily	IV	20 mg/dose	
Ranitidine	Stress ulcer prophylaxis	2 mg/kg	Twice daily	Oral	150 mg/dose	
LAXATIVES						
Bisacodyl (Magic Bullet)	Constipation	2 to <12 years: 5 mg 12 years and older: 10 mg	Once daily	Rectally	10 mg/dose	Start on post-op day 2
Fleets enema	Constipation	2 to <4 years: 33 mL 4 to <10 years: 66 mL 10 years and older: 133 mL	Once daily prn	Rectally	2 to <4 years: 33 mL/dose 4 to <10 years: 66 mL/dose 10 years and older: 133 mL/dose	Start on post-op day 2
Senna-docusate (8.6-50mg/tablet)	Constipation	2 to <6 years: ½ tablet 6 to <12 years: 1 tablet 12 years and older: 2 tablets	Twice daily	Oral	2 to <6 years: 1 tablet twice daily 6 to <12 years: 2 tablets twice daily 12 years and older: 4 tablets twice daily	Start on post-op day 1
Sennosides 8.8mg/5ml syrup	Constipation	2 to <6 years: 4.4 mg (2.5 mL) 6 to <12 years: 8.8 mg (5 mL) 12 years and older: 17.6 mg (10 mL)	Twice daily	Oral	2 to <6 years: 6.6 mg (3.75 mL) twice daily 6 to <12 years: 13.2 (7.5 mL) mg twice daily 12 years and older: 26.4 mg (15 ml) twice daily	Start on post-op day 1
Polyethylene glycol 3350 oral powder	Constipation	0.5-1.5 g/kg/dose Standard dosing: 4.25 g, 8.5 g, 17 g	Once daily	Oral	17 g	Start on post-op day 1

APPENDIX A. SPINE SURGERY PATIENT ALGORITHM FOR "EXPANDED" SURGICAL PROPHYLAXIS



Antibiotic Dosing *:	Antibiotic Dosing for Allergies*:
Cefazolin 30 mg/kg (max dose 2000 mg) Vancomycin 15 mg/kg (max dose 1000 mg) →	Clindamycin 10 mg/kg (max dose 900 mg)(redosing every 6 hrs or 50 % of dose with one half blood volume loss)
Pre-op dose started within 120min. before incision and completed prior to incision. Ceftriaxone 50 mg/kg (max dose 2000 mg) →	Levofloxacin 10 mg/kg (max dose 500 mg) – no redosing

If prolonged antibiotics in the previous 3 months antibiotics (IV and/or >2 days po) consult Epi MD for gram negative recommended surgical prophylaxis

*Applies to patients with normal renal and hepatic function. Otherwise consult Pharmacy

kp 6/21/2016

APPENDIX B. ASSSESSMENT OF ELIGIBILITY FOR PRE-OP SLEEP STUDY

Note: This assessment is completed by the Spine Nurses as part of the RN Spine Pre-Op Call flowsheet.

Evaluation Questions

1. Has your child had a sleep study? If yes, when and where?
2. Has your child used oxygen at home? If yes, When?
3. Does your child use CPAP or BiPAP? Have you even been told they need it?
4. Does your child snore, stop breathing at night, gasp at night?
5. Has your child had breathing or oxygen problems after surgery?

Scoring rubric for high risk spine sleep study evaluation:

- ☐ If yes to 1: need date and results. If has sleep disordered breathing, needs to see sleep clinic if not seen in the last year. If does not have sleep disordered breathing, answer questions 2-5 and see below.
- ☐ If no to 1, but yes to 2, 3, or 4: sleep study is indicated; Spine RN to send note to pulmonology via Epic In Basket. Pulmonology will review the note and order a sleep study if indication is confirmed.
- ☐ If no to 1-4, but yes to 5: see pulmonary; RN to send note to pulmonology via Epic InBasket. Pulmonology will review the note and order a sleep study if indication is confirmed.

APPENDIX C. EVALUATION OF NEED FOR PRE-ADMISSION URINE ANALYSIS AND/OR CULTURE

Obtain UA and/or culture preoperatively (7-14 days preoperatively) on all patients who have ANY of the following:

Spina bifida – UA and culture

Routine intermittent straight cath programs – UA and only obtain culture if positive UA as described

A history of UTI (with in the past 3 months) – UA and only obtain culture if positive UA as described

Are currently symptomatic - UA and culture

Evaluate all other high risk spinal fusion patients using the following questions:

- Do you have a history of urinary tract infections (UTIs)? If yes, when was the most recent UTI?

  Answer: NO – No urinalysis (UA) is needed

  Answer: YES – Clean catch UA and hold for culture if positive

- Do you currently have any frequency, burning or foul-smelling urine?

  Answer: NO – No UA is needed

  Answer: YES – Clean catch UA and culture

  Note: If UA is suggestive of UTI, a urine culture should be obtained and appropriate antibiotic coverage should be initiated

Refer to the Urinary Tract Infection clinical pathway for guidance on interpreting UA results.

APPENDIX D. SAFE FOR SURGERY CHECKLIST

This checklist will be completed by the spine nurses as part of the pre-op assessment process. Not all items are the responsibility of the spine nurse, but spine nurses will review to ensure all have been completed prior to surgery. This checklist is included as an example and will be updated/modified per the discretion of the spine nurses.

Patient Name			
MRN #			
DOS			
Surgeon			
Consult	**Completed**	**Recommendations**	**Follow up Needed**
Sleep Study			
Pulmonary			
Cardiology/EKG: If EKG abnormal has further work up been done?			
Nutrition			
Lab Work			
Pediatric Surgery (if chest tube is placed)			
Imaging studies			
Psych/mental health			
Other			
Developmental Level			
Pain Plan/Use PCA?			
Cooperate with lung expansion?			
Communication level			
Home Care/Equipment			
Home Care availability			
Wheelchair			
Bath Chair			
BiPap/Cpap			
Hospital Bed			
Has family received equipment and/or family aware it has been ordered?			
Other			
D/C plan for care			
Custody and care determined			
Home assessed for current mobility			

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CLINICAL IMPROVEMENT TEAM MEMBERS

Mindy Cohen, MD | Anesthesiology
Elise Benefield, RN, MSN, CPN | Program Coordinator, Orthopedic Spine Program
Suzy Evans, RN, BSN, CPN | Spine Nurse
Jason Zamkoff, MD | Hospital Medicine
Zachary Van Rheen, MD | Pediatric Critical Care
Lisa McLeod, MD | Hospital Medicine
Oren Kupfer, MD | Pulmonology
Gwen Kirby, MD | Pulmonology
Christine Baumgartner, PharmD, BCPPS | Clinical Pharmacist Specialist
Rachel Lovria, PharmD | Clinical Pharmacist
Jessica Cataldi, MD | Infectious Diseases
Sarah Nickels, PhD, MSW | Clinical Effectiveness

REVIEWED BY THE FOLLOWING EXPERTS

Elizabeth Staffieri, Parent Partner
Ada Koch, PharmD, Manager, Clinical Pharmacy Services
Kelly Capocelli, MD, Medical Director | Transfusion Medicine Services, Pediatric Pathology
Chris Nyquist, MD, MSPH | Epidemiology
Bruce Landeck, MD, Cardiology
Sumeet Garg, MD, Orthopedics
Sarah Parker, MD, Pediatric Infectious Diseases | Medical Director of Antimicrobial Stewardship
Christine MacBrayne, PharmD, Antimicrobial Stewardship
Janelle Statham, Physical Therapy
Jessica Proctor, Physical Therapy

APPROVED BY

Clinical Pathways and Measures Committee – February 19, 2018
Antimicrobial Stewardship – January 2018
Pharmacy & Therapeutics Committee – date here

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APPROVED BY	Lalit's signature here

REVIEW | REVISION SCHEDULE

Scheduled for full review on (4 years from date of CGMC approval).

Children's Hospital Colorado • Anschutz Medical Campus • 13123 East 16th Avenue • Aurora, CO 80045 • 720-777-1234 • childrenscolorado.org