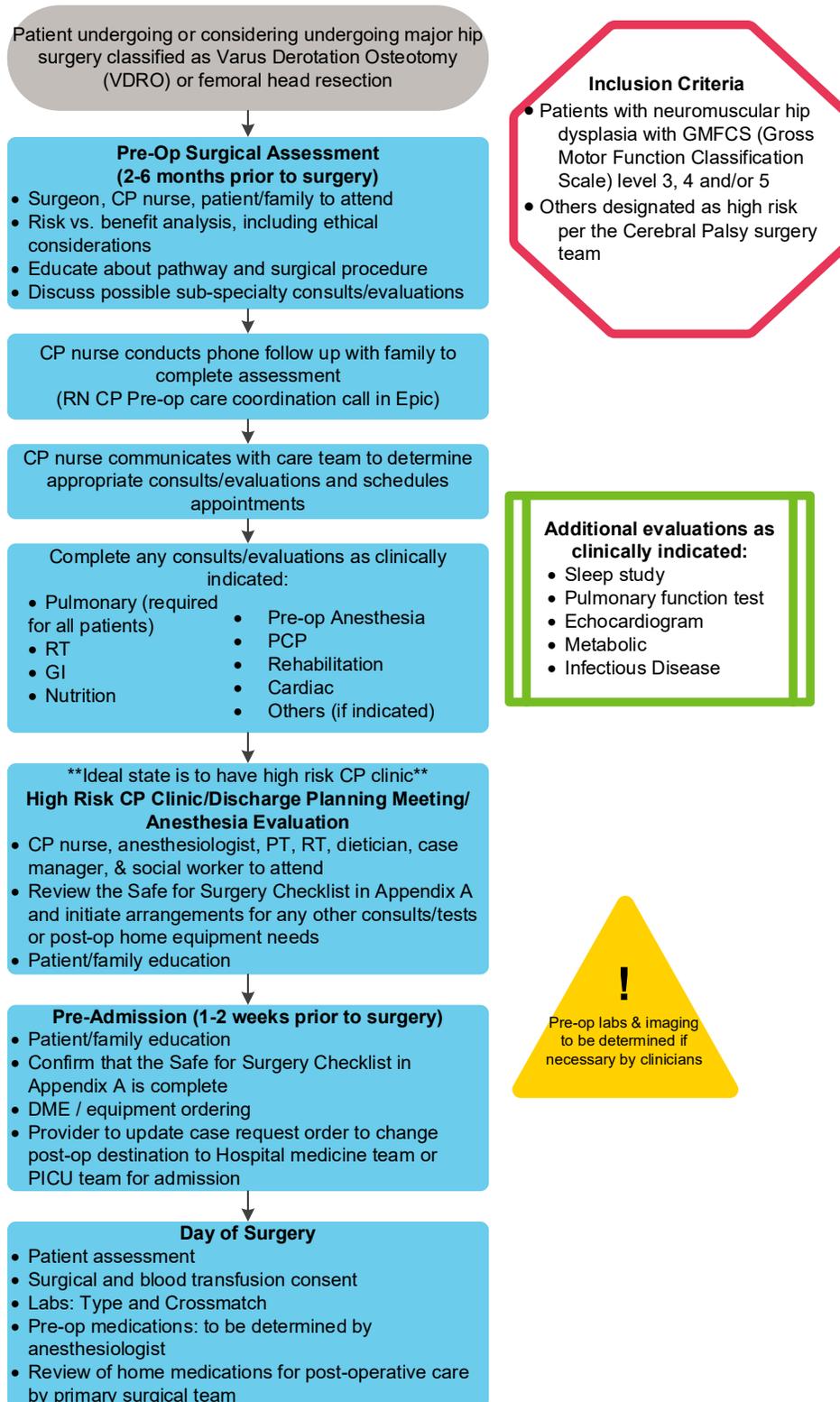
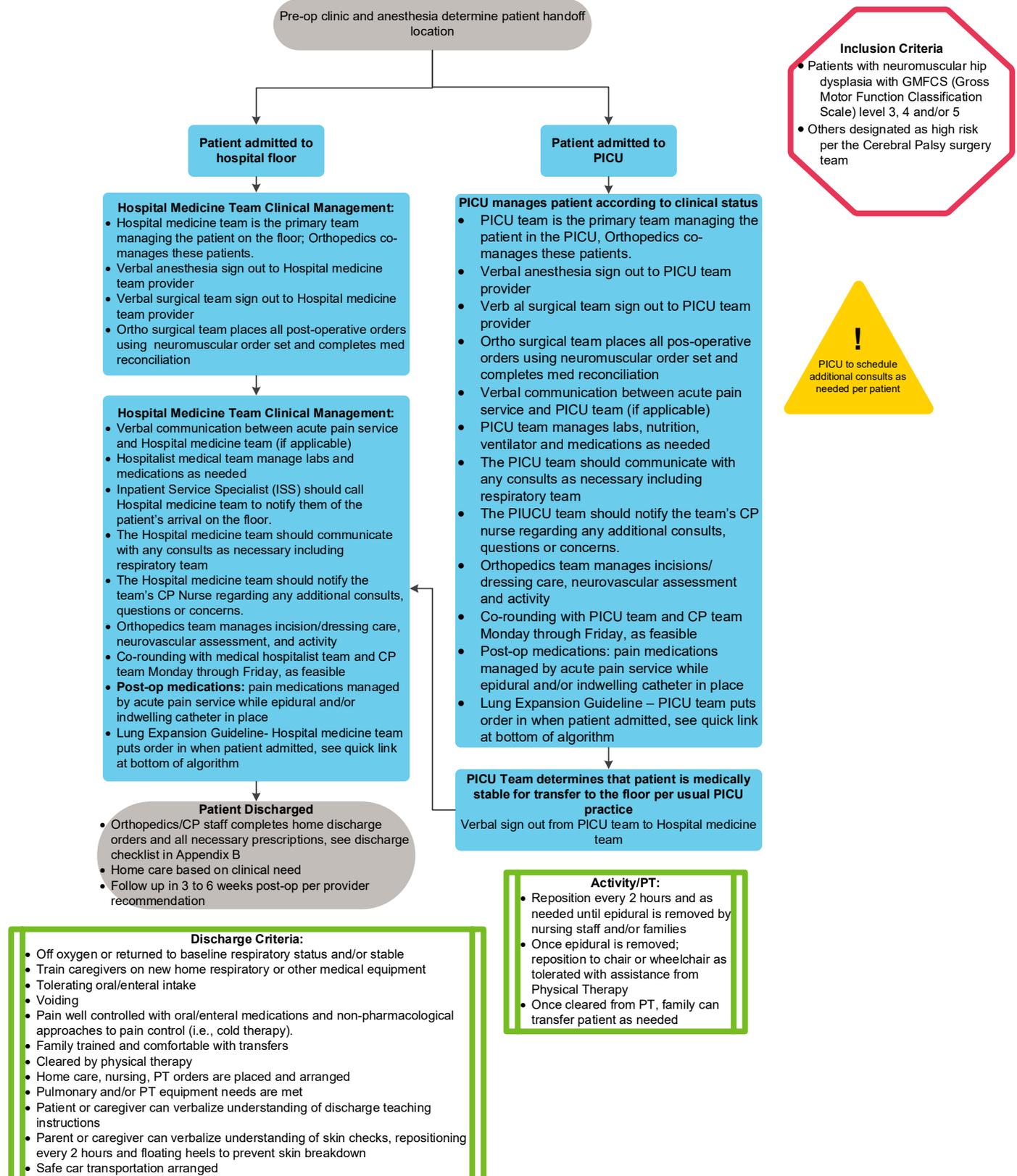


# High Risk Cerebral Palsy (for VDRO Surgery) Clinical Pathway

## ALGORITHM 1. Pre-operation



## ALGORITHM 2. Post-operation



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## TARGET POPULATION

### Inclusion Criteria

- Patients with neuromuscular hip dysplasia with Gross Motor Function Classification Scale level 3, 4 and/or 5
- Others designated as high risk per the cerebral palsy surgery team

## BACKGROUND | DEFINITIONS

This clinical pathway is based on the published Care Pathway for VDRO surgery developed by CHCO.

Patients who require major hip surgery, such as the VDRO procedure, often have many co-morbidities in addition to hip dysplasia.

VDRO 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 hip surgery for patients with progressive neuromuscular hip dysplasia 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. If the parents/caregivers, surgeon and patient (if able) cannot come to a consensus about surgical management, then an Ethics Committee consult could be considered, otherwise, this decision is left to the patient (if able), the parents/caregivers and the surgeon.

Clinical management: Pre op surgical assessment (2-6 months prior to surgery) Surgeons and CP team will discuss ethical considerations and risk/benefit analysis with patient/families to determine candidacy for hip surgery.

During initial meeting 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 CP RN Pre-Op call under a patient outreach encounter, including psychosocial assessment, involvement of specialty services, past medical and surgical history, current medications, previous hospitalizations, eligibility for sleep study and history of UTI.
- CP nurse will communicate with surgeon, surgeon's PA and subspecialties to determine work up as indicated.

## Consults

- Pulmonary consult is indicated for all patients undergoing major hip surgery to ensure a safe plan of care for patient's entire course of surgery and hospitalization.
- Nutrition assessment by registered dietician for:
  - Patients with 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 diagnosed gastrointestinal conditions
- Neurology consult is indicated for patients with uncontrolled seizures, severe dystonia, or if parents have questions about seizure medications
- Rehabilitation for tone management prior to surgery.
- PCP as clinically indicated when not seeing any subspecialty providers (i.e. nutrition, rehab)
- Cardiology as clinically indicated for patients who have a history of cardiac disease, pulmonary hypertension or abnormal cardiovascular exam.
- Pre-op anesthesia clinic is indicated for all patients undergoing major hip surgery to ensure a safe plan of care for intra-operatively and immediately post-operatively.

## Evaluations

- All further evaluations to be determined by consulting providers as clinically indicated per patient.
  - Sleep study
  - EEGs
  - EKGs
  - Pulmonary function tests
  - Additional labs
  - Further consults with others provider
  - Stress dose steroids

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

### Preoperative education class

- Virtual or in person based on family preference/current restrictions
  - Parent/Caregiver education
  - DME equipment ordering/disposition
  - Any barriers within the home (stairs, multiple homes etc) assessed and appropriate revisions/equipment ordered to accommodate needs of patient post-operatively
  - Transportation needs assessed/ordered (i.e. car seat)

## CONFIRM THE SAFE FOR SURGERY CHECKLIST IS COMPLETE (SEE [APPENDIX A](#) FOR REFERENCE)

### Day of surgery

- Patient assessment by PA/OR staff
- Surgical and blood transfusion consents signed by PA
- Labs: type and crossmatch to be done in OR
- Pre-op medications: to be determined by anesthesiologist
- Review of home medications for post op care by PA
- Call to Hospital medicine team OR PICU to notify them of pending admission

## INTRA-OPERATIVE CLINICAL MANAGEMENT

- Intra-operative clinical management to be determined by anesthesia team day of surgery or as indicated with pre-operative anesthesia appointment.

## POST-OPERATIVE CLINICAL MANAGEMENT

### Assessment/Monitoring

- Initial management following transfer from Orthopedics/Anesthesia Team to the Hospital team:
  - Hospital medicine team is the primary team managing the patient on the floor; Orthopedics co-manages these patients.
  - Verbal anesthesia sign out to Hospital medicine team provider.
  - Verbal surgical team sign out to Hospital medicine team provider.
  - Surgical team places all post-operative orders using neuromuscular order set and completes med reconciliation
  - Verbal communication between acute pain service and Hospital medicine team (if applicable)
  - Hospital medicine team manages labs and medications as needed
    - Inpatient Service Specialist (ISS) should call Hospital medicine team to notify them of the patient's arrival on the floor.
  - The Hospital medicine team should communicate with any consults as necessary including respiratory team.

- The Hospital medicine team should notify the team's CP Nurse regarding any additional consults, questions or concerns.
- Orthopedic team manages incision/dressing care, neurovascular assessment, activity
- Co-rounding with Hospital medicine team and CP team Monday through Friday, as feasible
- Post-op medications: pain medications managed by acute pain service while epidural and/or indwelling catheters in place.
- Lung expansion guideline – Hospital medicine team puts order in when patient admitted

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

- PICU team is the primary team managing the patient in the PICU, Orthopedics co-manages these patients.
- Verbal anesthesia sign out to PICU team provider.
- Verbal surgical team sign out to PICU team provider.
- Surgical team places all post-operative orders using neuromuscular order set and completes med reconciliation
- Verbal communication between acute pain service and PICU team (if applicable)
- PICU team manages labs, nutrition, ventilator and medications as needed
- PICU team should communicate with any consults as necessary including respiratory team
- The PICU team should notify the team's CP nurse regarding any additional consults, questions or concerns.
- Orthopedic team manages incision/dressing care, neurovascular assessment, activity
- Co-rounding with PICU team and CP team Monday through Friday, as feasible
- Post-op medications: pain medications managed by acute pain service while epidural and/or indwelling catheters in place.
- Lung expansion guideline – PICU team puts order in when patient admitted

### **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 extubating 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.
  - Other Consults as indicated based on individual patient characteristics (e.g. Cardiology, Neurology, nutrition etc.)

### **Transition of patient from PICU to Hospital medicine floor team:**

- PICU team determines when patient is medically stable for transfer to floor per usual PICU practice.
- Verbal sign out from PICU team to Hospital medicine team

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

- Please reach out to the team CP RN with any questions or concerns.
- Urinary catheter (foley):
  - Daily and every shift cares
  - Foley to remain in place until Epidural is discontinued, then foley can be discontinued
- Respiratory team to round on patient daily, make assessment and treatment recommendations based on patient's individual needs.
- Local expert consensus supports the use of Ez-PAP™ for prevention of post-operative atelectasis. Refer to the [Lung Expansion guideline](#) for more information.
- Neurovascular checks every 2 hours for 24 hours, then every 4 hours afterward.
- Repositioning patient every 2 hours in bed.
- Ensure abduction pillow is in place appropriately.
  - Abduction pillow is to remain in place at all times, exceptions include:
    - Patient has a very large bowel movement that requires full body clean up/abduction pillow is soiled.
    - Abduction pillow can be pulled down legs for diaper changes, ADLs or as needed with car seat positioning and then replaced to proper positioning when done.
  - Skin checks every 2 hours when repositioning.
    - Sacral dressing to patient's sacrum to prevent pressure sores
    - Check skin under knee immobilizers (if applicable)
    - Consider consulting wound care nurse for an Evaluation due to high risk of PI.
    - Float heels off bed at all times
  - Work on transfers to and from wheelchair and bed once epidural has been removed with Physical therapy.
  - Once physical therapy clears family/patient, continue to reposition patient in bed and make transfers to wheelchair and bed as tolerated OR every 2 hours.
  - Nutrition for GT/GJ feeds:
    - See [PICU Enteral Nutrition Guidelines](#)
    - Advance diet slowly/as tolerated by patient.
    - Consider starting with water/Pedialyte and then starting at half rate with formula to ensure patient can tolerate feeds without nausea/vomiting

## Transition of patient from PICU to Hospital medicine floor team:

- PICU team determines when patient is medically stable for transfer to floor per usual PICU practice.
- Hospital medicine 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 Hospital medicine team to notify them of the patient's arrival on the floor.
- The Hospital medicine 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 CP 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.)
  - o POD #1: All patients have hemoglobin checked
  - o POD # 2: Only check hemoglobin if the hemoglobin from POD #1 is < 10
  - o 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 euvoemia, dizziness with ambulation, or oxygen requirement.
    - Blood product choice
    - Patient ≤ 25 kg: 10 ml/kg PRBCs
    - Patient 25 to 49 kg: 1 unit PRBCs
    - Patient over 50kg: 2 unit PRBCs
  - If considering additional transfusion, recheck hemoglobin and refer to above criteria
- Other labs to be ordered as clinically indicated by the provider

## THERAPEUTICS

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

### Antibiotics

Order antibiotics for routine orthopedic post-operative prophylaxis. Antibiotic should be continued for only 24 hours post operatively even if drains are left in place.

- Cefazolin
  - 30 mg/kg/dose (max 2000 mg/dose) intravenous every 8 hours for 3 doses
- For cephalosporin allergy, use clindamycin
  - 10 mg/kg/dose (max 900 mg/dose intravenous every 8 hours for 3 doses

### Antiemetics

Indicate first line, second line and third line antiemetics using the Ortho IP Neuromuscular order set

- Ondansetron
  - 0.1 mg/kg/dose (max: 4 mg/dose) every 6 hours PRN
  - Available as intravenous injectable, oral solution, \*ODT\* oral disintegrating tablet, tablet
- Promethazine
  - 0.25-1 mg/kg/dose (max: 25 mg/dose) every 6 hours PRN
  - Available as intravenous injectable, oral syrup, tablet
- Metoclopramide
  - 0.1 mg/kg/dose (max: 10 mg/dose) every 6 hours PRN
  - Available as intravenous injectable, oral syrup, tablet

- Diphenhydramine
  - 0.5-1 mg/kg/dose (max: 50 mg/dose) every 6 hours PRN
  - Available as intravenous injectable, oral liquid, tablet

### Pain Medications

- Acetaminophen
  - 10-15 mg/kg/dose (max: 650 mg/dose) Oral/NG/GT every 4 hours for 48 hours, then every 4 hours PRN
- Ketorolac
  - 0.5mg/kg/dose (max: 30 mg/dose) intravenous every 6 hours for 48 hours (total of 8 doses) to start POD#2 once the epidural is turned off, then ibuprofen 10mg/kg/dose (max: 800mg/dose) every 6 hours PRN until discharge (Oral/NG/GT)
- Oxycodone
  - 0.1-0.15 mg/kg/dose (max: 10 mg/dose) Oral/NG/GT every 4 hours scheduled for 48 hours starting once the epidural is turned off, then every 4 hours PRN
  - Available as oral liquid, tablet
- Morphine
  - 0.05-0.1 mg/kg/dose (max: 4 mg/dose) intravenous every 2 hours PRN for severe pain not controlled by acetaminophen, NSAIDS or enteral opioids
- Hydromorphone
  - 0.005-0.015 mg/kg/dose (max: 1 mg/dose) intravenous every 3 hours PRN severe pain not controlled by acetaminophen, NSAIDS or enteral opioids

### Muscle Relaxants

- Diazepam
  - 0.05-0.1 mg/kg/dose (max: 4 mg/dose) Oral/NG/GT every 6 hours PRN for spasms
  - Available as intravenous injectable, oral solution, tablet

### Other Medications

- Nalbuphine
  - 0.05 mg/kg/dose (max: 5 mg/dose) every 3 hours as needed for pruritis if hydromorphone is in epidural

### Bowel Regimen

- Docusate sodium
  - 2 to less than 12 years: 50 to 150 mg/day in single or divided doses
  - 12 years and older: 50 to 360 mg/day in single or divided doses
  - Available as oral liquid or capsule
- Senna/Docusate 8.6/50 mg tablet
  - 2 to less than 6 years: ½ tablet twice a day (max: 1 tablet/dose)
  - 6 to less than 12 years: 1 tablet twice a day (max: 2 tablets/dose)
  - 12 years and older: 2 tablets twice a day (max: 4 tablets/dose)
- Polyethylene glycol
  - 0.5-1.5 g/kg/dose (max: 17 g/dose) once a day

- Available as powder for oral solution; Round dose to standardize dosing of 4.25 g, 8.5 g or 17 g
- Bisacodyl (Magic Bullet) suppository
  - 2 to less than 12 years: 5 mg once a day PRN (max: 10 mg/dose)
  - 12 years and older: 10 mg once a day PRN (max: 10 mg/dose)
- Fleets enema
  - 2 to less than 4 years: 33 mL once a day PRN
  - 4 to less than 10 years: 66 mL once a day PRN
  - 10 years and older: 133 mL once a day PRN

## PARENT | CAREGIVER EDUCATION

- Education begins during clinical visit when surgical intervention is determined, 3-6 months prior to actual surgical date.
  - Provider to explain diagnosis and surgical interventions. Education to include risks and outcomes of surgery vs no surgical intervention.
  - Nurse for team will provide initial verbal education at time of clinic visit and provide family with educational handbook.
  - Handbook includes both pre-surgical and post-surgical information.
  - At clinic visit or via outreach encounter, team RN will review CP Surgical Preparation Form, including involvement of specialty services, past medical and surgical history, current medications, previous hospitalizations, and equipment needs.
  - RN will communicate with surgeon, surgeons PA, and subspecialists to determine work up as indicated.
  - One time per month, and no more than 4 weeks prior to surgery, families will participate in online/in person class with other families undergoing VDRO surgery.
  - Class to be coordinated and conducted by team RN.
  - RN and family to review educational handbook, ask questions, and meet other families.
  - Team RN to contact family approximately 7-10 days prior to surgery to review questions and send orders for equipment needs.

## 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
  - 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.
- CP team nurse calls patient 24-72 after discharge from hospital to check on family and patient and to answer any questions
- Physical therapy to start 6 weeks post-operatively



## Appendix B : Discharge Checklist

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

<b>Ready for Discharge Checklist</b>			
<b>Goals to be met for discharge</b>	<b>Yes</b>	<b>No</b>	<b>In Process</b>
Ensure home discharge orders and all home prescriptions are completed.			
Ensure patient is off oxygen or back to baseline			
If not off oxygen, ensure home oxygen orders are done			
Tolerating oral/enteral intake			
Voiding			
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			
Home care orders placed and arranged if applicable (i.e., nursing, therapy)			
All equipment needs are met (PT, RT)			
Parent or caregiver can verbalize understanding of skin checks, repositioning every 2 hours and floating heels to prevent skin breakdown			
Parent or caregiver can verbalize understanding of discharge teaching instructions			
Safe car transportation arranged			

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## REFERENCES

1. Brooks, J. T., Yaszay, B., Bartley, C. E., Bastrom, T. P., Sponseller, P., Shah, S. A., . . . Newton, P. O. (2019). Do All Patients With Cerebral Palsy Require Postoperative Intensive Care Admission After Spinal Fusion? *Spine Deformity*, 112-117.
2. Cooper, T., Harris, B., Mourad, A., Garros, D., & El-Hakim, H. (2017). Comparison between selective and routine intensive care unit admission post-supraglottoplasty. *International Journal of Pediatric Otorhinolaryngology*, 90-94
3. Galvez, J. A., Yapor, M., Maeder-Chieffo, S., Simpao, A. F., Tan, J. M. Wasey, J. O., . . . Rehman, M. (2019). STBUR: Sleep trouble breathing and unrefreshed questionnaire: Evaluation of screening tool for postanesthesia care and disposition. *Paediatrics Anaethia*, 821-828.

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Clinical Pathways and Measures Review Committee – September 27, 2021  
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## REVIEW | REVISION SCHEDULE

Scheduled for full review on September 27, 2025.

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