Blood Transfusion Guideline for Preterm Infants in the Neonatal Intensive Care Unit (NICU)

Policy #:	16.07.210
Issued:	December 2018
Reviewed/Revised:	1/2022, 12/2024
Section:	Maternal Child Health

Purpose:

This policy will outline criteria for the transfusion of packed red blood cells (PRBC) for preterm infants admitted to the Neonatal Intensive Care Unit (NICU) at Boston Medical Center (BMC).

Policy Statement:

1. Due to a possible theoretical relationship between PRBC transfusion and subsequent development of necrotizing enterocolitis (NEC) in infants, the NICU at BMC pursues a policy to limit feeds during PRBC transfusion.
2. Infants at increased risk for NEC include:
   Birth weight <1500gms (VLBW)
   VLBW <34 weeks corrected age
3. Clinical judgement may determine an alternative plan of care for feeding during PRBC transfusion per the discretion of the neonatologist.

Application:

All preterm infants in the NICU requiring PRBC transfusion.

Exceptions:

None

Equipment:

None

Procedure:

A. **For one aliquot of PRBC transfusion over 3 hours**
   1. Three hours before transfusion infant receives last feeding and then is NPO
      - Place saline lock if infant does not have one in place prior to feeding
      - Feed infant
      - Start IV fluid of D10W with 2meq NaCl/100ml and 1meq KCl/100 ml at 120 ml/kg/day after feeding is completed
   2. Begin PRBC transfusion three hours following last feeding
      - Stop D10W infusion during transfusion and use same IV site to administer transfusion
   3. Administer PRBC 15ml/kg transfusion over 3-4 hours
   4. Check point of care blood glucose two hours after starting blood transfusion

- If infant is hypoglycemic contact neonatology physician for treatment plan

5. Restart IV fluids at 120ml/kg/day once transfusion is complete and infuse for three hours
6. Three hours after transfusion is complete, discontinue IV fluid and resume feedings at previous amount and caloric density

Example of one aliquot PRBC transfusion timeline (NPO for nine hours):

- 0800: saline lock placed, infant is fed over 30 minutes
- 0830: infant is now NPO and IV fluid is started
- 1100: stop IV fluid and start PRBC transfusion - same IV is used for blood transfusion
- 1300: blood glucose check
- 1400: PRBC transfusion complete and IV fluid restarted
- 1700: infant feedings resume

B. For two aliquots of PRBC transfusion each aliquot transfused over three hours:

1. Three hours before transfusion infant receives last feeding and then is NPO
   - Place saline lock if infant does not have one in place prior to feeding
   - Feed infant
   - Start IV fluid of D10W with 2meq NaCl/100ml and 1meq KCl/100 ml at 120 ml/kg/day after feeding is completed
2. Begin first aliquot of PRBC transfusion three hours following last feeding
   - Stop D10W infusion during transfusion and use same IV site to administer transfusion
3. Administer PRBC 10-15ml/kg transfusion over 3-4 hours
4. Check point of care blood glucose two hours after starting blood transfusion
   - If infant is hypoglycemic contact neonatology physician for treatment plan
5. Restart IV fluids at 120ml/kg/day once transfusion is complete and infuse for three hours
6. Three hours after transfusion is complete, stop IV fluid and start second aliquot of PRBC transfusion
7. Administer PRBC 10-15ml/kg transfusion over 3-4 hours
8. Check point of care blood glucose two hours after starting second aliquot of PRBC transfusion
   - If infant is hypoglycemic contact neonatology physician for treatment plan
9. Restart IV fluids at 120ml/kg/day once transfusion is complete and infuse for three hours
10. Three hours after transfusion is complete, stop IV fluid and resume feeds at previous amount and caloric density

Example of two aliquots PRBC transfusion timeline (NPO for 18 hours):

- 0800: saline lock placed, infant is fed over 30 minutes
- 0830: infant is now NPO and IV fluid is started
- 1100: stop IV fluid and start first aliquot PRBC transfusion - same IV is used for blood transfusion
- 1300: blood glucose check
- 1400:PRBC transfusion complete and IV fluid restarted
- 1700: stop IV fluid and start second aliquot PRBC transfusion
- 1900: blood glucose check
- 2000: PRBC transfusion is complete and IV fluid is restarted
- 2300: infant feedings resume

C. Hematocrit threshold for transfusion for infants <34 weeks GA at birth:

Clinical Status	Age		
	0-7 days	7-15 days	>15 days
Respiratory support	<32	<29	<25
No respiratory support	<29	<25	<21

For infants >34 weeks GA at birth decision per attending discretion.

Consider a liberal transfusions threshold per attending discretion for:

- Potential signs of symptomatic anemia
  -Sustained tachycardia >180 for 24 hours
  -Poor growth
  -Significant apnea (considered as >6 spells in a 24 hours period) not responsive to caffeine bolus.
- Critical congenital heart disease or respiratory failure
- Chronic pulmonary overflow and congestive heart failure
- Elevated lactate
- Prior to procedure or active bleeding (including intra-cranial bleeds)
- PPHN
- Hemodynamic instability requiring pressors
- Hemolytic disease of the infant
- Fetal maternal hemorrhage
- Congenital anemia

Responsibility:

RN, MD/DO

Clinical Information:

1. The goal for the infant is to remain NPO during transfusion for neonates at risk for NEC (<1500 gms, <34 weeks corrected age)
2. D10W with 2meq NaCl/100ml and 1meq KCl/100 ml should be IV fluid infused unless infant is < 24 hours of life or at discretion of neonatology physician
3. Standard PRBC transfusion will be 10-15ml/kg over 3 hours
4. Low moisture oral swabs with breastmilk maybe given during period of NPO

Forms:

None

Other Related Policies:

03.34.000 - Administration of Blood Components

Initiated by:

Neonatology

Reviewed by:

Perinatal committee

References:

Franz, A. R., Engel, Poets, C. F. (2020). Effects of Liberal vs Restrictive Transfusion Thresholds on Survival and Neurocognitive Outcomes in Extremely Low-Birth-Weight Infants: The ETTNO Randomized Clinical Trial. JAMA : The Journal of the American Medical Association, 324(6), 560–11.

https://doi.org/10.1001/jama.2020.10690

Kirpalani, H., Bell, E. F., Hintz, S. R., Tan, S., Schmidt, B., Chaudhary, A. S., Johnson, K. J., Crawford, M. M., Newman, J. E., Vohr, B. R., Carlo, W. A., D'Angio, C. T., Kennedy, K. A., Ohls, R. K., Poindexter, B. B., Schibler, K., Whyte, R. K., Widness, J. A., Zupancic, J. A. F., … Das, A. (2020). Higher or Lower Hemoglobin Transfusion Thresholds for Preterm Infants. The New England Journal of Medicine, 383(27), 2639–2651. https://doi.org/10.1056/NEJMoa2020248

Kirpalani, H., Whyte, R. K., Andersen, C., Asztalos, E. V., Heddle, N., Blajchman, M. A., Peliowski, A., Rios, A., LaCorte, M., Connelly, R., Barrington, K., & Roberts, R. S. (2006). The premature infants in need of transfusion (pint) study: A randomized, controlled trial of a restrictive (LOW) versus liberal (HIGH) transfusion threshold for extremely low birth weight infants. The Journal of Pediatrics, 149(3), 301-307.e3. https://doi.org/10.1016/j.jpeds.2006.05.011

Enteral Feeding Guideline

Guideline #:	16.07.170
Issued:	May 2015
Reviewed/Revised:	6/2017, 3/2021, 3/2024
Section:	Maternal Child Health

Purpose:

The purpose of this guideline is to standardize the administration of gut priming and enteral feedings to infants in the Neonatal Intensive Care Unit (NICU).

Guideline/Policy Statement:

1. Enteral feedings are required for not only nutritional support, but also to uphold the functional integrity of the gastrointestinal system).
2. For parenteral nutrition guidelines for very low birth weight (VLBW) and extremely low birth weight (ELBW) infants, please see the Parental Nutrition Guidelines - Pediatric.

Application:

Infants admitted to the NICU

Exceptions:

Infants admitted to areas outside of the NICU.

Equipment

1. Mother's own milk (MOM), donor milk or formula
2. Feeding pump
3. Gastric tube and enteral feeding tubing

Procedure:

1. Type of Feeding

Mother's own milk (MOM) is the preferred feeding type for infants. Breastfeeding should be initiated as soon as infant is stable and showing appropriate feeding cues.

If MOM is unavailable, pasteurized donor human milk (PDHM) is available for the following populations (Refer to Pasteurized Human Donor Milk Policy):

Enteral feeding options:

a) MOM

b) PDHM with parental consent

- Eligibility criteria for preterm infants:
  - All preterm infants
  - s/p necrotizing enterocolitis (NEC) or s/p any GI surgery
  - s/p whole body therapeutic hypothermia
  - Any infant whose birthing person is committed to breast feeding as a bridge to mother's own milk
- Use until infant is 34 0/7 weeks or >1500 grams whichever comes later
- As bridge PDHM: late preterm (LPT) infants 34 0/7 – 36 6/7 weeks
  - Eligible to receive breastmilk per BMC policy
  - May use until infant reaches 100 ml/kg/day à supplementation with formula

For those infants not receiving MOM or PDHM the following formulas are available:

Full term formulas

Transitional formulas

Preterm formulas

Hydrolyzed (and partially hydrolyzed) formulas

2. Mouth Care with MOM

- Even while NPO, MOM should be used to provide mouth care at every care time As soon as it is available- Goal is within 12 hours of life.
- This will introduce a healthy microbiome to the newborn and decrease inflammation and risk for infection.

3. Enteral Tube Placement and Verification

Enteral tube placement should be verified by one of the following methods:

- Measure from nose to earlobe to a point midway between the xiphoid process and the nose-ear-mid-umbilicus (NEMU) for nasogastric or mouth to earlobe to a point midway between the xiphoid process and the umbilicus for Orogastric
- Use formulas for orogastric (3x[weight in kg]+12) and nasogastric tubes (3x[weight in kg]+13)
- Radiological examination if necessary

Largest enteral tube for the size of the infant should be used to allow to gastric decompression if infant is receiving CPAP.

Tube verification should be done prior to each feed by either auscultation, aspirating back **only** until gastric contents visible (0.1-0.5 cc and then refeed contents) and /or by ensuring measurement of tube placement depth (cm marking at mouth or nare) is still in accurate.

Enteral feeding tubes will be changed every 7 days and remeasured prior to new tube insertion.

4. Gut Priming

Also known as trophic feedings, or minimal enteral feeds, trophic feedings have been associated with improved feeding intolerance, reduced intestinal permeability, and decreased risk of late onset sepsis. They are small volume feedings, not calculated into the total fluid volume and do not significantly contribute calorically.

Administer 10 ml/kg/d MOM or donor milk

Start within 24 hours of life for hemodynamically stable preterm infants PDA treatment with or without indomethacin, whole body therapeutic hypothermia and indwelling umbilical arterial catheterization are **not** contraindications for gut priming.

Contraindication for gut priming:

- NEC (1st 7-10 days of treatment at the discretion of the provider)
- Intestinal perforation
- Inotropic support- Dopamine >10 mcg/kg/min (gut priming maybe initiated if Dopamine is < 10 mcg/kg/min)

Enteral Feeding chart:

The primary driver of enteral feeding chart is gestational age. However, if the infant's weight is smaller than indicated for that column or meets criteria for risk factors for NEC (see risks below) consider a more conservative pathway, either one or two columns to the left of the pathway for that gestational age.

Examples:

1. Weight is smaller than specified for that gestational age: 34 wk infant 1900 gms, consider using the standard risk instead of late preterm/term pathway.
2. Single risk factor: 31 wk infant 1600 gms, s/p pressors, consider using moderate risk instead of standard pathway.
3. Multiple concerning risk factors: 30 wk infant 1600 gms requiring chest compressions in the DR, has culture proven infection, and is s/p pressors, consider using high risk instead of the standard pathway

RISK FACTORS FOR NEC to be considered for slow initiation and/or advancement of feedings or close surveillance of NEC.

- <28 weeks
- <1000 grams
- Culture proven infection
- Received pRBC transfusion within 48 hours
- History of hypotension treated with inotropic meds
- Persistent metabolic acidosis
- SGA (<10%)
- 5 minute APGAR =< 5
- DR resuscitation including chest compression, epinephrine

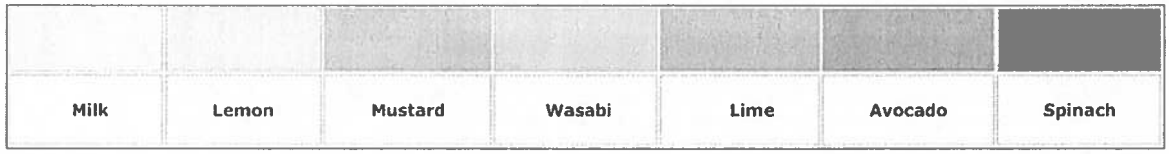
Enteral Feeding Chart

	HIGH RISK	MODERATE RISK	STANDARD RISK	LATE PRETERM/TERM
Approximate Gestational Age (weeks)	<28	28 – 29 6/7	30 – 33 6/7	>34
Approximate Weight (grams)	<1000	1001 – 1500	1501 – 2000	2001 – 2500
Initial rate (ml/kg/day)	10	10	20	Min 20
Days on initial rate	3	1-2	1	1
Volume increase	10 ml/kg/day BID	10 ml/kg/day BID	15 ml/kg/day BID	15 ml/kg/day BID
Suggested initial TFG (ml/kg/day)	100	80-100	80	20 (EF only) 60 (IVF only)
Full feeding volume = 150 ml/kg/day				

TFG = Total Fluid Goal; Min = minimum

Residuals vs NEC: See residual color chart below:

Residual Color Chart



- Bilious residuals, while somewhat concerning, should **not** automatically be discarded.
  - Residuals the color of spinach, or over-ripe avocado may be discarded
  - Residuals that are lighter yellow/green like mustard, wasabi, lime should be given back to the infant because of the pepsin and hydrochloric acid in those residuals.
    - Discarding those elements actually put the baby at higher risk for NEC because hydrochloric acid helps limit intestinal bacteria proliferation which can lead to inflammation and NEC.

Troubleshooting Residuals backing up the NG tube:

- If the residual is >50% of the feed it is considered abnormal, consult the MD.
- Increased residuals for 2-3 feeds may be an early sign of feeding intolerance.
- If NO OTHER signs of intolerance, feeds should not be held for residuals.

- Try repositioning the baby prone or right laterally for increased gastric emptying.
- Try a glycerin suppository to increase gastric motility
- Try a larger French gastric tube for gastric venting between feedings (vent feeding tube 30 minutes post feed to allow for absorption of feeding)

Indications to Potentially Hold Feeds:

- Significant abdominal distension (>2cm change)
- Significant abdominal discoloration
  - Acute change in erythema or bluish hue
- Significant change in hemodynamic stability
  - Increased Apnea/Bradycardia /Desaturation events
  - Tachycardia
  - Bradycardia
  - Hypotension
  - Temperature instability or temp ≤97.0 axillary
  - Increased respiratory effort
    - Need for more O2 or increasing support
- Lethargy
- Bloody residuals or stools
- Vomiting
- Bilious aspirates (spinach or avocado colored)
- Gastric residuals >50% of feeding for 2-3 bolus feeds
  - Or >2hr volume for infants on continuous feeds.

If above signs of feeding intolerance are present notify provider for further NEC evaluation

5. Fortification

If fortification is needed and baby is tolerating feeds, advance to 24 calorie/ounce at 80 ml/kg/day

1. Further fortification is done dependent on patient's needs
2. Type of fortifier is also guided by patients gestational age and clinical needs
3. If receiving preterm formula start with sim special care 24.

6. Standard Feeding Delivery

- Feedings should initially be administered over 30 minutes every 3-4 hours. If breast milk is administered over > 30 minutes, or when syringe is not tilted at a 45 degree angle there is a significant loss of nutrients
- Enteral feeding tubing should be changed every 4 hours or at every feed if Q3 hours feeding schedule.

Responsibility:

Nursing and Neonatology

Clinical Information:

1. Aggressive nutrition, including parenteral nutrition, is necessary for VLBW and ELBW infants to prevent extra uterine growth restriction (EUGR)).
2. Enteral feedings can be delayed for many reasons, such as hemodynamic instability.
3. However delayed enteral feeding is associated with atrophy of the intestinal mucosa, increased intestinal permeability and bacterial translocation, and a delay in the maturation of intestinal motor activity and intestinal motility.

Forms:

Electronic Medical Record

Other Related Policies:

Breast feeding infant feeding guideline

Initiated by:

Nursing, Neonatology

Reviewed by:

Perinatal Committee

References:

American Academy of Pediatrics Committee on Nutrition.
Appendix R. In: Kleinman RE, Greer FR, eds. *Pediatric Nutrition*. 7th ed. Elk Grove Village, Illinois: American Academy of Pediatrics; 2014:96, 107, 1431. 5.

Dias, F., Emidio, S., Lopes, M., Shimo, A., Beck, A., & Carmona, E. V. (2017). Procedures for measuring and verifying gastric tube placement in newborns: an integrative review. Revista latino-americana de enfermagem, 25, e2908. https://doi.org/10.1590/1518-8345.1841.2908

Gephart, S., Spitzer, J., Halpern, M., McGrath, J. (2014). Discrimination of GutCheck: a clinicalrisk index for necrotizing enterocolitis. Journal of Perinatology, 34, 468-475.

Huston RK, Markell AM, Mcculley EA, Gardiner SK, Sweeney SL. Improving Growth for Infants ≤1250 Grams Receiving an Exclusive Human Milk Diet. *Nutrition in Clinical Practice*. 2018;33(5):671–678. doi:10.1002/ncp.10054. 6.

Baylor College of Medicine,Department of Pediatrics, Section of Neonatology. *Guidelines for Acute Care of the Neonate*. 26th ed. Houston, Texas; 2018-2019.

Morgan J, Young L, McGuire W,. Slow advancement of enteral feed volumes to prevent necrotizing enterocolitis in very low birth weight infants. Cochrane Database Syst Rev. 2015.

APPROVAL DATE	COMMITTEE
March 2021	Perinatal Committee

Policy #:	16.02.070
Issued:	May 1998
Reviewed/ Revised:	5/2001, 6/2003, 12/2003, 4/2006, 12/2006, 12/2009, 3/2012, 3/2015, 4/2015, 7/2015, 9/2015, 3/2016, 4/2019, 7/2019, 3/2021, 1/2023, 11/2024, 1/2025
Section:	Maternal Child Health

Human Milk Administration and Storage for the Hospitalized Infant

Purpose:

To ensure the proper labeling, storage, thawing and administration of human milk at Boston Medical Center (BMC). Mother's own milk (MOM) is the preferred milk for an infant and breastfeeding should be presumed, unless noted otherwise in the medical record.

Pasteurized donor human milk (PDHM) is available for eligible infants.

Policy Statement:

1. Each bottle of MOM must be labeled with a human milk storage label which displays the following information:
    - Infant's name
    - Infant's MRN number
    - Infant's date of birth
    - Date and time the human milk was expressed - written on label by parent.
2. Storage
    - The temperature of all human milk storage refrigerators and freezers will be checked and recorded twice daily. Refer to Appendix A: Human Milk Storage Chart for appropriate temperatures and storage times. See Appendix B: Refrigerator and Freezer Log for recording temperatures.
    - In Postpartum Unit:
        a. Dedicated human milk refrigerator in the newborn nursery.
        b. Donor milk is stored in a freezer.
            - Refrigerator and freezer temperature is monitored and maintained within range (see Human Milk Storage Chart below).
    - In PICU/Pediatric Unit:
        a. Dedicated refrigerators will be provided for human milk.
        b. The dedicated refrigerators will be maintained in a secure area and accessed by staff only.
    - In the NICU:
        a. Dedicated refrigerators/freezers will be provided for human milk storage in the NICU.
        b. The dedicated refrigerators/freezers will be maintained in a secure area and accessed by staff only.
        c. Refrigerator/freezer will have designated shelves only for human milk and formula storage.
3. Administration
    - MOM must be checked to ensure the correct milk for the correct patient prior to administration for mouth care, gut priming/trophic feedings, or enteral feedings following the procedure listed below.

4. If the infant is transferred to another floor at BMC, or a facility outside of BMC, human milk will be transferred with the infant by RN after reviewing patient identifiers.
5. MOM should be sent home with the infant at discharge. If MOM is left after discharge at the infant, all attempts will be made to contact the family regarding picking up milk. If no contact is made with the birthing parent, MOM milk that is left behind will be discarded after 7 days.
6. Pasteurized Donor Human Milk (PDHM), NICU and Mother Infant Unit
    - For eligibility, please see Pasteurized Donor Human Milk Policy.
    - PDHM is kept in designated, secure, human milk refrigerators and freezers.

Application:
All mother's own milk (MOM) and Pasteurized Donor Human Milk (PDHM) human milk stored in the hospital for inpatients.

Exceptions:
None

Equipment:
- Human milk storage labels- infant name, MRN and date of birth
- EMR scanning human milk label-name of infant, date of birth, MRN and location
- Human milk containers

Procedure:
Instructions for the birthing parent/family:
- Instruct the person giving birthing to wash their hands prior to and after expressing and handling human milk.
- Store in a clean, dry, non-sterile hard plastic container with solid lid.
- Leave a space at the top of the bottle, if freezing, to allow for expansion.
- Write date and time milk was expressed on label.
- For further instructions, refer to written expressing and storage instructions provided to birthing parent while at BMC.

When accepting human milk from the birthing parent of the infant, the RN will:
- Verify the accuracy of the birthing parent and infant name and medical record number.
- Verify that the time and date of expressing is on the human milk storage label.
- If frozen or mostly frozen, and unless needed for immediate feeding, can be placed in freezer.
- If fresh human milk, store in the appropriate location (refrigerator or freezer) depending on when it will be used and how much milk is in refrigerator. For guidance, see Appendix A.

If mixing additives into human milk:
- Ensure the patient identification sticker information matches the intended recipient prior to mixing. Fortified human milk expires at 24 hours from mixing.

For MOM:
Prior to administering MOM, the RN will:
- Perform proper hand hygiene before and after handling human milk.
- Don gloves
- Ensure the MOM container (syringe or bottle) has the human milk storage label attached and labeled with date and time of thawing/fortification.

- Scan the human milk storage label in EMR for infant. Validate label matches infant summary page by checking MRN, name and DOB.
- Print EMR scanning human milk label and apply to container (syringe or bottle). If infant is using a reusable personal bottle system, apply EMR scanning human milk label to volufeed bottle.
- Nurse may draw up all feeds for the shift in syringes with caps and properly label at the same time following policy for scanning at time of feed. The nurse will place bin with patient name and MRN label in the milk refrigerator.
- Nurse will bring labeled milk container to infant's bedside and open EMR.
- The nurse will open infant's intake/output tab in flowsheet.
- The nurse will scan patient identification band on infant and scan EMR scanning human milk label on bottle or syringe prior to administering milk.
- If infant is using a reusable personal bottle system, pour contents of volufeed labeled container into bottle system after warming.
- If there is a question about the integrity of the MOM, if the label is not clearly visible, or if the date/time of expression is not visible, the MOM must be discarded and parents will be informed of reason unable to use milk. .
- Gently swirl the milk prior to administration. Please do not shake.

For Pasteurized Donor Human Milk (PDHM):

- Print EMR scanning PDHM label and apply to container (syringe or bottle). If infant is using a reusable personal bottle system, apply EMR scanning PDHM label to volufeed bottle.
- Nurse may draw up all feeds for the shift and properly label at the same time following policy for scanning at time of feed. The nurse will place bin with patient name and MRN label in the milk refrigerator.
- Nurse will bring labeled milk container to infant's bedside and open EMR.
- The nurse will open infant's intake/output tab in flowsheet.
- The nurse will scan patient identification band on infant and scan EMR scanning human milk label on bottle or syringe prior to administering milk.
- The nurse will document PDHM lot # and expiration date under PDHM feed in EMR intake/output flowsheet once per shift or when opening a new PDHM bottle.
- If infant is using a reusable personal bottle system, pour contents of volufeed labeled container into bottle system after warming.
- Patient specific identification sticker should be added to the Pasteurized Donor Human Milk (PDHM) if calories are added, or if no other infant will be using.
- If more than one infant will be using the same Pasteurized Donor Human Milk (PDHM), each patient identification sticker should be placed on the container.

Scanning human milk and infant identifier band as medication, as outlined in the Nursing Medication Administration Policy is meant to prevent human milk errors. If there is a human milk administration error and the wrong human milk is administered to the wrong infant:

- Notify Provider, Nurse Manager/Off Shift Nurse Manager, Charge Nurse.
- File an online incident report.
- Debrief the report to identify error and review policy/practice of correct human milk administration.
- Disclose the human milk error to both birthing parent who expressed milk and birthing parent of receiving infant. Complete a full infectious laboratory evaluation.
- Refer both parents to ID clinic on Shapiro 9
- Refer birthing parent who expressed milk to sign a release of information to birthing parent of receiving infant to allow birthing parent or family to receive results.

If a Physical or Occupational Therapist, or other healthcare provider, will be administering human milk to the infant:

- The therapist will identify the patient by name and medical record number. The information on the patient's identification band will be compared to ensure agreement.
- The therapist must notify the patient's RN that they need human milk as part of the therapy session.
- The RN will obtain the human milk and give to the therapist for infant administration following the proper labeling, scanning, and warming procedure.
- The therapist will document in the medical record that a milk verification was performed. They will enter a **smart phrase** into the patient chart **(.milk)** which states "Breastmilk verification was performed with RN prior to administration of milk to infant."

During EMR downtime or if label unable to be printed utilize double RN check and document in EMR flowsheet.

Antenatal Milk Expression

Antenatal milk expression (AME) refers to the practice of an expecting parent expressing colostrum during pregnancy, often to bring into the hospital for use after delivery. This practice was shown to be safe for both birthing parent and infant starting at 36 weeks' gestation in a large randomized controlled trial of over 600 women with diabetes in pregnancy (2017 DAME Study).

How to label

When the birthing parent arrives, apply that birthing parent's medical record label on each syringe or container of expressed colostrum. Place the syringes with the colostrum in a bag or container.

Once the infant is born, if the milk is to be used the nurse should apply a human milk storage label with infant's name, MRN and date of birth to the syringe or container prior to administration. Prior to administration, the RN should follow the policy for administration and scanning of human milk.
If the expressed milk is from the non-birthing partner, follow the same procedure (use the birthing parent's medical record label). Once the infant is born, the human milk storage label can be applied.

Storage

Store the syringes in the Birthing parent Infant Unit Nursery Freezer and notify the postpartum nursery nurse and birthing person's nurse that it is in freezer. Labor and Delivery staff will go to this location to get the milk if it is needed for use in Labor and Delivery. It is best if the milk is frozen right up until it is needed. Defrost and then warm in the milk warmer as needed. Once milk is defrosted it should be stored in the refrigerator. This defrosted colostrum/milk is approved for use for 48 hours.

At discharge, any unused frozen milk will go home with the parents.

Charting

When antenatally expressed milk is fed to the infant, chart milk volume in the EMR intake and output flowsheet (in the same fashion that donor milk or infant formula milk is indicated). If milk is administered in L&D 2 RNs should verify birthing parent's name and MRN or infant's name and MRN prior to administration.

If milk is administered in NICU or Birthing parent Baby unit, milk should be administered in the same practice as birthing parent's milk is given. The RN will print an EMR label and apply to milk syringe or container to be able to scan prior to administration. Please refer to above practice.

Responsibility:
RN, LC, PNP, MD/DO

Attachments:
Appendix A: Human Milk Storage Recommendations for High Risk Infants Chart
Appendix B: Refrigerator/Freezer Temperature Log

Clinical Information:
None

Other Related Policies/Protocols/Guidelines:
16.06.030 Pasteurized Donor Human Milk

References:
Bertino, E., Giribaldi, M., Baro, C., Giancotti, V., Pazzi, M., Peila, C., Tonetto, P., Arslangoglu, S., Moro, G., Cavallarin, L., & Gastaldi, D. (2013). Effect of prolonged refrigeration on the lipid profile, lipase activity, and oxidative status of human milk. *Journal of Pediatric Gastroenterology and Nutrition, 56* (4), 390-396.

Forster DA, Moorhead AM, Jacobs SE, et al. Advising women with diabetes in pregnancy to express breast milk in later pregnancy (Diabetes and Antenatal Milk Expressing [DAME]): a multicentre, unblinded, randomised controlled trial. *Lancet.* 2017;389(10085):2204-2213.

Human Milk Banking Association of North America (HMBANA)- Best Practice for Expressing, Storing and Handling Human Milk in Hospitals, Homes and Childcare Settings. (2024) 5th edition

Slutzah, M., Codipilly, C., Clark, R., & Schanler, R. (2010). Refrigerator Storage of Expressed Milk in the Neonatal Intensive Care Unit. *The Journal of Pediatrics, 156* (1), 26-28.

Initiated by:
Lactation Service

Contributing Departments:
Perinatal Committee (Jan 2021)

Appendix A: Human Milk Storage Recommendations for High Risk Infants Chart

Human Milk	**Time at Room Temp** **77 degrees F or below**	**Time in Refrigerator** **36 to 41 degrees**	**Time in Freezer** **0 degrees F**
Freshly expressed	Ideal: Refrigerate immediately Acceptable 6hours Milk that is being fed to an infant via continuous feeding can be safely administered over a 4 hour period.	6 days	≤ 6 months Use oldest milk first. ≤ 3 months in freezer compartment of 2 door refrigerator/freezer
Completely thawed, previously frozen, **Not fortified**	2 hours	Up to 48 hours	Do not refreeze
Partially thawed with ice crystals	2 hours	Up to 24 hours	Do not refreeze
Leftover from feeding	Use within 2 hours per CDC	Use within 2 hours	Do not refreeze
Pasteurized Human Donor milk (once thawed)	2 hours	Up to 96 hours	Up to 12 months Do not refreeze
If fortified	Keep refrigerated until use.	up to 24 hours	Do not refreeze

Appendix B:



Refrigerator/Freezer Temperature Log

UNIT NAME_____ **Month/Year**_____

	Date	Refrigerator Temp (36° to 41° F)	Freezer Temp (0° to -10° F)	Ambulatory Locations ONLY Weekend/Holidays MIN	MAX	INITIALS	CORRECTIVE ACTION INCLUDING RECHECK TIME AND TEMP
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

TEMPERATURE STANDARDS: REFRIGERATOR 41°F OR BELOW and FREEZER O°F OR BELOW.

CALLControl WHENEVER TEMPERATURE GOES ABOVE 41°F. 8-4144

DO NOT USE COOLER WHEN TEMP GOES ABOVE STANDARD - MOVE ITEMS.

** NOTE: IF TEMP DOES NOT MEET STANDARD: RECHECK IN 1 HOUR AND NOTE NEW TEMPERATURE IN CORRECTIVE ACTION COI

(NICU) Humidity: Settings and Care for the Premature Newborn

Guideline #: 16.07.100
Issued: March 2008
Reviewed/Revised: 12/2009, 7/2012, 3/2018, 5/2021, 5/2024
Section: Maternal Child Health

Purpose:

To provide standards for premature newborns treated with humidity therapy, which is used to reduce trans epidermal and insensible water loss (TEWL, IWL) and preserve skin integrity. Humidity will be used for newborns <31 weeks gestational age and/or <1000 grams in the first weeks of life.

Guideline Statement:

1. All newborns less than 31 weeks gestational age and/or less than 1000 grams should be admitted to an infant warmer/isolette that can provide humidification (Giraffe Omnibed).
2. Humidity may also be considered for newborns with compromised skin barrier for example congenital ichthyosis.
3. Isolette humidity should be set by Nursing (per chart below) when admission is anticipated.

Gestational Age (weeks)	Initial Humidity (%)	Weaning Humidity	Discontinue Humidity
<28	80%	Start weaning after completing 7 days; Wean by 5% daily.	Discontinue after 24 hours at 40%
28-30 6/7	80%	Start weaning after completing 24 hours of 80%; Wean by 5% daily.	Discontinue after 24 hours at 40%

4. Rain-Out
   - Wipe down the condensation
   - First attempt to allow the isolette environment to adjust, by keeping the doors closed and canopy down.
   - If this does not stop the condensation, humidity can be decreased 5% every hour until resolution.

5. Only sterile distilled water should be used in the humidity reservoir.
6. Cleaning
   - **The humidity reservoir should be cleaned or replaced weekly while using humidity by nursing.**
   - If rain-out if significant, isolette should be changed and cleaned more frequently.

- Intake filter located behind the humidifier reservoir should be replaced every 3 months, or when visibly dirty or following bed use with infectious patients.

Application:

All newborns less than 31 weeks gestational age or less than 1000 grams

Exceptions:

None, unless specified by attending physician.

Equipment:

Giraffe Omnibed
Distilled sterile water

Procedure:

Starting humidification

1. Newborns less than 31 weeks gestation or less than 1000 grams will be placed in a Giraffe Omnibed where physiologic stabilization, placement of necessary tubes and lines and radiographic confirmation of their position can be accomplished.
2. The team will assess gestational age and weight to determine the need for humidification.
3. An order for humidification will be written.
4. When using the Giraffe Omnibed:
   - Fill the humidity reservoir with distilled sterile water.
   - Set humidity per policy.
   - Ensure proper functioning and humidification.
5. The newborn's axillary temperature should be checked every 30 minutes until stable x2, then as needed to ensure appropriate temperature stability.
6. Document relative humidity (set humidity), actual humidity and newborn's temperature on flow sheet every four hours, and as needed.

Care of the Newborn/Weaning

1. Inspect the warmer/isolette with each newborn care.
2. Document humidity and temperatures in the medical record.
3. Rain-Out:
   - If visible condensation occurs, ensure the canopy is down and doors closed to allow the environment to stabilize, and wipe down the condensation.
   - If this does not resolve the condensation, decrease the humidity by 5% hourly until the condensation dissipates. This does not require an order.
4. Monitor axillary temperature and document relative humidity (set humidity), actual humidity and newborn's temperature on flow sheet every four hours, and as needed.
   - The newborn's axillary temperature should be checked and documented for stability prior to each wean.
   - Continuing, weaning or discontinuation of humidity may be adjusted based on individual infants' needs and stability.

- For example, a 22-24 week infant may require humidity for slightly longer periods if fluid and electrolyte balance is a challenge. The decision to continue humidity will be a discussion among the NICU providers.

Responsibility:

RN and MD

Clinical Information:

1. ELBW infants or premature newborns benefit from isolette humidity for many reasons including the following:
   - Fluid homeostasis: Due to immature skin and high surface area, ELBW/premature newborns are at risk for high TWEL or IWL, which may lead to dehydration. Without humidity, high amounts of fluid administration may be required which can increase the risk of chronic lung disease and patent ductus arteriosus.
   - Stabilization of electrolytes and osmolality: High fluid infusion rates to prevent TEWL and IWL may lead to hypernatremia, hyperkalemia, metabolic acidosis, hyperglycemia, hyperosmolarity. Hyperglycemia and hyperosmolarity have been associated with interventricular hemorrhage.
   - Improved skin integrity
2. Humidity reservoir should be changed weekly.
3. Giraffe Omnibed's humidity reservoir heats water to 55°C, which is bactericidal.
4. If newborn requires humidification longer than two weeks, the isolette should be changed every two weeks, or more frequently based on clinical judgment.

Forms:

Electronic Medical Record

Other Related Policies:

16.02.230 - Thermoregulation of the Newborn

Initiated by:

NICU

Reviewed by:

Nursing
NICU Physician Staff

References:

Healthcare, G. (2022, September 23. Giraffe Omnibed Operator's Manual. *Giraffe Omnibed Operator's Manual*. Laurel, MD: Ge Medical Systems.

https://www.gehealthcare.com/support/manuals?search=eyJzZWFyY2hUZXJtIjoiMjA3Nzk1NS0wMDEiLCJsYW5ndWFnZU5hbWUiOiJFbmdsaXNoIChFTikifQ%3D%3D

Pediatrics, A. A. (2022). *Neonatal resuscitation 8th. edition.* Elk Grove Village: AAP.

Robin L. Bissinger, d. J. (2020). *Golden Hours Care of the very low brith weight infant.* Chicago : National Certification Corporation.

APPROVAL DATE	COMMITTEE
March 2021	Perinatal Committee

(NICU) Cerebral Function Monitor: Olympic CFM 6000

Guideline #:	16.07.130
Issued:	September 2008,
Reviewed/Revised:	3/2012, 2/2015, 3/2018, 11/2021, 11/2024
Section:	Maternal Child Health

Purpose:

To provide guidelines for the use of the Olympic CFM 6000 Cerebral Function Monitor.

Guideline Statement:

1. The Olympic CFM 6000 is intended to be used per physician order, by a variety of trained clinicians, for the acquisition of electroencephalography (aEEG) signals that can be used in conjunction with other clinical data to:
   - Monitor neurological activity
   - Assist in the predication of the severity of hypoxic-ischemic encephalopathy (HIE) and the long-term outcome in infants who have suffered a hypoxic-ischemic event
   - Assist in the clinical management and treatment of a patient by monitoring neurological status to indicate how the treatment affects the neurological status
   - Monitor and record frequency and intensity of seizures to assist in the management of anticonvulsive therapy

Application:

Infants being evaluated for hypoxic-ischemic encephalopathy (HIE) or potential seizure activity

Exceptions:

None

Equipment:

Olympic CFM 6000 system
Electrodes –low-impedance (needle type)
Adhesive tape, transparent medical dressing

Procedure:

1. Set up of CFM device and placement of leads
   - Verify that the digital amplifier module is connected to the CFM 6000
   - Determine placement method: biparietal or frontal
   - **Low-impedance needles will be used for infants assessed for hypoxic ischemic encephalopathy (HIE) and need for hypothermia treatment.**

2. Biparietal placement of low-impedance needle electrodes (see guide at the end of this policy)
   - Locate the vertex, or top/crown of the head
   - Locate 25mm (2.5 cm) anterior and place the one electrode at this location
   - Locate a point about 50mm (5cm) posterior to the vertex
   - Place the one electrode about 37mm (3.7 cm) to the left of the above point
   - Place the one electrode about 75 mm (7.5 cm) to right of the red electrode
   - Secure electrodes with tape or transparent medical dressing

3. Attaching the electrodes:
   - Low impedance electrodes – insert needles subcutaneously up to the plastic hub and secure in the same manner as an IV
   - Needles can face towards the front of head or back. However, all three needles need to face the same direction.

4. Strain relief: to minimize motion artifact
   - Collect the three leads into a bundle and tie the bundle into a small, loose loop near the electrodes.
   - Note – the strain relief should be as close to the electrodes as possible, while remaining isolated from them.

5. Connect the leads to the digital amplifier module

6. Power the device "On"

7. Verify the digital amplifier module is connected to the CFM 6000, the device is on, and the electrodes are connected to patient and digital amplifier module

8. Touch "Record"

9. Enter patient information (can be done prior to or during Recording)

10. Prior to ending session, print, archive or delete file

11. Documenting (MD)
    - Make copy of printed tracing and document findings in newborn's chart

12. Shutdown Procedure:
    - Remove electrodes from patient
    - Unplug electrodes from digital amplifier module and discard
    - Clean system with mild cleaning disinfectant, wiping exterior, screen, amplifier module, and power cable

Responsibility:

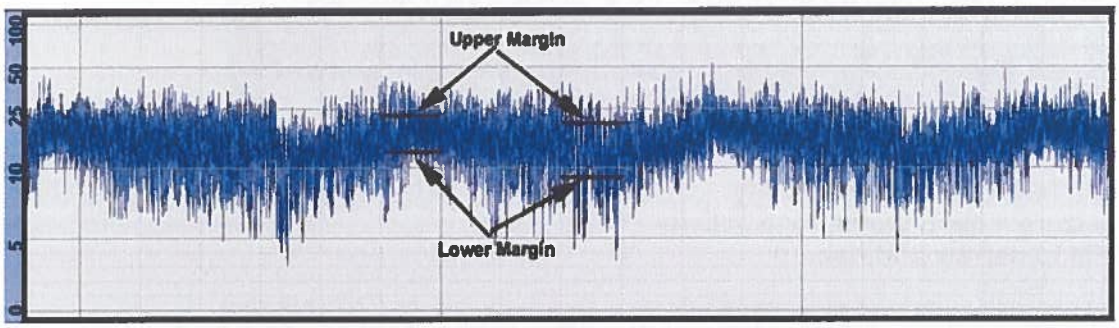
RN for lead placement, monitoring newborn and shut down procedure
MD for monitoring and reading tracings and documenting findings

Clinical Information:

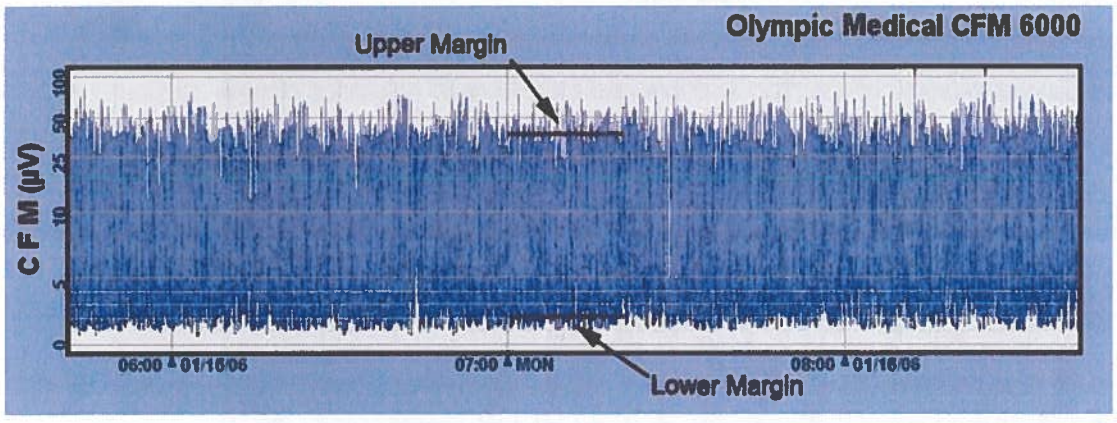
1. The Olympic CFM 6000 records and displays three types of tracings: CFM (or aEEG), EEG, and Impedance.
2. The CFM 6000 may be applied any time, or used continuously, to determine the neurological status of a patient
3. A minimum of 90 minutes of trace should be observed to make a determination of neurological status
4. If there is a question about the presence of seizures, or potential changes in neurological status as a result of illness or other clinical treatment, observe for a longer, continuous period
5. The CFM 6000 may record continuously for up to 30 days
6. The CFM 6000 records a single channel of electroencephalograph (EEG) from two electrodes placed on either side of the head. The signal is filtered so that only signals from 2 to 15 Hertz (Hz) are passed, thus, reducing artifacts caused by movement, electrocardiogram (ECG), and other electronic equipment.

It is then rectified, compressed and semi-logarithmically displayed. The result is displayed on a color liquid crystal display (LCD) touch-screen. The display speed is fixed at 6 cm per hour (1mm per minute).

7. Because the CFM produces such a highly processed output, it is no longer treated as a regular EEG signal. Regular EEG is usually displayed as positive and negative excursions on a linear scale centered at zero micro Volts (u Volts). The CFM is displayed as a semi logarithmic signal ranging from 0 to 100 u Volts. A low level of the CFM trace indicates low activity. A high reading indicates high activity.
8. A normal CFM trace will appear as a band of activity ranging from about 10 – 40 µVolts. This indicates normal variability of the electro cortical background activity.
   Normal CFM
   - **Sleep/Wake Cycling**
   - **Upper Margin > 10 µVolts**
   - **Lower Margin > 5 µVolts**
   - **Limited Variability**



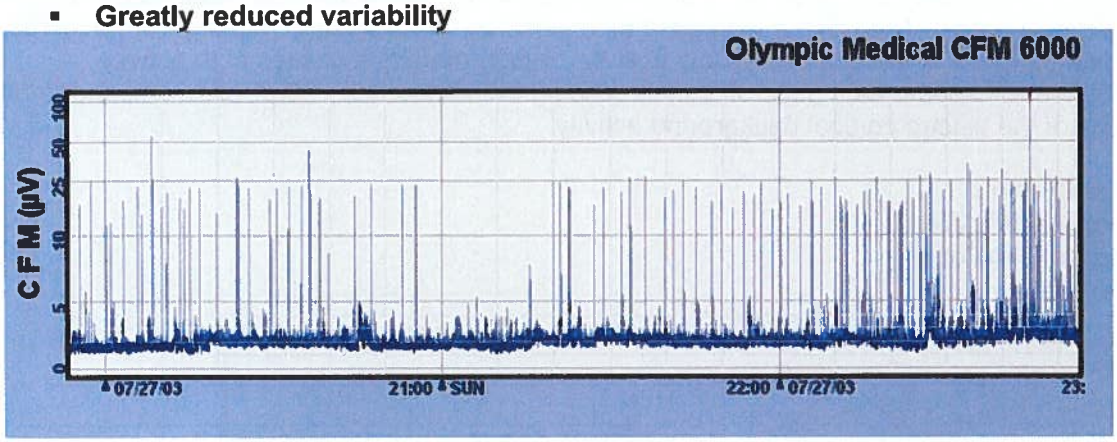
9. A mild to moderate hypoxic or ischemic insult may cause increased variability with increased periods of lower activity. This will appear as a widening of the band as the lower margin decreases. This is known as discontinuity. The width of the trace depends on the degree of discontinuity.
   CFM – Moderately Abnormal
   - **No Sleep/Wake**
   - **Upper Margin > 10 µVolts & Lower Margin < 5 µVolts**
   - **Increased variability**



10. With increasing severity of the insult, there will initially be increasing width of the band. Eventually, there will be decreasing periods of high activity and the upper margin of the band will begin to decrease. Very severe insults can result in a very low voltage activity or burst suppression that is displayed as a low voltage, a narrow band of activity that may be accompanied by bursts of higher voltage activity.

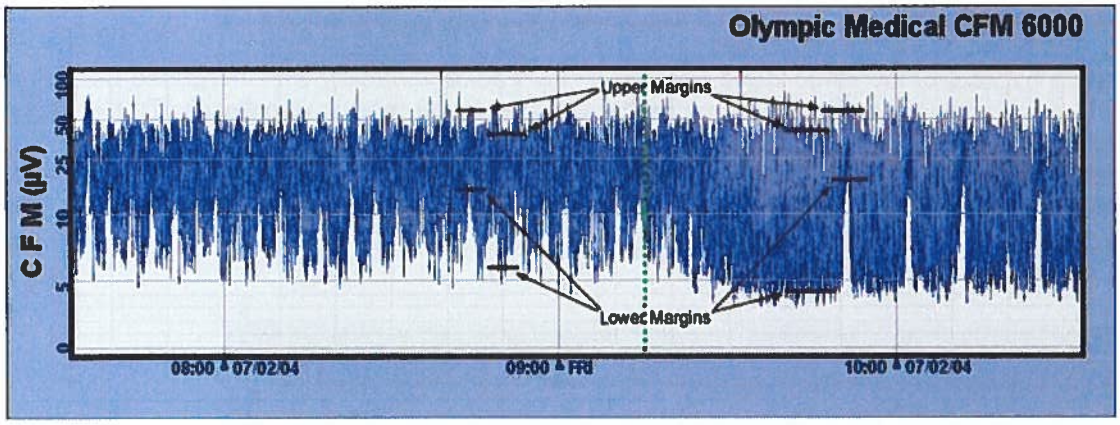
CFM Severely Abnormal

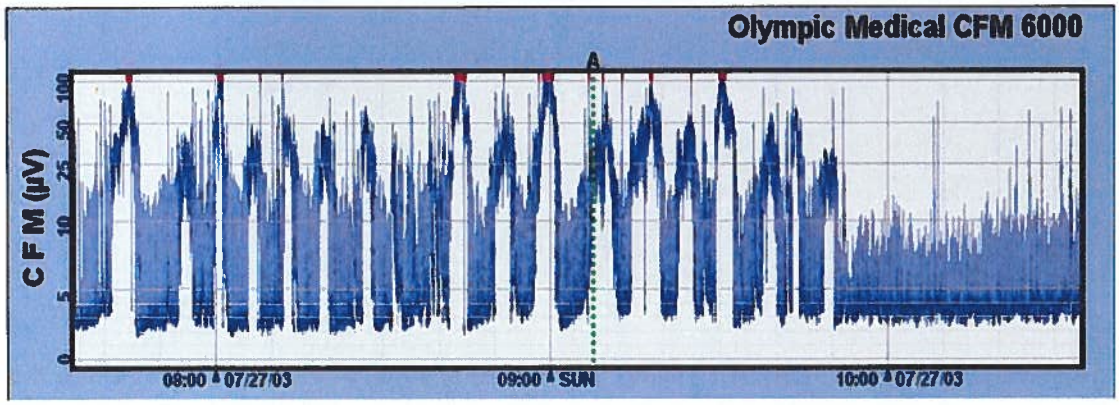
- **No Sleep/Wake**
- **Upper Margin < 10 µVolts**
- **Greatly reduced variability**



Seizures

- **Injured brain has increased variability**
- **Onset of seizure > continuous, high activity**
- **Causes CFM to narrow and rise up**





11. The following features of the trace should be evaluated: presence of sleep/wake cycling, the amplitude of the upper and lower margins of the trace, and the presence of seizure activity.
12. The position of the margins can be assessed by comparing the upper and lower edges of the main band of activity to the scale displayed on the screen.
13. The CFM can display the filtered, unprocessed EEG signal simultaneously with the CFM signal to assist in recognizing seizures or artifact.
14. As the clinician gains more experience with the CFM 6000 they will learn to recognize a wider range of waveforms that can be useful in managing infants with a variety of neurological complications. More information on the extended use of the CFM can be found in *An Atlas of Amplitude Integrated EEGs in the Newborn* by Lena Hellstrom-Westas, *et. Al.*
15. See the Olympic CFM 6000 System Operator's Manual and Service Manual for additional supportive material.

Forms:

Electronic Health Record

Other Related Policies:

16.07.140 Hypothermia Treatment for Neonatal Encephalopathy

Initiated by:

NICU

Reviewed by:

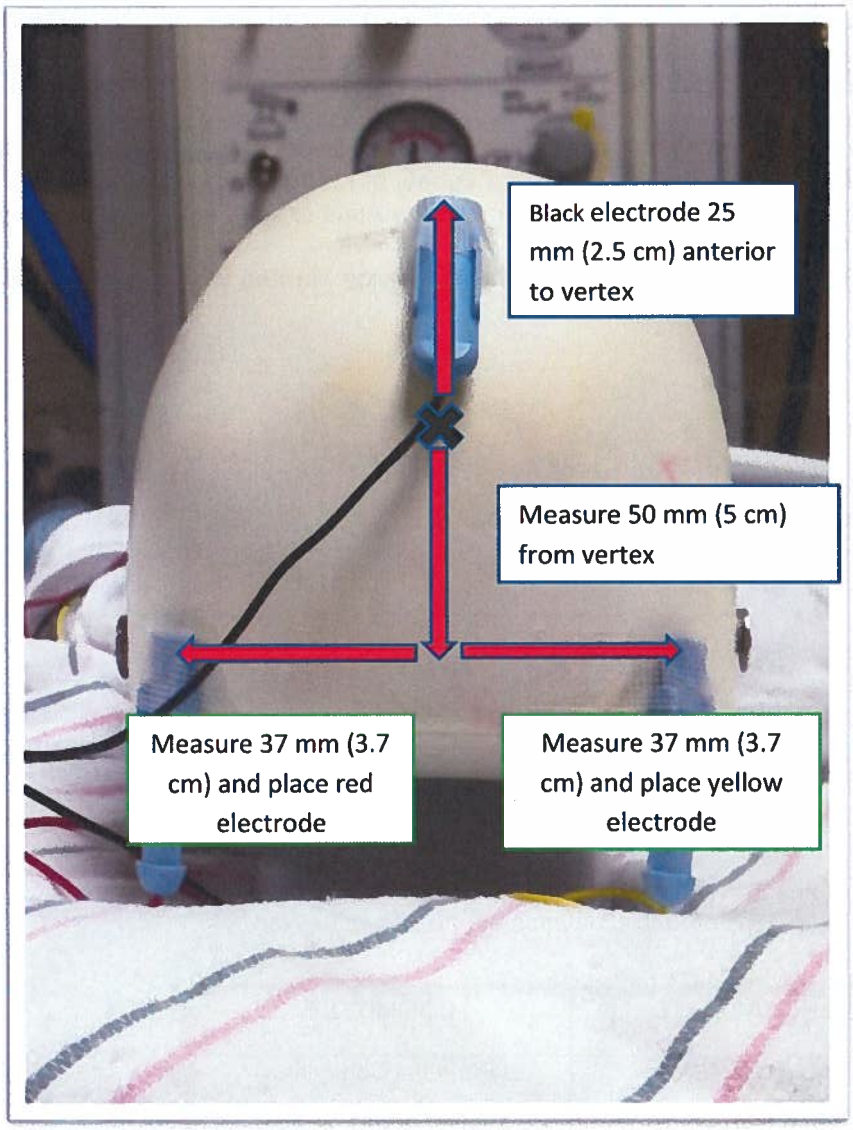
Nursing
NICU Physician Staff
Pediatric Neurology

References:

Olympic CFM 6000 Training Manual and Service Manual
Lena Hellstrom-Westas, e. A. (n.d.). *An Atlas of Amplitude Integrated EEGs in the Newborn.*

APPROVAL DATE	COMMITTEE
March 2018	Perinatal Committee
May 2018	Medical Executive Committee

Guide: Placement of CFM/aEEG monitor electrodes



X = Vertex, top or crown of the head

Therapeutic Hypothermia for Neonatal Encephalopathy

Policy #:	16.07.140
Issued:	September 2008
Reviewed/ Revised:	3/2012, 2/2015, 3/2018, 2/2022, 1/2023, 6/2023, 1/2024, 6/2024, 5/2025, 8/2026
Section:	Maternal Child Health

Purpose:

To ensure proper therapeutic hypothermia treatment and re-warming for newborns greater than or equal to 34 weeks gestational age (GA) and above 1750gms who meet inclusion criteria for Whole Body Therapeutic Hypothermia for Neonatal Encephalopathy. Therapeutic hypothermia treatment for newborns 34-35 weeks gestation babies may be considered on a case-by-case basis at NICU attending's discretion after discussions with parents.

Guideline Statement:

1. Whole body therapeutic hypothermia will be utilized, per physician order, to treat moderate to severe hypoxic-ischemic encephalopathy (HIE) or to prevent or reduce the severity of neurologic injury associated with HIE. Newborns will be assessed for Neonatal Intensive Care Unit (NICU) admission.
2. Newborns with normal or rapidly improving neurological exams in delivery room by 30 minutes of life may remain in couplet care in labor and delivery and be admitted to mother baby unit. Newborns will be monitored in nursery until neurological exams are completed by NICU attending physician and the newborn exits the protocol (Appendix A).
3. The NICU attending physician is responsible for performing all neurological examinations.
4. Patients must meet inclusion criteria, as follows:

   Criteria: Clinical evidence of moderate to severe HIE is defined by Criteria A and B (below), please refer also to appendix B

   A. Physiologic Criteria: (ANY OF BELOW)
   - Chest compression in delivery room
   - Apgar < 5 at 10 minutes of life
   - Intubation or positive pressure ventilation (PPV) ongoing at 10 minutes of life
   - Cord gas or postpartum gas (within 1 HOL) with pH < 7.1 or base deficit < -10 mmol/L

   B. Clinical Criteria:

   Neurologic Examination: (any of below)
   - Neononatal encephalopathy score (NES) ≥4 on serial neurological exams refer to Appendix B
   - NES ≥ 1 AND abnormal electroencephalogram (EEG) Refer to Appendix C
   - Clinical seizure

5. **Application of aEEG/CFM (amplitude-integrated electroencephalogram/cerebral function monitor)**
   - aEEG/CFM will be done on all newborns with abnormal clinical exam during evaluation for therapeutic hypothermia
   - While useful in evaluation for encephalopathy, aEEG/CFM findings are not a necessary criteria to initiate therapeutic hypothermia treatment.
   - However an aEEG/CFM should be started as soon as possible. Preferably readings should start by one hour of life.

- Do not performed aEEG/CFM within 30 minutes following intravenous (IV) anticonvulsant therapy, as this may cause suppression of EEG activity.
- Please see Policy #16.07.130 (NICU) Cerebral Function Monitor to determine degree of encephalopathy or seizures.
- The aEEG/CFM can change over time. The aEEG/CFM reading may be run as long as needed, but run aEEG/CFM preferably for 90 minutes to obtain most accurate reading.
- The aEEG recording will be uploaded in EMR along with documentation of aEEG findings

6. If A & B Criteria are met, as defined above, therapeutic hypothermia should begin within six hours of birth (with goal of treatment starting as early as possible
7. Treatment will continue for a total of 72 hours (including interruptions) or until discontinued per physician order.
8. Active rewarming will take approximately 6 hours.

Application:

Newborn at greater than or equal to 34 weeks GA with evidence of hypoxic ischemia encephalopathy.

Exceptions:

- Exclusions to therapeutic hypothermia:
- Intracranial hemorrhage (initiation of therapeutic hypothermia should not be delayed for obtaining HUS).
- Birth weight of < 1,750 g, GA < 34 weeks.
- Presence of known lethal chromosomal anomaly, metabolic disorder or other irreversible condition.
- Uncontrolled, spontaneous bleeding or hemorrhage.

Equipment:

- Radiant warmer with skin/servo temperature sensor
- NICU Arctic Sun unit or if NICU Arctic Sun unit is not available may use one from another BMC unit (page clinical engineering to reset the unit to NICU settings or call 24 hour artic sun help #)
- Cerebral Function Monitor
- Subdermal needles for aEEG/CFM
- Hypothermia blanket
- Dry pillow case
- Connecting cable for temperature probe
- Esophageal temperature probe
- Surgilube
- Distilled water: Water should be visible at the strainer (at the bottom of the water fill opening)



Video instructions on filling water

Procedure:

1. Therapeutic hypothermia treatment:
   - Begin passive cooling in the delivery room with radiant warmer powered off.

- While passively cooling, the radiant warmer's heat should remain off in NICU with temperature probe on newborn to ensure newborn's temperature does not fall below 34°C. If newborn's temperature falls below 34°C , the radiant warmer's heat should be turned on and set at 33.5°C or on minimal heat to prevent over cooling of newborn.
- Active cooling should begin as soon as newborn meets eligibility criteria.
- aEEG/CFM leads should be placed as soon as possible, CFM should be recorded for 90 minutes
- A, B, of inclusion criteria should be reviewed
- Please consult neurology service as soon as possible for review of newborn and to establish EEG monitoring. Therapeutic hypothermia should not be delayed while awaiting Neurology service review.

Follow Appendix A for *Evaluation of Newborns at Risk for Neonatal Encephalophathy*

- **Goal esophageal temperature is 33.5**°C **with a range of 32.5-34.5**°C
- Esophageal Temperature is continuously monitored and documented hourly in EHR. Axillary temperatures should be documented at a minimum of every 4 hours. If axillary temperature is unreadable due to low body temperature, document in EHR comments "unable to obtain due to low temperature-UTO".
- Notify MD/DO if temperature drops below 31°C, or if the temperature is >1°C outside of the acceptable range.
- Hypothermia blanket should remain dry. If wet, replace with new blanket.
- See *Monitoring During Therapeutic Hypothermia*

2. Sedation
   A. Morphine Dose recommendation
      - Give loading dose 0.05 mg/kg intravenous (IV) (repeat PRN x 1 for shivering, severe irritability tachycardia HR > 120 beats/min and at the discretion of the neonatologist). Minimize bolus use and attempt non-pharmacological means of providing comfort.
      - Start continuous infusion: 0.01 mg/kg/hr IV drip.
        - Reduce rate to 0.005 mg/kg/hr after 12 hours

Morphine infusion should be discontinued once rewarming phase beings unless otherwise directed by NICU attending.

- Increasing morphine dosage should be done with caution in non-intubated patients, due to reduction in respiratory drive.
- Benzodiazepines and anticonvulsants should be avoided, when used for sedation, as they will mask seizure activity
- Agitation will disrupt therapeutic hypothermia. Sedation should be adjusted as needed based on patient's agitation level.

3. Access:
   A. Establish peripheral access as soon as possible.
   B. Placement of a double lumen umbilical venous catheter (UVC) is preferred.
      - UVC for IV fluids and medications
      - The primary port of UVC can be heparin locked and flushed with heparin per protocol.
      - If blood can be drawn via the UVC and the newborn is hemodynamically stable, umbilical artery catheter (UAC) may not be needed.
      - If blood cannot be drawn via the UVC, or the newborn is hemodynamically unstable, arterial access should be obtained (UAC or peripheral arterial line).
   C. Placement of UVC and UAC should not delay therapeutic hypothermia.

4. Imaging and Neurological Monitoring
   - Head Ultrasound (HUS) should be done as soon as possible after initiation to rule out intracranial hemorrhage. It is NOT required prior to initiation of hypothermia therapy. It may

be helpful to obtain this before the EEG leads are put on as the leads can interfere with HUS imaging.
- MRI to be done on DOL 4, after re-warming. Follow up to be done as advised by Neurological team.
- EEG should be performed as soon as possible to evaluate for seizure activity. Treatment of seizures is usually in consultation with neurology team.

5. Fluid, electrolytes and nutrition:
   - Trophic feeds on human milk may be allowed after 24 hours of therapeutic hypothermia if newborn is physiologically stable. Oral care with human milk can begin anytime afeter birth.
   - Consider fluid restriction (to 50-60 ml/kg/day) to avoid cerebral edema. Aim to maintain glucose infusion rate (GIR) of no less than 4-5 mg/kg/min.
   - Sodium should be maintained 140-148 mmol/L to avoid cerebral edema.
   - Magnesium is potentially neuroprotective and should be maintained between 1.9-2.2 mg/dL
   - Acidosis: Avoid base replacement therapy if hemodynamically stable; patient may self-correct over time. Acidosis may take up to three days to fully correct. If there is worsening acidosis or cardiovascular collapse with base excess (BE) > -12 mmol/L consider normal saline bolus and sodium bicarbonate therapy
6. Respiratory:
   - Avoid hypocapnia and hyperoxia
7. Infectious Disease:
   - Obtain blood culture and start antibiotics Ampicillin and Cefepime. Discontinue antibiotics after 48 hours if blood cultures are negative.
8. Rewarming Treatment:
   - Rewarming will begin after 72 hours of therapeutic hypothermia
   - Avoid rapid rewarming. Rewarming should take place over 6 hours.
   - Notify the MD/DO if difficult to maintain esophageal temperature goals during re-warming

Responsibility:
RN and MD/DO

Considerations:
1. If at any time during treatment, an exclusion criterion is met or if the attending physician or newborn's guardian deems necessary to stop the cooling protocol, **rewarm** the newborn according to the ***Re-Warming Procedure*** in this guideline.
2. Subcutaneous fat necrosis. This does not require treatment and it will resolve spontaneously, but newborn will need serum calcium levels monitored as hypercalcemia is a risk during resolution. It also requires skin assessment every 4 hours and documentation in electonric health record (EHR).
3. Oral care with human breast milk or sterile water should be done each care time.
4. EEG leads can be removed by NICU nurse if EEG tech is unavailable and patient requires removal for MRI or redirection of care.

Other Related Policies/Protocols/Guidelines:
16.07.130 (NICU) Cerebral Function Monitor: Olympic CFM 6000

References:

1. Azzopardi DV, Strohn B, Marlow N, Brocklehurst P, Deirel A, Eddama O, et al. Effects of hypothermia for perinatal asphyxia on childhood outcomes. *N Engl J Med*. 2014; 371(2):140-9.
2. Organization, A. M. (2016). Therapeutic Hypothermia in Neonates: Recommendations of the Neonatal Encephalopathy Task Force. Boston: Harvard medical Institutions Incorporated.

Initiated by:

NICU

Contributing Departments:

Nursing
NICU Physician Staff
Pediatric Neurology Service

APPROVAL DATE	COMMITTEE
May 2025	Perinatal Committee

Boston Medical Center
HEALTH SYSTEM
Medication Guideline

Issued:	March 2018
Full Review	October 2025
Last Revised:	September 2026
Section:	Pharmacy/Nursing

Neonatal Opioid Withdrawal Syndrome (NOWS) Clinical Guidelines

Indications for use of these guidelines: Infants chronically exposed to opioid medications *in-utero* such as methadone, buprenorphine (Subutex or Suboxone), morphine, oxycodone, hydromorphone, and heroin. NOWS is also known as Neonatal Abstinence Syndrome (NAS).

Inpatient monitoring for NOWS: Methadone and buprenorphine exposed infants should be monitored in the hospital for a minimum of **5-7 days** for signs of withdrawal.

Quick Link

- Methadone algorithm
- Secondary agent algorithm
- Appendix A: IV Morphine Sulfate Dosing for NPO patients with NOWS
- Appendix B: NWAS and ESC Assessment Tools

Vivitrol (extended-release naltrexone) or oral naltrexone: This is newer option for treatment of opioid use disorder in pregnancy. It is not an opioid medication. Infants exposed to naltrexone do not require monitoring for NOWS. These mother-infant dyads should receive a social work consultation and maternal toxicology testing per L&D policy. They should be referred to the SO FAR clinic and/or Baby Steps, but do not require Ophthalmology follow-up or an Early Intervention referral. Breastfeeding is permitted for individuals who are stable on naltrexone. Page Elisha Wachman or Kelley Saia with further questions.

NOWS Risk Factors: 40-50% of exposed infants are treated with medication for NOWS at BMC

- **Increased risk:** Methadone; concurrent medications including benzodiazepines and SSRIs; nicotine; poly-pharmacy exposure; fentanyl exposure
- **Decreased risk**: Breastfeeding; prematurity; buprenorphine; short-acting opioids

Goals of Treatment:

- Decrease irritability; optimize ability to interact with environment
- Normalize feeding; minimize diarrhea and vomiting; provide adequate nutrition
- Promote sleep (>2 hours between feeds), but do not heavily sedate infant
- Involve family in care, as appropriate, or work with DCF to identify foster care as early as possible

Non-Pharmacologic Treatment: ***All infants should receive these interventions as first-line treatment***

- Skin-to-skin holding with parents as often as possible
- Encouragement of parental presence at the bedside as often as possible
- Decreased stimulation (light and voice)
- Cluster care to avoid unnecessary waking between feeds

- Swaddling and sleep sacks
- Pacifier

NOWS admission orders and consultations:

- Please give ***NOWS parent brochure*** and ***NAS bundle of care handout*** upon admission
- See NOWS computerized order set: "Neonatal Opioid Withdrawal Syndrome (NOWS)"
    - NOWS "ESC" assessments every 3-4 hours *(see below)*
    - Similac Advance 20 formula if not breastfeeding *(see below)*
- Consults:
    - Social Work, Occupational Therapy, and Nutrition for all infants
    - Lactation for breastfeeding babies
    - Pediatric ID consult if mom HIV positive or Hepatitis C positive
    - Project RESPECT pager 2593 for BMC Main patients

Monitoring and Scoring:

- Infants should be assessed while in the patient's postpartum room, and can be assessed skin-to-skin on the parent
- BMC utilizes the **Eat, Sleep, Console (ESC) NOWS Care Tool** and the **NICU Withdrawal Assessment Tool (NWAS)** according to the table below:

Table: Assessment Tool Indications

ESC NOWS Care Tool	NWAS Assessment Tool
All infants in the Normal Nursery / Postpartum Unit	Infants in the NICU < 34 weeks CGA
All infants on the Pediatric Inpatient Unit	Infants in the NICU regardless of gestational age who are critically ill (*ie, on respiratory support or who are NPO for critical illness)*
Infants in the NICU >34 weeks CGA and well (ie, not on respiratory support and on enteral feedings)	
***Infants receiving NG feedings who meet the above criteria should still be assessed by ESC*	

- For infants ≥34 weeks GA, the decision to treat should be based on the Neonatal Opioid Syndrome Assessment Tool **"ESC"**. For infants < 34 weeks, the NICU Withdrawal Assessment Scale **(NWAS)** should be utilized for assessments. Please see **Neonatal Opioid Withdrawal Syndrome Algorithm** for guidelines for pharmacotherapy.
- Infants on methadone therapy do not require a baseline EKG. There is no reported risk for prolonged QTc with this dosing in neonates. Consider EKG and/or consult pediatric pharmacy if infant is on other medications known to prolong the QTc. If an EKG is obtained for other clinical reasons and the QTc is >500ms, please consult with pediatric pharmacy and hold methadone.
- **Vital sign monitoring for infants on PRN or standing methadone**:
    - Infants do not require continuous cardiorespiratory or oximetry monitoring. PRN or standing methadone may be given in the postpartum room.
    - Check infant vital signs (**HR and RR**) prior to giving dose of **PRN or standing methadone**: If HR < 80 or RR < 20, please consult with the nursery attending prior to giving.
    - The infant should have **hourly HR and RR checks** in the postpartum room until **4 hours** after the first methadone dose. If the dose is tolerated well with no apnea or bradycardia events, the infant should then have vital signs every 8 hours for the duration of methadone treatment.
    - Criteria to be placed on a continuous monitor in the nursery include, *but are not limited to*:
        - Apnea or hypopnea (RR < 20) *(defined as >20 second pause in breathing,*

or any apnea with desaturation < 85%)
- O2 sat < 93%
- HR consistently < 80. *Infants with transient HRs to the 70's that self-resolve can be discussed with the nursery attending on a case by case basis*.

Nutrition:
- Breastfeeding should be encouraged for methadone and buprenorphine exposed infants who meet eligibility criteria. See **Breastfeeding with Prenatal Substance Use Guidelines.**
- Use **Similac Advance 20 formula** for all infants who are opioid exposed, symptomatic and/or IUGR if the mother chooses not to breastfeed, is unable to breastfeed, stops breastfeeding or when supplementing breastfeeds. Nutrition should be consulted.

Toxicology Testing for Infants:
- The goal of toxicology testing is to help guide the medical management of the infant.
- Indications for obtaining a urine toxicology test on the infant:
  - Symptoms consistent with CNS irritability including seizures or signs and symptoms of neonatal substance withdrawal of unknown etiology affecting management of the infant,.
  - Known maternal substance use disorder during pregnancy in which there is no maternal toxicology test obtained on Labor and Delivery
- Consent:
  - Parental consent is not required for a toxicology testing if any of the above indications are met
  - The pediatric provider must meet with the parent(s) to explain the reasons for the sample collection and the possible consequences associated with positive test results for non-prescribed substances (e.g., notification to DCF).
  - Upon completion of the testing, the provider should meet with parent(s) again to discuss the results of the testing and the plan for the infant.
- What to order when sending a toxicology test:
  - Urine toxicology test "Basic screen" (amphetamines, barbiturates, benzodiazepines, cocaine metabolites and opiates)
  - Urine "Expanded opioid panel" (buprenorphine, methadone, oxycodone, fentanyl)
  - *Note: It is not recommended to screen for marijuana (THC) due to unreliability*
  - *Note: Epidural fentanyl may interfere with maternal or infant toxicology testing results*

Guidelines for NPO Patients: First line therapy is IV morphine: See ***Appendix A*** on the Neonatal Opioid Withdrawal Syndrome Algorithm for dosing guidelines.

Circumcision Timing:
- Circumcisions can be done at any point after the first 24 hours of life, either while the infant is still on the Mother Infant Unit or after transfer to Yawkey 5 Pediatrics. All circumcisions will be performed on the Yawkey 4 unit regardless.
- Consider deferring circumcision if the baby is escalating in NOWS symptoms until the infant is more stable.

Discharge Planning (BMC Main):
- Refer all opioid-exposed infants to the **SOFAR (Supporting Our Families Through Addiction and Recovery)** at BMC as a primary care option. Call 617-414-6672 to schedule an appointment with Dr. Costello, Dr. Stulac or the Green Team.
- Referral to **Baby Steps Program** for all infants with NOWS; give Baby Steps brochure

- **Early Intervention** referral for all infants with NOWS should be arranged through the ward assistant.
- **Ophthalmology** referral for all infants with NOWS due to higher risk of refractive errors: Call Rose Joseph at **4-4071** to schedule appointment with Dr. Christiansen at 4-6 months of age
- **Pediatric ID** follow-up appointment for Hepatitis C exposed infants
- If on **phenobarbital,** phenobarbital wean should be detailed in the discharge prescription and discharge summary
- Phone communication with primary care physician
- VNA for all infants with NOWS
- Document in the discharge summary if a **Plan of Safe Care** is in place based on Social Work assessment

Contributing Departments:

NOWS Working Group: Elisha Wachman, MD (NICU), Elizabeth Hutton, MD (Inpatient Pediatrics), Sue Minear, MD (Birth Place), Karan Barry, RN (Inpatient Pediatrics), Ginny Combs, RN (Birth Place), Donna Stickney, RN (NICU), Cheryl Slater, RN (Birth Place, NICU), Judy Burke, RN (NICU), Hannah Simons, RN (Birth Place), Julie Slomkowski, PharmD (Pharmacy), Jennifer Alami, PharmD (Pharmacy), Kelley Saia, MD (Obstetrics)

Note: This protocol was developed using scientific data and expert opinions available at the time of its last review. The clinician may choose to deviate from the protocol based on clinical judgment and assessment of a specific patient's clinical condition and needs.

References:

1) Hudak ML, Tan RC. Committee on Drugs; Committee on Fetus and Newborn; American Academy of Pediatrics. Neonatal drug withdrawal. *Pediatrics*, 2012; 129(2): e540-60. PMID:22291123; DOI: 10.1542/peds.2011-3212
2) Wachman EM, Newby PK, Vreeland J, et al. The relationship between maternal opioid agonists and psychiatric medications on length of hospitalization for neonatal abstinence syndrome. *J Addict Med*, 2011; 5: 293-9. PMID: 21857233; DOI: 10.1097/ADM.0b013e3182266a3a
3) Jones HE, Heil SH, Tuten M, et al. Cigarette smoking in opioid-dependent pregnant women: neonatal and maternal outcomes. *Drug Alcohol Depend,* 2013; 131(3):271-7. PMID: 23279924; PMCID: PMC3694998; DOI: 10.1016/j.drugalcdep.2012.11.019
4) Wachman EM, Saia K, Humphreys R, et al. Revision of Breastfeeding Guidelines in the Setting of Maternal Opioid Use Disorder: One Institutions' Experience. *J Hum Lact,* 2016; 32(2): 382-7. PMID: 26514156; DOI: 10.1177/0890334415613823
5) Bagley SM, Wachman EM, Holland E, et al. Review of the assessment and management of neonatal abstinence syndrome. *Addict Sci Clin Pract,* 2014; 9(1): 19. PMID: 25199822; PMCID: PMC4166410; DOI: 10.1186/1940-0640-9-19
6) Jones HE, Seashore C, Johnson E, et al. Psychometric assessment of the Neonatal Abstinence Scoring System and the MOTHER NAS Scale. *Am J Addict*, 2016; 25(5): 370-3. PMID: 27287965; DOI: 10.1111/ajad.12388
7) Holmes AV, Atwood EC, Whalen B, et al., Rooming-In to Treat NAS: Improved Family-Centered Care at Lower Cost. *Pediatrics*, 2016; 137(6). PMID: 27194629; DOI: 10.1542/peds.2015-2929
8) Hall ES, Meinzen-Derr J, Wexelblatt SL. Cohort Analysis of a Pharmacokinetic-Modeled Methadone Weaning Optimization for Neonatal Abstinence Syndrome. *J Pediatr* 2015;167:1221-25.e1. PMID: 26477866; DOI: 10.1016/j.jpeds.2015.09.038
9) Brown MS, Hayes MJ, Thornton LM. Methadone versus morphine for treatment of neonatal abstinence syndrome: a prospective randomized clinical trial. *J Perinatol,* 2015; 35(4): 278-83. PMID: 25357093; DOI: 10.1038/jp.2014.194
10) Humbarger O, Galanto D, Saia K, Bagley SM, Wachman EM, et al. Childhood Health and Development in a Cohort of Infants Exposed Prenatally to Methadone or Buprenorphine. *J Addict Res Ther,* 2016; 7:263. http://dx.doi.org/10.4172/2155-6105.1000263
11) Howard MB, Schiff DM, Wachman EM, et al. Impact of Paternal Presence at Infants' Bedside on NAS. Hosp Pediatr, 2017; Jan 30. Epub ahead of print.
12) Oei HL, Melhuish E, Uebel H, et al. NAS and High School Performance. Pediatrics, 2017, Jan 16. EPub ahead of print.
13) Grossman M, Berkwitt A, Osborn R, Xu Y, Esserman D, Shapiro E, Bizzarro M, "An initiative to improve the quality of care of infants with neonatal abstinence syndrome" *Pediatrics*, June 2017.

October 2025

NOWS METHADONE ALGORITHM

For infants in the NICU < 34 weeks or critically ill on respiratory support utilize NWAS

- Begin **ESC / NWAS assessments** within **4 hours** of birth. Infants may be assessed on the mother skin-to-skin.
- Infants should be assessed every **3-4 hours** with routine feeds / cares.
- **NOWS Bundle of Care:** Encourage breastfeeding (if eligible), skin-to-skin with parents, parental presence at the bedside, feeding on demand, swaddling, decreased noise and light stimulation

1) Consider starting **PRN Neonatal Methadone** **1mg/ml oral solution 0.07mg/kg/dose q8 hours PRN** after a **team huddle** if:

- Infant with **any 1 "Yes"** responses **to ESC: 1) E = Poor feeding due to NOWS, 2) S = Sleep < 1 hour due to NOWS, OR 3) C = Console (Unable to Console within 10 minutes) or NWAS >3 AND:**
- **Non-pharmacologic care has been optimized first,** and non-NOWS causes ruled out
- Additional doses may be given **q8 hours PRN** for continued **"YES"** responses to **ESC** due to NOWS or **NWAS >3** despite optimal non-pharm care. A **team huddle** and/or **MD notification** should occur around each **PRN** dose. Dosing may occur at **q6 hours** for severe cases with uncontrolled symptoms.

2) Further optimize **non-pharmacologic care** as **first-line treatment:**
*** CALM Cuddlers:** Call 44511 (Yawkey 5) or 45844 (Volunteer Services) to request a cuddler
* **There are no maximum number of PRN methadone doses**
* Infants who are not improving with PRN dosing should have a **huddle** to consider **standing Level 1**

3) Level	Starting dose of STANDING Methadone 1mg/ml oral solution
1	**0.2 mg/kg/day** PO divided q8 hours = 0.07 mg/kg/dose
2	**0.4 mg/kg/day** PO divided q8 hours = 0.13 mg/kg/dose
3	**0.6 mg/kg/day** PO divided q8 hours = 0.2 mg/kg/dose
4	**0.8 mg/kg/day** PO divided q8 hours = 0.27 mg/kg/dose

Always use **BIRTH WEIGHT** to dose methadone

4) Increase oral methadone dose to **next level** if:
- Continues to have "**Yes"** to **ESC** due to NOWS or **NWAS >3**
- Methadone can be increased **1 time per day** (q16 hours)

5a) Methadone Weaning:
- Wean by **10%** of maximum dose in **mg/kg/day** once daily as tolerated if primarily **"NO"** for **ESC** over the past 24 hours or **NWAS <3**.
- **Discontinue** methadone when dose is **10%** of maximum dose.
- **Consider increasing methadone interval** for infants with challenging weans in consultation with pharmacy.
- Infants should be monitored for **48 hours** off methadone before discharge home.

5b) Failed Weans:
If after a wean, persistent **ESC** "Yes" due to NOWS or **NWAS >3**, then:
Option 1: Consider **increasing methadone dose** by 10%.
Option 2: Attempt to **hold current dose** for up to 24 hrs, particularly towards the end of the weaning process.
Option 3: Consider **adding secondary agent** if <50% through wean.
Option 4: Towards end of the wean, may **increase interval** to q12 then q24 hours with pharmacy consultation

6) Re-Initiation of methadone after discontinuation:
- Consider for persistent **ESC** "Yes" due to NOWS or **NWAS >3**
- Option 1: Can trial **PRN dosing** with **0.07mg/kg/dose**
- Option 2: Re-start at **20%** of maximum dose, then wean once down to **10% dose** before discontinuing.

7) All methadone and buprenorphine exposed infants should be observed inpatient for a minimum of **5-7 days** for need for medication treatment.
* Infants treated with **PRN methadone** must be monitored for **48 hours** after the final dose before discharge.

NOWS Secondary Agent Algorithm

For infants in the NICU < 34 weeks or critically ill on respiratory support utilize NWAS

1) Consider **adding secondary agent** if:
- the maximum oral methadone dose (level 4) is reached and symptoms persist with **ESC** "Yes" due to NOWS or **NWAS** >3, OR if
- Stalled weaning for 2-3 days after first attempting methadone re-stabilization
- Use **Phenobarbital** as secondary agent particularly if infant is polypharmacy, benzodiazepine, illicit drug (including heroin) and/or alcohol exposed or if infant exhibiting severe neurological symptoms.
- Use **Clonidine** as a third-line agent if infant has not responded well to Phenobarbital
- 24 hours after initiation, wean methadone if "NO" to ESC or NWAS <3 over the past 24 hours

2a) Phenobarbital loading dose = 20 mg/kg PO

Always use **BIRTH WEIGHT** to dose phenobarbital

2b) Clonidine dose = 1 mcg/kg PO q4 hours
- Monitor blood pressure every 4 hours. Hold dose if SBP <65 or DBP <35.
- Never increase dose > 1 mcg/kg/dose

3a) Reload phenobarbital If:
- Persistent **ESC** "Yes" due to NOWS or **NWAS >3**
- **10mg/kg/dose PO every 8-12 hours as needed x 2 more doses** until the cumulative total of all loading doses reaches a maximum of 40mg/kg

3b) Once stable, wean off methadone, then decrease **clonidine** dose every 24 hours as tolerated by extending the dosing interval from q4hr to q8hr to q12hr, then off.
- After discontinuation, observe for 48 hrs minimum before preparing for discharge.

4a) Begin **phenobarbital maintenance dosing** 24 hours after last loading dose and give maintenance dose every 24 hours. Maintenance dose depends on sum of all loading doses received:

Cumulative Sum of Loading Doses	Maintenance Dose
20 mg/kg	5 mg/kg/day
30 mg/kg or higher	6.5 mg/kg/day

Phenobarbital serum levels:
- If a cumulative total of 30mg/kg of loading doses have been given, **draw a serum level** prior to giving any further loading doses.
- For all infants on Phenobarbital, obtain a baseline trough level 48 hours following the last loading dose.
- Ideal phenobarbital serum level to control NOWS is 20-30mg/ml. If the level is >40mg/ml, consider decreasing the dose and contact the pediatric pharmacist for additional guidance.
- Additional serum levels may be drawn as clinically indicated.

5a) Once an infant is off of oral methadone, **phenobarbital** may be **weaned** by the inpatient team or the primary care physician.
- Phenobarbital can generally be discontinued after a 4-8 week taper
- Wean phenobarbital by 20% every 3 to 5 days, as long as the infant is not exhibiting withdrawal symptoms
- Include phenobarbital weaning in **discharge Rx** and instructions in the **discharge summary**

Appendix A – IV Morphine Sulfate Dosing for NPO Patients with NOWS

- Note that IV morphine is not well studied for use for NOWS and may put the patient at greater risk for adverse effects such as respiratory depression and sedation.
- **Indications for us of IV morphine for NOWS**: Infants unable to tolerate enteral methadone dosing
- **Assessments:** Preterm infants < 34 weeks GA should be assessed with the **NWAS** (see Appendix B or NICU Sedation Guidelines) instead of ESC every 3-4 hours with cares. Infants should be started on IV morphine for **NWAS scores >3 on 2-3 consecutive assessments.**
- **Consultation**: If starting a baby on IV morphine protocol, please notify the pediatric pharmacist within 24 hours of initiation for assistance with management.
- **Initiating IV Morphine Infusion:**
    - IV morphine should be ordered as a **continuous morphine infusion** through the **Neonatal Opioid Withdrawal Syndrome (NOWS) order set.**
    - Initial dose: **0.01 – 0.02mg/kg/hour.** Dosing should be based on **birth weight.**
    - Concentration: Please reference the **NICU Continuous Infusion Binder** for drip rates to select the most appropriate concentration. Most patients will require the **0.05mg/mL** concentration. Other options include the 0.1mg/mL or 0.5mg/mL solutions. **Drip rates should be rounded to the nearest "0.1mL/hr" for pump accuracy.**
    - Carrier fluid: Select D5, D10, or NS
- **Escalation of IV Morphine Infusion:**
    - If infant has continued "NWAS scores >3, the morphine infusion should be increased in increments of **0.01mg/kg/hr** q12-24 hours to a maximum recommended dose of **0.05mg/kg/hr.**
    - If NWAS scores consistently >3 on maximum dosing of IV morphine, second-line therapy with **IV phenobarbital** may be considered at this time. Dosing is equivalent to PO phenobarbital per ***NOWS Secondary Agent Algorithm.***
- **Weaning of IV Morphine Infusion:**
    - Once infant has stable NWAS scores ≤3 for 24 hours, may wean the IV morphine by **0.01mg/kg/hr** daily.
- **Conversion to PO Methadone:**
    - Once able to tolerate enteral medications and the infant has weaned down to a maximum of **0.03mg/kg/hr** of the IV morphine solution, the IV morphine can be converted to PO methadone solution at a ratio of **2mg IV morphine = 1mg PO methadone.**
    - Should then proceed to **wean by 10%** of the **maximum PO daily dose** until down to **20% of maximum**, then discontinue.

Sample Calculation for Conversion from IV morphine infusion to PO methadone:

1. Wean down to minimal IV infusion rates of morphine:
   - Morphine: 0.01-0.03 mg/kg/hour
   - Conversions to enteral methadone can be made from higher doses of morphine if required to remove central line and advance enteral feedings.
2. Calculate 24-hour dose of morphine (mg/kg/day)
3. Convert morphine dose (Step 2) to an equipotent dose of methadone
   - 2 mg IV morphine = 1 mg PO methadone
4. Determine the mg/kg/day of methadone, and then divide into Q8H dosing per the NOWS guidelines
   - Order in mg/kg/day per Neonatal Opioid Withdrawal Syndrome (NOWS) order set
   - Wean by 10% in mg/kg/day based on highest methadone dose

Example: Conversion of continuous morphine to PO methadone:

Infant is on 0.01 mg/kg/hour morphine

Multiply by 24 to get the daily dose of IV morphine
0.01 mg/kg/hour x 24 hours = 0.24 mg/kg/day

Divide by 2 to get the daily dose of PO methadone
0.24 mg/kg/day / 2 = 0.12 mg/kg/day PO methadone

Appendix B – NWAS and ESC Assessment Tools

EAT, SLEEP, CONSOLE (ESC) CARE TOOL 3rd edition v.4/22/21

- **Review ESC behaviors, signs of withdrawal,** and **Non-Pharm Care Interventions (NPIs)** with parent(s)/caregiver **every 2-4 hours** (using **Newborn Care Diary**), **clustering care** with infant's wakings and feedings.
- With each assessment, **reinforce NPIs** that are currently being implemented well (**"R"**), **coach** in ways **other NPIs** can be **increased now** (**"I"**), and **educate** in ways to increase in the **future** (**"E"**).
- If **Yes** for any **ESC** item *or* **3** for **Consoling Support Needed**: Perform a **Formal Parent/Caregiver Huddle.**
- If **2nd Yes in a row** for **the same ESC** item *or* **2nd 3 in a row** for **Consoling Support Needed** *AND* **NPIs maximized** for infant's current clinical setting *OR* if **other significant concerns** are present: Perform a **Full Care Team Huddle.**

See back of ESC Care Tool for tool item definitions & details regarding Formal Parent Caregiver and Full Care Team Huddles

Perform assessment of ESC behaviors, signs of withdrawal, and NPIs for time period since last ESC assessment – note date/time:	
NOWS/NAS RISK ASSESSMENT	
Are signs specific for withdrawal present? (e.g., hyperactive startle/Moro, disturbed & undisturbed tremors, hypertonia, excessive/disorganized suck, watery stools, continuous crying/excessive irritability in absence of other etiology) Yes / No	
If Yes, is timing of withdrawal consistent with known opioid exposure? Yes / No / Unsure	
Are co-exposures present that may be contributing to signs of withdrawal? Yes / No / Unsure (please list co-exposures)	
Are other significant concerns present? (e.g., apnea, seizures, excessive caregiver sleepiness) Yes / No / Unsure	
Are NPIs maximized to fullest extent possible in infant's current clinical setting? Yes / No / Unsure	
EATING	
Takes > 10 min to coordinate feeding *or* **breastfeeds < 10 min** *or* **feeds < 10 mL** (*or* other age-appropriate duration/volume) **due to NOWS?** Yes / No	
SLEEPING	
Sleeps < 1 hr due to NOWS? Yes / No	
CONSOLING	
Takes > 10 min to console (*or* **cannot stay consoled for** *at least* **10 min) due to NOWS?** Yes / No	
Consoling Support Needed *(assessed independent of NOWS)* **1**: Able to console on own **2**: Able to console within (and stay consoled for) 10 min with caregiver support **3**: Takes > 10 min to console (*or* cannot stay consoled for *at least* 10 min) despite caregiver's best efforts	
CARE PLAN	
Formal Parent/Caregiver Huddle Indicated to formally review NPIs to be increased further? Yes / No / NA (choose NA if Full Care Team Huddle indicated as this includes Parent/Caregiver)	
Full Care Team Huddle Indicated to formally discuss ESC difficulties and/or other significant concerns present, consider all possible etiologies for symptoms, re-assess if NPIs are maximized, and determine if NOWS pharmacologic treatment or other changes in management are needed? Yes / No	
Management Decision **a: Continue/Optimize NPIs** **b: Initiate NOWS Pharmacologic Treatment** (please list medication initiated) **c: Continue NOWS Pharmacologic Treatment** **d: Other** (please describe - e.g., LC &/or OT/PT Consult, Start 2nd Pharm Agent [indicate name]; Increase, Wean or Stop Medication)	
PARENT/CAREGIVER PRESENCE SINCE LAST ASSESSMENT	
> 3 hours (includes if parent/caregiver present entire time), **2-3 hours**, **1-2 hours**, **< 1 hour**, **0 hours** (no parent/caregiver present)	
NON-PHARM CARE INTERVENTIONS (I = Increase Now, **R** = Reinforce, **E** = Educate for Future, **NA** = Not Applicable/Available)	
Rooming-in (i.e., caring for infant in their own room with earlier caregiver response to infant stress or hunger cues)	
Parent/caregiver presence to help calm and care for infant	
Skin-to-skin contact when caregiver fully awake/alert to help organize infant feeding behaviors, calming & sleep	
Holding by parent/caregiver/cuddler to help calm infant & aid in sleep (with caregiver fully awake/alert)	
Safe & effective swaddling (e.g., extremities swaddled in flexed position, blanket snug, no extra blanket around baby's face)	
Optimal feeding (e.g., baby offered feedings when showing hunger cues & fed till content)	
Non-nutritive sucking with infant's hand, pacifier, adult caregiver's washed or gloved finger	
Quiet, low light environment to help limit overstimulation of infant (e.g., tv volume down, quiet "white noise" machine or phone app)	
Rhythmic movement provided by parent/caregiver or infant calming device (e.g., "jiggling" or infant swing in presence of alert adult)	
Additional help/support in room (e.g., other parent, family member, friend, cuddler, staff member, recovery coach, DCYF worker)	
Limiting # of visitors & duration of visit(s) to minimize disruptions in infant's care environment & sleep	
Clustering care & assessments with infant's awake times (e.g., RN & infant provider perform assessment together after infant feedings)	
Safe sleep/fall prevention (e.g., infant sleeps on back, safely swaddled, in own sleep space)	
Parent/caregiver self-care & rest (e.g., identifying another adult to care for infant so parent can rest or take a walk/break)	
Optional Comments: (e.g., staff caring for baby as parents not available or able to safely care for baby; other NPIs [please describe])	

© 2017 Boston Medical Center Corporation, Yale-New Haven Children's Hospital, and Children's Hospital at Dartmouth-Hitchcock; 3rd edition v.4/22/21

NICU Withdrawal Assessment Scale (NWAS)

Autonomic and GI assessment	
Loose or watery stools	*No = 0* *Yes = 1*
Feeding intolerance ***due to withdrawal***	*No = 0* *Yes = 1*
Temperature instability, tachycardia, or tachypnea ***due to withdrawal***	*No = 0* *Yes = 1*
Neurologic assessments	
Baseline state	*Sleeping, or awake and calm = 0* *Awake and distressed = 1*
Tremors	*None/mild = 0* *Moderate/severe = 1*
Startle response	*Normal for GA = 0* *Exaggerated startle for GA = 1*
Muscle tone	*Normal for GA = 0* *Increased for GA = 1*
Consolability assessment	
Consolability rating	*Able to console on their own = 0* *Consoles with support in < 10 minutes = 1* *Does not console within 10 min = 2*
Total score (0-9)	

Cut-off scores: Scores in general >**3** for 12-24 hours can consider that infant is having withdrawal that may warrant holding weans / increasing dose as clinically indicated. Scores in general **≤3** for 12-24 hours, can consider weaning as clinically indicated.

Instructions:

General instructions:

- Start NWAS scoring from the first day of weaning in patients who receive opioids and/or benzodiazepines by infusion or regular dosing for prolonged periods (Ex: ≥5 days).
- Score infant with the NWAS tool every 3-4 hours in coordination with care times.
- The score should encompass the entire 3-4 hour prior since the last assessment.
- Please only indicate scoring for these items if thought to be **DUE TO OPIOID or BENZODIAZEPINE WITHDRAWAL**, not other etiologies.

Autonomic and gastro-intestinal (GI) assessment:

This can be done by review of the electronic medical record over the previous 3-4 hour period since the last assessment.

- **Loose / watery stools:** Score 1 if any loose or watery stools were documented in the past 3-4 hours; score 0 if none were noted.
- **Feeding intolerance due to withdrawal:** Score 1 if any vomiting, large residuals, abdominal distention, or other feeding intolerance thought to be related to withdrawal were documented in the past 3-4 hours; score 0 if none were noted. Only score 1 if thought to be related to withdrawal. If unsure if due to withdrawal versus other etiology, score 1.
- **Temperature instability, tachycardia, or tachypnea due to withdrawal**: Score 1 if in the past 3-4 hours the temperature documented was greater than 37.8C in an open crib, temperature instability in isolette, tachycardia more than baseline, or tachypnea more than baseline that is thought to be related to withdrawal; score 0 if this is not the case. If temperature instability, tachycardia, and/or tachypnea are thought to be related to other etiologies, do not score 1. If unsure if symptoms are due to withdrawal, score 1.

Neurologic assessment:

This should be done as you are doing your infant care time through observation of the infant's behavior and physical exam.

- **Baseline State**: Score 1 if the infant is awake and distressed at the beginning of your assessment; score 0 if the infant is asleep or awake and calm at the beginning of your assessment.
- **Tremor:** Score 1 if the infant demonstrates moderate to severe tremors involving the arms or legs during your assessment; score 0 if you do not observe any tremors, or the tremors are mild involving only the feet and hands.
- **Startle response:** Score 1 if the infant has an exaggerated startle response for gestational age (GA) during your assessment; score 0 if the startle response is appropriate for GA.
- **Muscle tone:** Score 1 if tone increased per GA during your assessment; score 0 if the tone is normal per GA.

Consolability assessment:

This should be done at the end of the care time when attempting to console and settle the infant.

- **Consolability rating:** Score 0 if the infant is able to quickly self-console and achieve calm state on their own after cares with minimal intervention (Ex: pacifier, swaddling, covering isolette); score 1 if the infant requires moderate assistance in consoling but is able to console within 10 minutes; score 2 if the infant is difficult to console despite interventions, and / or takes greater than 10 minutes after cares to return to a calm state despite caregiver efforts to create a calm environment.