MATERNAL/NEWBORN & NICU FELLOWSHIP
PRETERM INFANT NUTRITION

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OBJECTIVES

- Discuss nutrition goals for preterm infants and differences in nutrient needs between preterm and term infants
- Detail typical progression of nutrition support for preterm and low birth weight infants
- Explain common enteral feeding types, including maternal breast milk, donor breast milk, and infant formulas
- Discuss discharge nutrition needs of preterm and low birth weight infants
- Explain purpose of centralized feeding preparation and procedures used by Methodist Women's Hospital's Infant Nutrition Lab

PRETERM INFANT NUTRITION GOALS

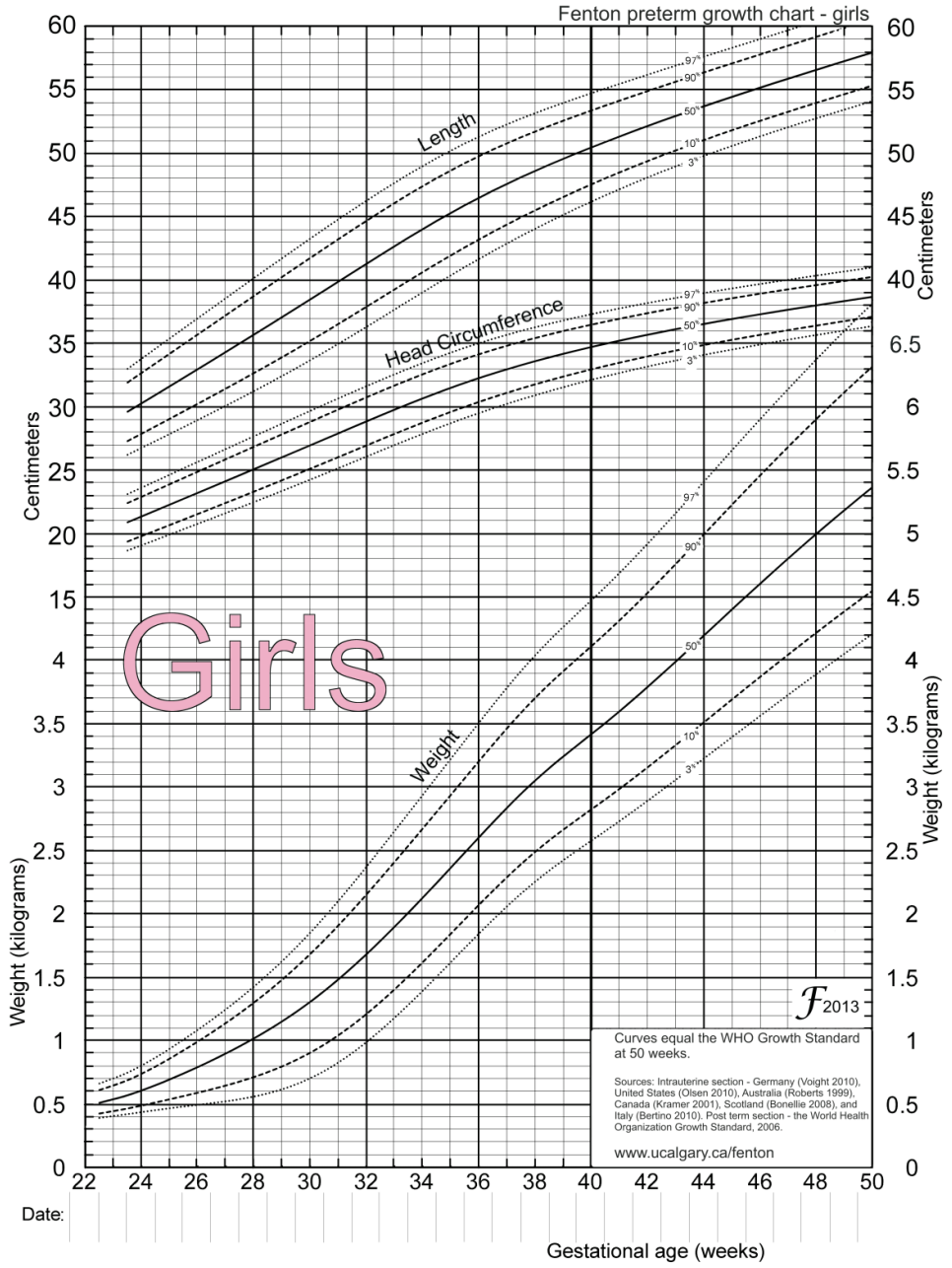
- Fetal nutrient accretion occurs rapidly in the 3rd trimester
- A healthy, AGA, full term baby has enough nutrient stores to receive only colostrum for the first days of life and can thrive on exclusive breastfeeding

PRETERM INFANT NUTRITION GOALS

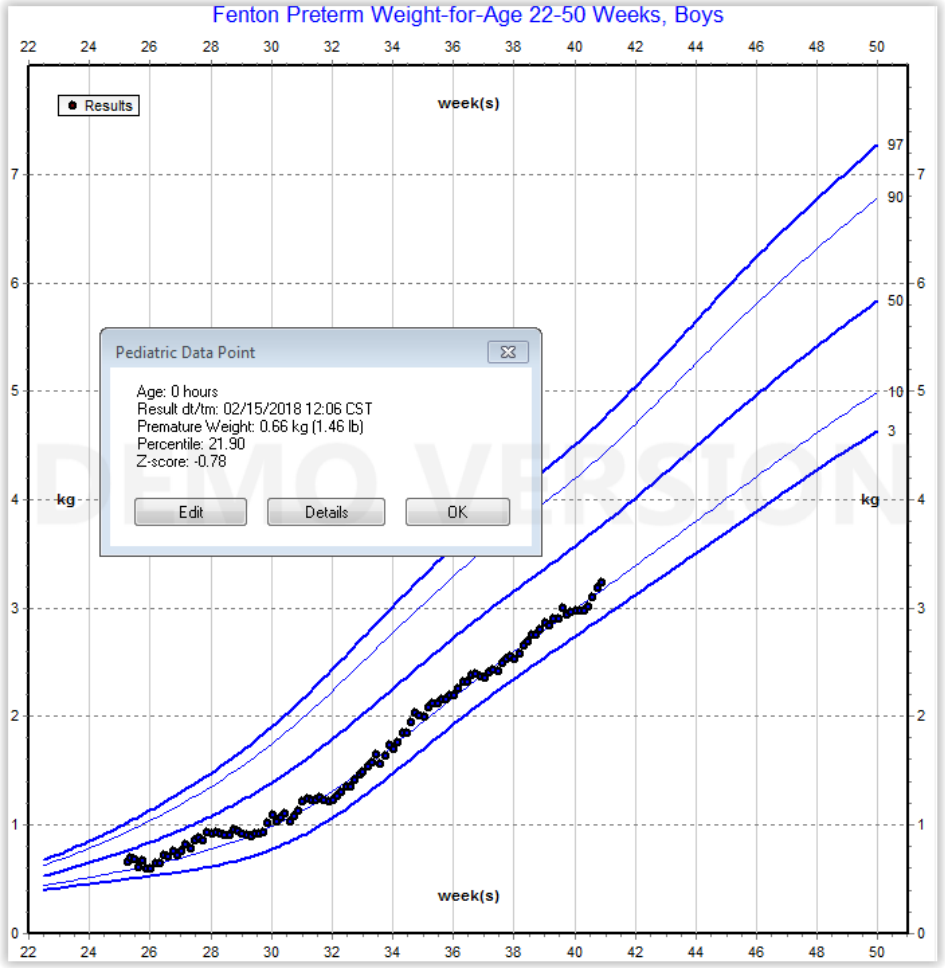
- But the nutrient stores and nutrition needs of preterm babies are very different!
- The goal of nutrition support is to provide nutrients to approximate the rate of growth and composition of weight gain for a normal fetus of the same post-conceptual age

FENTON PRETERM GROWTH CHART

- Weight, length, and head circumference charts
- Updated 2013 to plot daily on gender specific charts
- Used for babies born <37 weeks
- Merges with WHO chart at 50 weeks corrected age



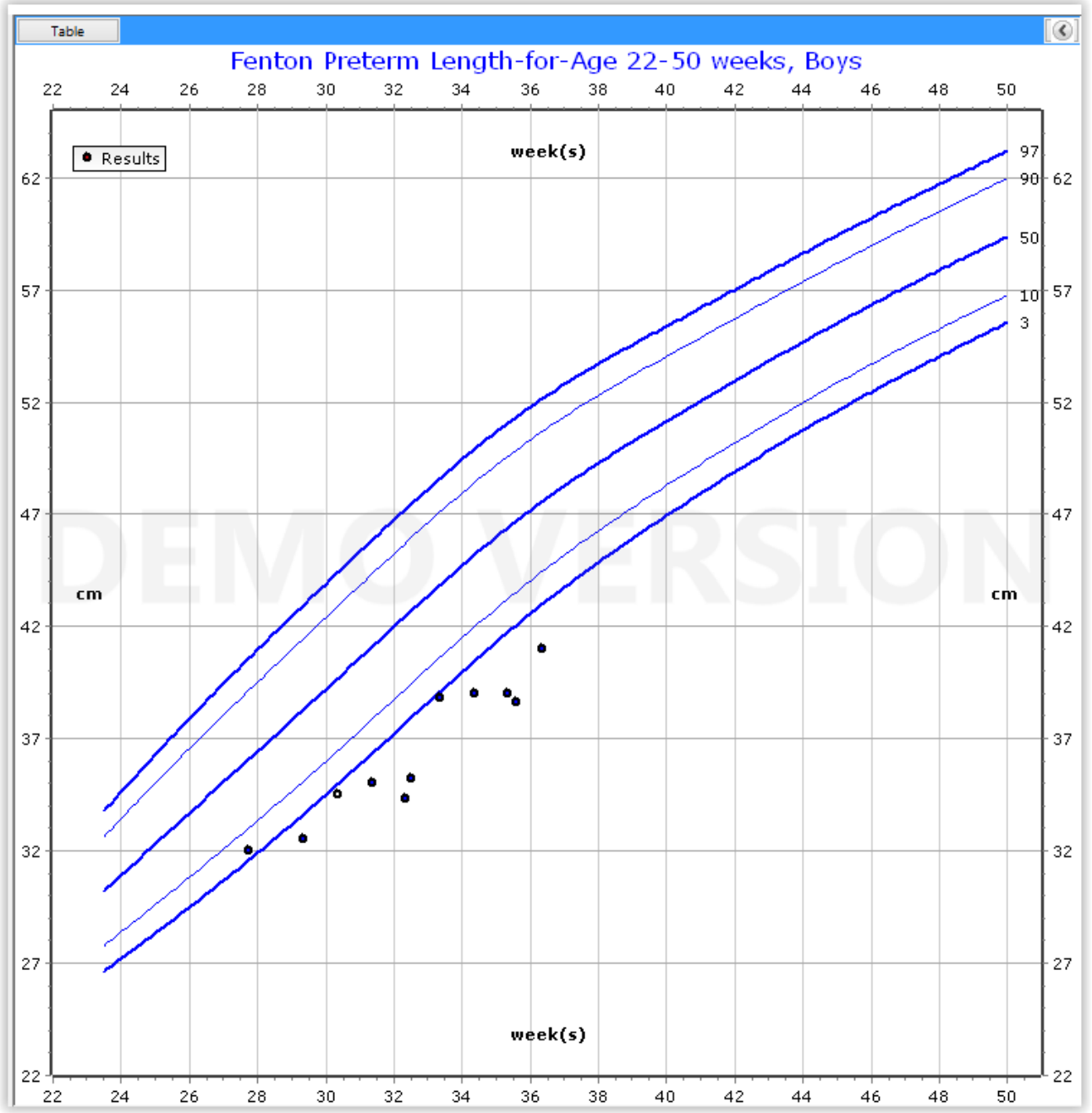
GROWTH GOALS



- Goal is to maintain percentiles after adjusting for initial diuresis
- Difference in Z-score from birth <0.8
  - Weight: 8-37+ g/day goal based on current percentile, CGA, and catch up needs
  - Length: 0.8-1.1 cm/wk
  - Head Circumference: 0.8-1cm/wk

GROWTH GOALS

- We rely on accurate length measurements to help us diagnose malnutrition
- Length and head circumference growth are best indicators of adequate protein provision and lean body mass accretion



LENGTH MEASUREMENT

- Length is most accurately measured with a length board
- Accurate length measurement requires <u>two individuals to measure.</u>
  - One measurer holds the infant's head in contact with the headpiece, with infant looking vertically upward.
  - The second measurer aligns the infant's trunk and fully extends both legs, placing one hand on the knees to maintain full leg extension. This measurer then slides the footpiece to make firm contact with the infant's heels, with infant's toes pointing upward.

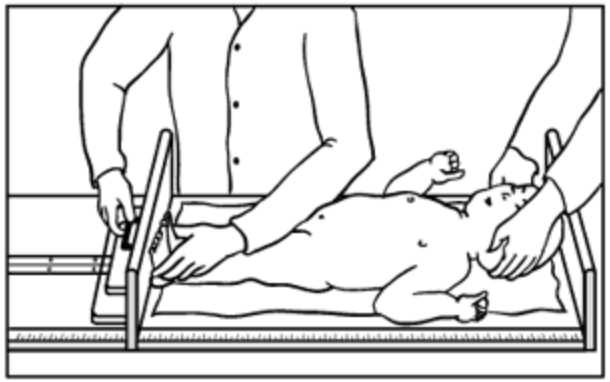
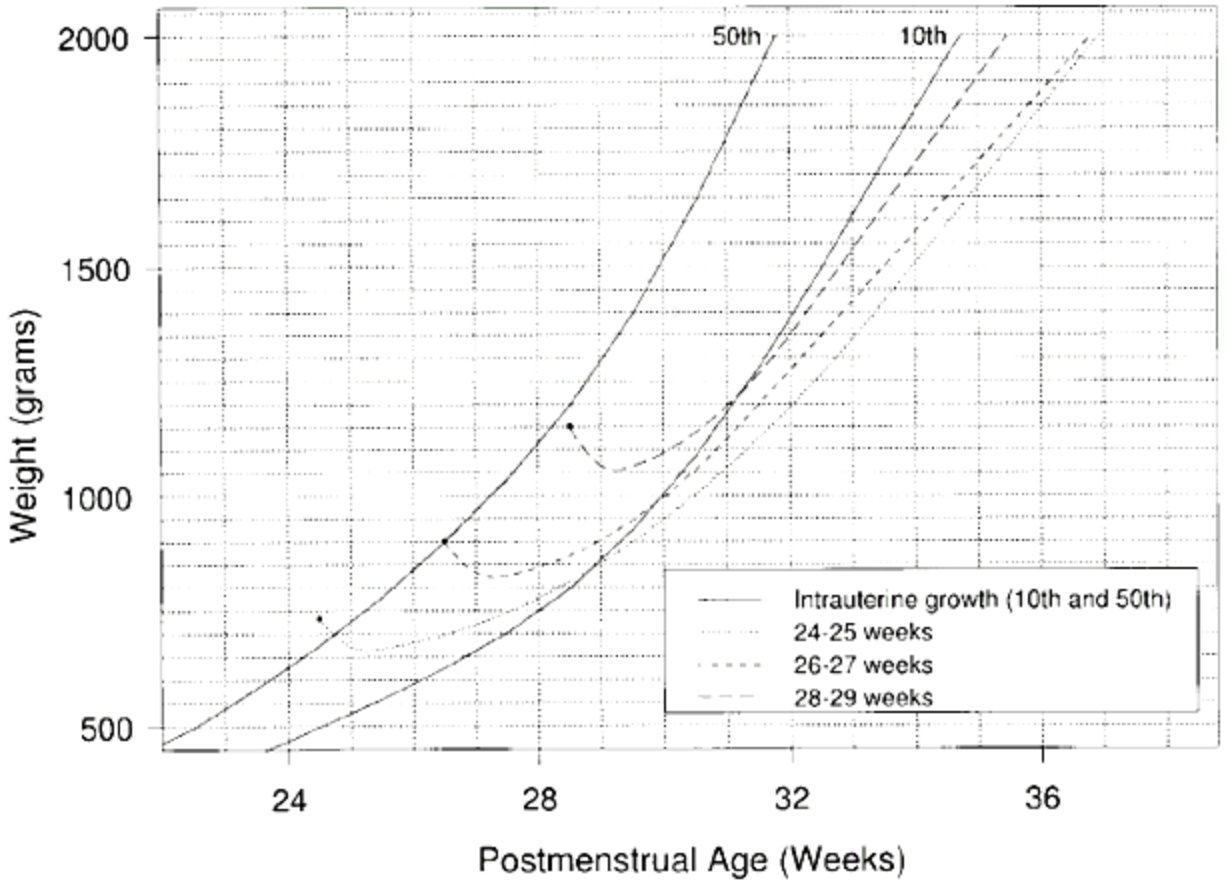


Illustration © Nardella, M, Campo, L, Ogata, B, eds. Nutrition Interventions for Children with Special Health Care Needs, Olympia, WA, State Department of Health, 2001.

POSTNATAL GROWTH FAILURE

- Inadequate nutrition leads to growth failure
- Discharged under-grown
  - Weight affected first, then length, then head circumference
- Why Do We Care? Neurodevelopmental Outcomes!
  - Adequate nutrition and growth in the NICU is strongly linked to better developmental outcomes into school age years and beyond.



MACRONUTRIENT GOALS

- Calories
  - Term: 100-110 kcal/kg/day (150-180ml/kg/day)
  - Preterm: 110-130 kcal/kg/day
- Protein
  - Highly dependent upon body weight/EGA
    - Term: 1.5-2 g/kg/day
    - Preterm: 3.2-4.5 g/kg/day
- Must adjust for any accrued deficit!

MEETING NUTRIENT NEEDS – TPN

- Vanilla TPN started at birth for all preterm infants on IV fluids
- Custom TPN started by DOL 1 on most babies <33 weeks EGA or <2000g BW
  - Carbohydrate
  - Protein
  - Fat
    - SMOFlipid = mix of soy, MCT, olive, and fish oils
  - Electrolytes/vitamins/minerals/trace elements
- Total fluid goal approximately 80ml/kg/day on DOL 0, advance by 20ml/kg/d to goal of 140-160ml/kg/day

MEETING NUTRIENT NEEDS – FEEDING ADVANCEMENT

- Feeds are ideally initiated with human milk on DOL 0-1 at 20-40 mL/kg/day depending on EGA
- Trophic Feeds – Minimal Enteral Nutrition
  - Low volume feeds for the smallest infants
    - At MWH, 15-20ml/kg x3 days for <28wks birth GA or <1000g BW
  - Intended to "prime" the gut
  - Increase feeding tolerance, assists with maturation of GI tract, decreased risk of NEC
- Feeds advance by 20-40 mL/kg/day to goal of 150-170 mL/kg/day
- Human Milk Fortifier added once feedings reach approximately 60ml/kg or after 72 hours of feedings, whichever is later

MEETING NUTRIENT NEEDS – ENTERAL NUTRITION

- Maternal Milk
  - Gold standard! Many benefits
  - Ideal nutrition for a healthy, AGA, term infant
  - Must be fortified with human milk fortifier for preterm infants to meet higher nutrient needs
  - Mothers of infants born preterm produce "preterm" milk with slightly different nutrient content that gradually turns to "term" milk over the first 2-4 weeks.
    - Not adequate nutrition alone for <35 weekers, but often enough for otherwise healthy infants born at 35-36 weeks

	Preterm Infant Needs per kg	150ml Preterm Human Milk Provides	150ml Term Human Milk Provides
Calories	110-130 kcal	101 kcal	102 kcal
Protein	3-4 g	2.1 g	1.5 g

MEETING NUTRIENT NEEDS – ENTERAL NUTRITION

- Donor Milk
  - Milk donated by moms with extra milk
  - Donors and milk tested and either pasteurized or sterilized
  - Inferior nutritionally but retains some protective factors
  - NICU patients at MWH can receive donor milk until DOL 5 or 34 weeks CGA, whichever comes later.
  - Goal is just to bridge the gap between birth and mom's milk coming in. Mom's own milk is best!

HUMAN MILK FORTIFIER

- Product Options:
  - Enfamil Human Milk Fortifier
  - Similac Human Milk Fortifier
    - + optional additional Liquid Protein
  - ProlactPlus H2MF
    - Human milk-based HMF
- Indications for use:
  - <35 weeks EGA and/or <1800g BW

INFANT FORMULAS

- Preterm Infant Formulas (Enfamil Premature, Similac Special Care)
  - <35 weeks gestation
  - <1800 gm birth weight
- Transitional/Post-Discharge Formulas (Enfamil Enfacare, Similac Neosure)
  - Former preterm infant at discharge
  - SGA/IUGR 35-37 weeks gestation

DISCHARGE NUTRITION

- Discharge feedings depend on:
  - EGA and weight at birth
  - Growth history during NICU stay
  - Whether mom is breastfeeding or pumping and milk supply
- Possible discharge feedings:
  - MBM plus 2-3 feedings per day of discharge formula
    - Most common! Helps if moms know about discharge formula feedings ahead of time!!
  - MBM alone
  - Preterm discharge formula
  - Specialty formula
  - Fortified MBM

SPECIALTY FORMULAS

- Partially hydrolyzed protein
  - Enfamil Gentlease, Similac Total Comfort, Gerber Good Start
- Extensively hydrolyzed protein
  - Nutramigen, Alimentum
- Amino acid based
  - Neocate, Elecare
- Enfamil AR
  - Rice starch used as a carbohydrate source, thickens at a low pH (in the stomach) to reduce reflux
  - Slightly to mildly thick at time of mixing – swallowing difficulty

CENTRALIZED FEEDING PREPARATION

- To provide optimal nutrition to preterm infants, unit dosed NICU feedings are prepared in a central, clean environment
- Goal is to prevent exogenous contamination and optimize accuracy
- Children's Hospital of Orange County study comparing bedside vs. centralized formula preparation
  - Powdered formula
    - Bedside prep: 43.7% with microbial growth
    - Centralized prep: 4% microbial growth
  - Sterile liquid products
    - Bedside: 6.3% microbial growth
    - Centralized prep: 0% microbial growth
- Bedside prep is 24x more likely to show contamination!

METHODIST WOMEN'S HOSPITAL INFANT NUTRITION LAB

- Human milk, formula, and additives can be measured to the nearest 0.2 mL or 0.2 gram for precision and minimal waste
- Management of donor milk
- Twice daily feeding prep and delivery
- Timeless Medical tracking of all human milk and prepared formula feedings

Babies ON Lab Service	Babies NOT On Lab Service
Babies <36 weeks CGA with ordered feeding volume (not ad lib)	Babies who are ≥36 weeks CGA *and* have feeding orders for only unfortified MBM and/or ready-to-feed formula
Babies with an order for donor milk	Babies <36 weeks CGA age on *ad lib* feedings of unfortified MBM and/or ready-to-feed formula
Babies with an order for fortified breast milk	
Babies with an order for formula that must be mixed (not ready-to-feed)	

DAILY INFANT NUTRITION LAB WORKFLOW

- Infant Nutrition Lab hours are 7am-6pm
- 7am tech collects MBM from room refrigerators and brings it downstairs to prepare feeds.
- A second tech comes in at 7:30. They prepare the 11am/12pm and 2pm/3pm feeds for delivery around 10am. Any new MBM is also picked up from room refrigerators at that time.
- **After the 10am delivery time, if mom brings in more milk the nurse needs to call the lab to let them know. Otherwise, that milk is used the following day.**
- A third tech comes in at 11am. Once the physician has rounded, the techs prepare 6 feedings from the new feeding order the 5pm/6pm feed through the 8am/9am feed the next day. **New feeding orders go into effect at 5pm unless a special request is communicated to the lab.**
- Techs deliver afternoon feeds 3-4pm and will return any unused milk to the fridge or freezer.

CENTRALIZED FEEDING PREPARATION

SUMMARY

- Optimize early nutrient delivery for preterm infants to minimize early deficits
- Feed appropriately fortified maternal milk whenever possible
- Monitor growth
  - Weight
  - Length
  - Head Circumference
- Consider increased nutrient needs when developing discharge feeding plan
- Use centralized feeding preparation for optimal safety and accuracy

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