Caring for the Preterm Infant as a Pediatric Clinician

Carrie Phillipi MD, PhD
Professor of Pediatrics

DOERNBECHER CHILDREN'S HOSPITAL
OHSU
Oregon Health & Science University

Late Preterm Infants

Photo courtesy of Janelle Aby

- 34 0/7 to 36 6/7 weeks' gestation
- Represent ~70% of preterm births; rising incidence globally
- Higher risk than term infants for morbidity, readmission, and developmental concerns

Objectives

- Practical newborn nursery management
- Newborn outpatient follow-up care
- Following growth and nutrition
- Promoting development
- Highlight controversies and the latest evidence in caring for preterm infants

What do you worry about when caring for preterm infants?

Practical Newborn Nursery Management

- Admission location
- Thermoregulation
- Hypoglycemia
- Feeding
- Jaundice
- Discharge Readiness

Baby Luke

2.1 kg 35 1/7 week male infant born to a G2P2 mother vaginally in setting of pre-eclampsia. Pregnancy and delivery were otherwise without complication.

Luke had initial normal temperatures, was placed on warmer after one temperature of 36.4, and is now 36.7 while skin-to-skin. He was treated once for hypoglycemia for a CBG of 30 which improved after dextrose gel and donor milk feeding.

Is Luke a good candidate for the newborn nursery?

Admission: NICU or Newborn Nursery?

Admitting low-acuity infants born at 35 weeks' gestation to the NICU was associated with decreased readmission, but with longer length of stay and decreased exclusive breast milk feeding at 6 months.

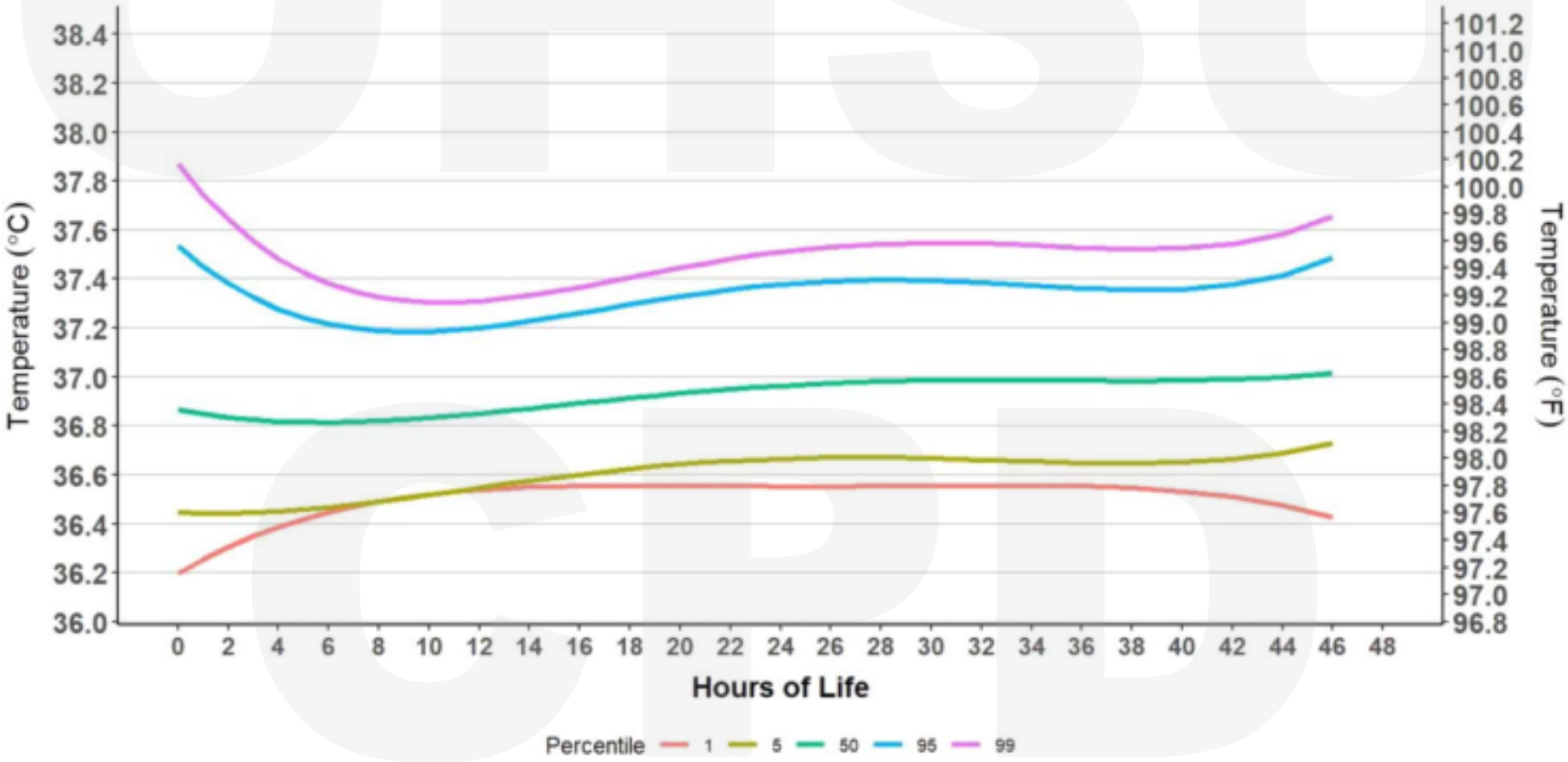
If < 2kg and admitted initially to newborn nursery, ~30% go on to transfer to NICU

Pediatrics (2023) 151 (4): e2022056861

Thermoregulation

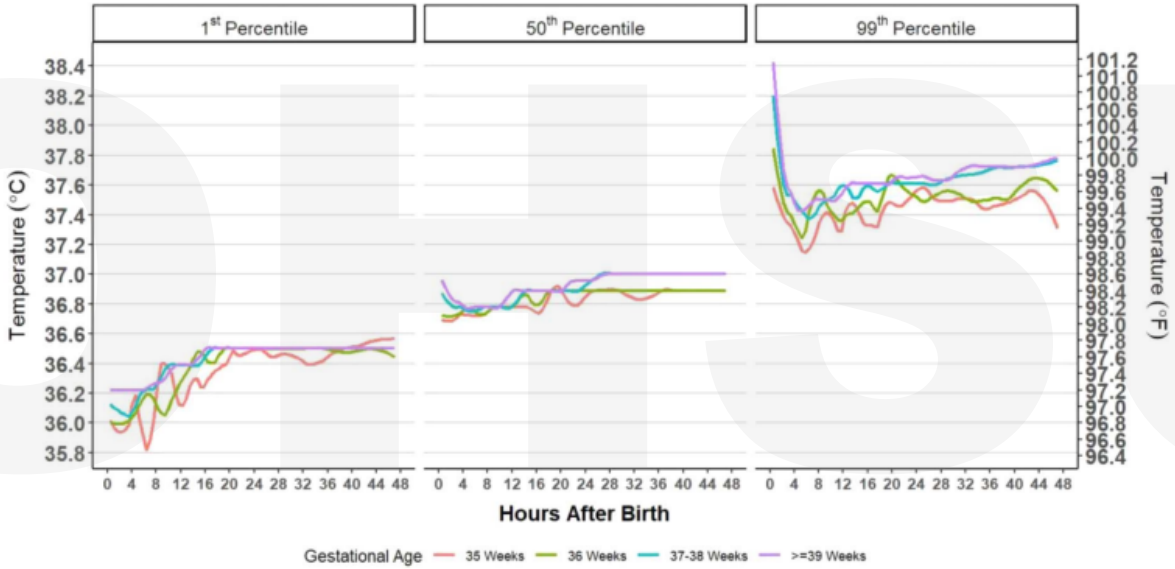
Thermoregulation

Beyond >36.5

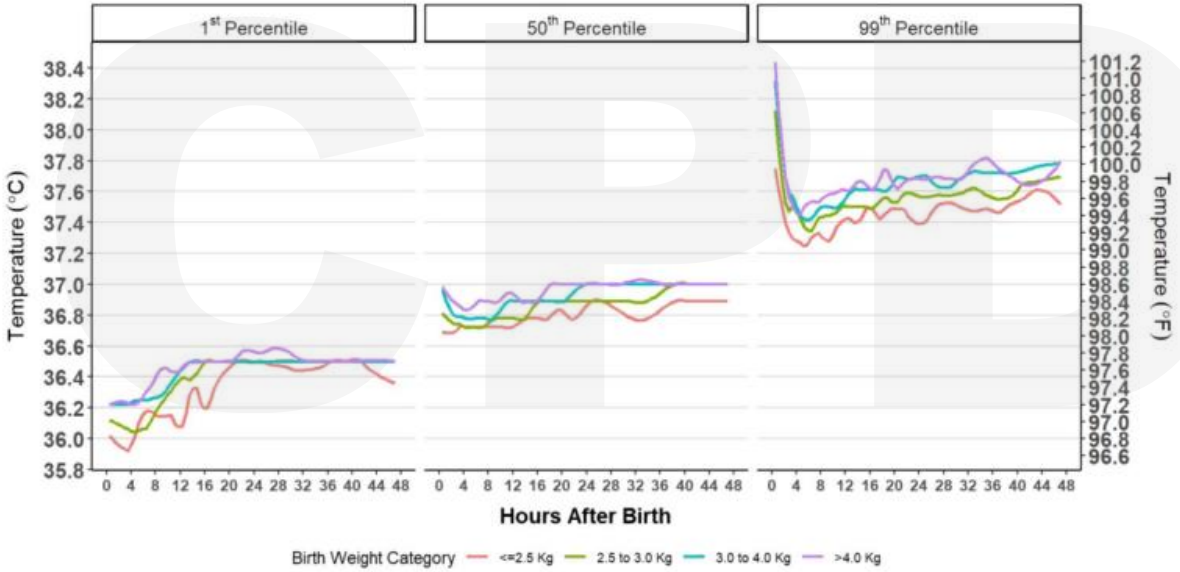


Pediatrics (2025) 156 (3): e2025070973.

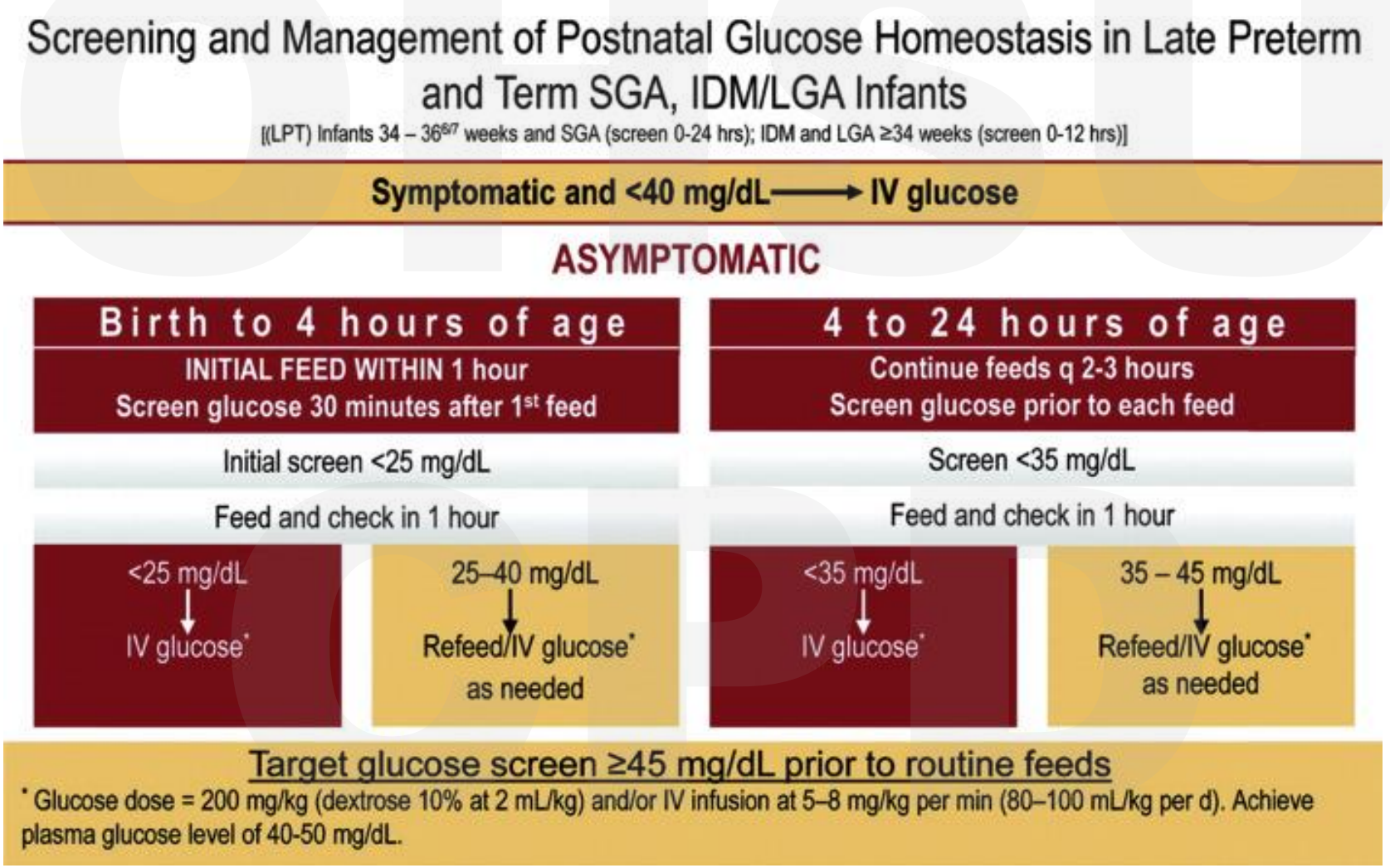
Newborn Temps according to Gestational Age



Newborn Temps according to Birth Weight



Hypoglycemia



Breastfeeding Outcomes in Late Preterm Infants

For women intending to provide breastmilk to their late preterm infants, approximately half providing any breastmilk at 6 months.

Formula as the first milk feed (negative) and intention to breastfeed >6 months (positive) were significant predictors of breastfeeding duration.

PLoS One 12022 Aug 15;17(8):e0272583

Baby Luke

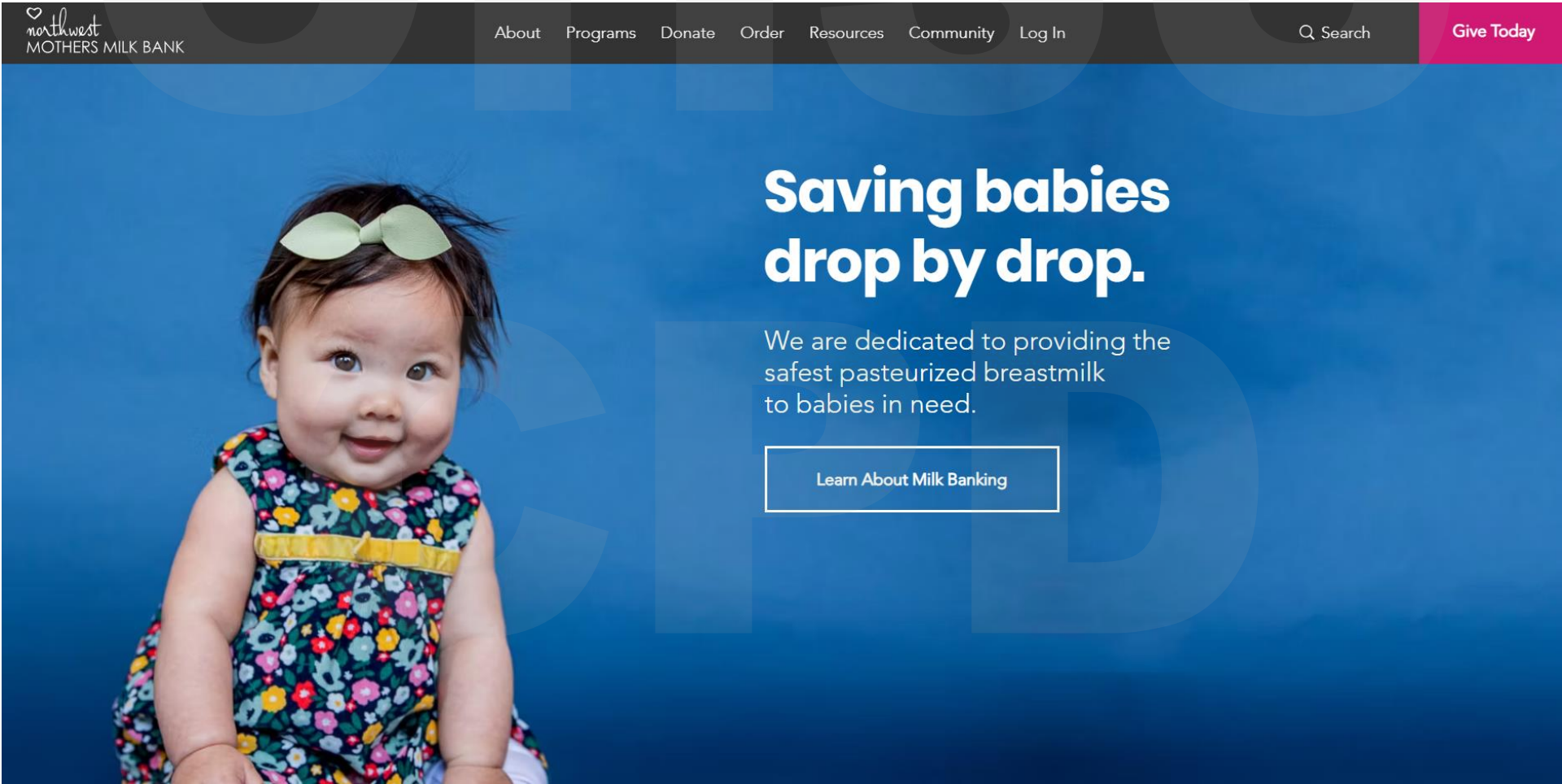
Luke's mother wanted to breastfeed her first infant but wasn't as successful as she would have liked. Her first child was born at 36 weeks and was admitted to the NICU. Her milk never really came in. She is motivated to provide breastmilk for Luke.

How can we support Luke's mother?

Newborn Feeding

northwest MOTHERS MILK BANK

Evie's Fund
by Northwest Mothers Milk Bank



JAMA

QUESTION Among extremely preterm infants fed minimal maternal milk, does feeding of donor human milk compared with preterm formula during the birth hospitalization result in improved neurodevelopmental outcomes?

CONCLUSION Among extremely preterm infants, donor milk feeding did not result in different 2-year neurodevelopmental outcomes compared with preterm formula feeding.

POPULATION

234 Females
249 Males

Extremely preterm infants

Median gestational age:
26 weeks

LOCATIONS

15
Academic centers in the US

INTERVENTION

483 Patients randomized

239

244

Donor milk
Base diet and donor milk from banks of the Human Milk Banking Association of North America

Preterm formula
Base diet and preterm infant formula, bovine human milk fortifier, and other dietary supplements

PRIMARY OUTCOME

Bayley Scales of Infant and Toddler Development cognitive score at 22 to 26 months' corrected age (score range, 54-155; a score of ≥85 indicates no neurodevelopmental delay)

FINDINGS

Adjusted mean cognitive score

Donor milk
80.7 (SD, 17.4)

Preterm formula
81.1 (SD, 16.7)

Donor milk vs preterm formula was not significant:

Adjusted between-group mean difference, **−0.77**
(95% CI, −3.93 to 2.39)

Colaizy TT, Poindexter BB, McDonald SA, et al. Neurodevelopmental outcomes of extremely preterm infants fed donor milk or preterm infant formula: a randomized clinical trial. Published online January 30, 2024. *JAMA*. doi:10.1001/jama.2023.27693

Composition of Preterm Human Milk (26-36wks)

Comparison to mature term human milk	
Protein	50-100% higher during first 4-7 wks
Sodium	30-150% higher first 4-6 wks
Chloride	30-80% higher during 3-4 wks
Potassium	30-75% higher during first 3-4 wks
IgA	Higher during first 2-3 months
Medium chain FA	40-80% higher during first 3 months
Polyunsat FA	40-70% higher in colostrum and transitional milk
Enzymes and growth factors	Equal to mature human milk

Preterm human milk and formula have different compositions than "term milk" and formula

Nutrient per 100 ml	'Term' formula	'Preterm' formula
Total energy (kcal)	68	80
Protein (g)	1.4	2.4
Fat (g)	3.6	4.3
Carbohydrate (g)	7.3	8.6
Calcium (mg)	50	140
Phosphorus (mg)	30	75

Infant Feeding

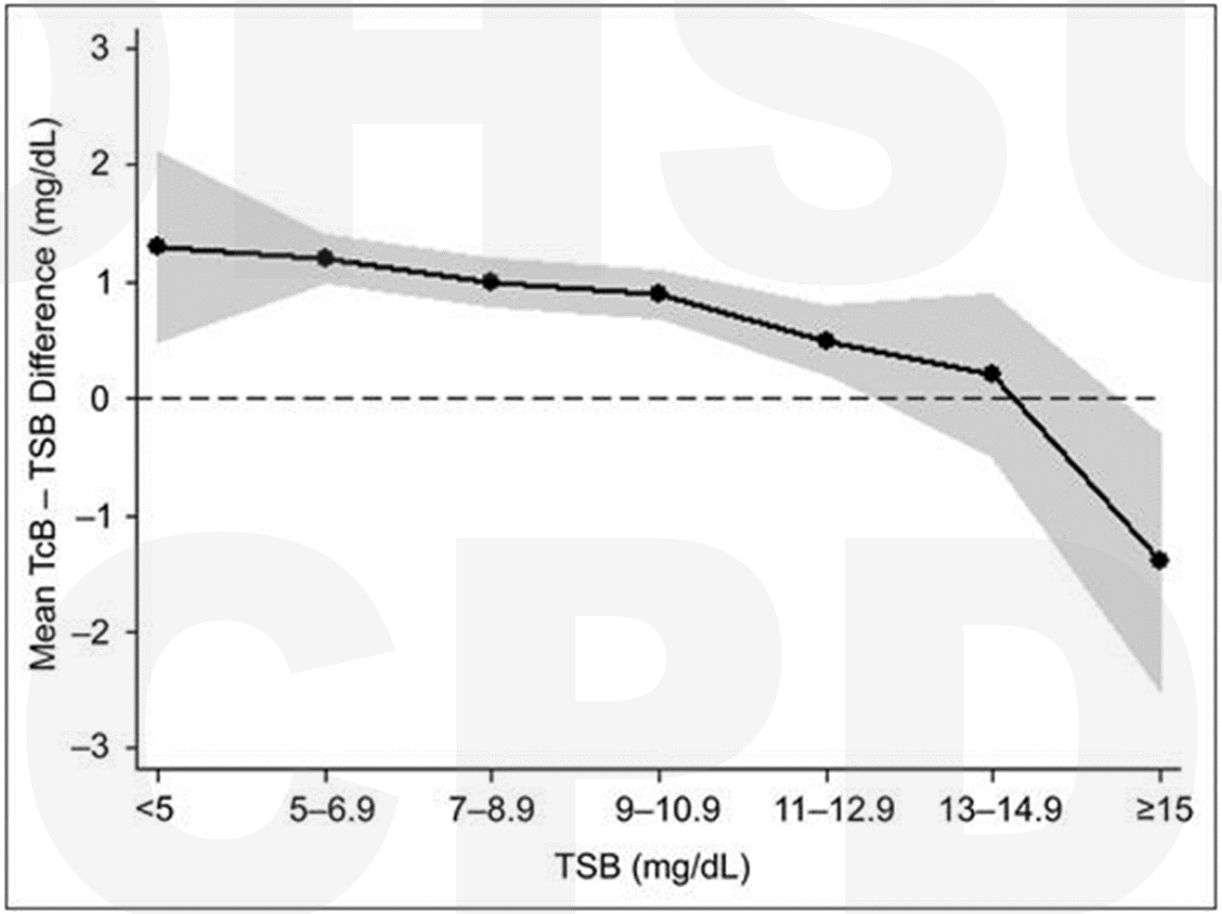
34-34 6/7 weeks	35-35 6/7 weeks	36-36 6/7 weeks
Breastmilk	Breastmilk	Breastmilk
22/24kcal breastmilk or formula	22/24kcal formula or Term formula	Term formula
Term formula at 40 weeks or 3.5 kg		

~20-30 grams per day

Jaundice

BORN
Better Outcomes through Research for Newborns

Discrepancies in TcB versus TsB measurements



Obtain a serum if TcB is within 3 points of treatment

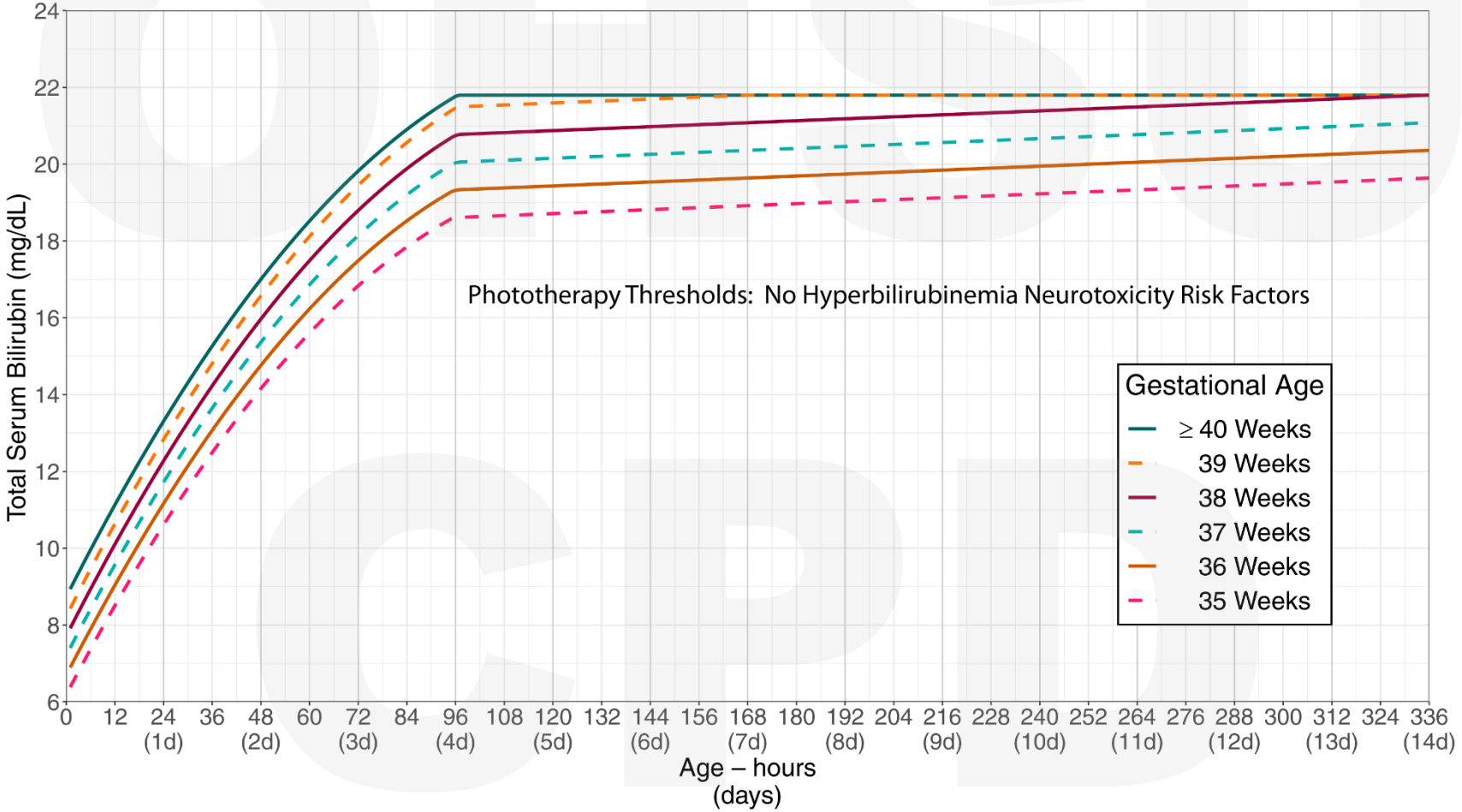
Neonatal Hyperbilirubinemia 2022 AAP Guidelines

- Improve recognition and efficient management of infants at high risk of complications of hyperbilirubinemia
- Decrease unnecessary testing
- Deliver safe, effective, and appropriate phototherapy
- Decrease unintended harm: family anxiety, decreased breastfeeding, unnecessary costs or treatment, potential risk of phototherapy

American Academy of Pediatrics

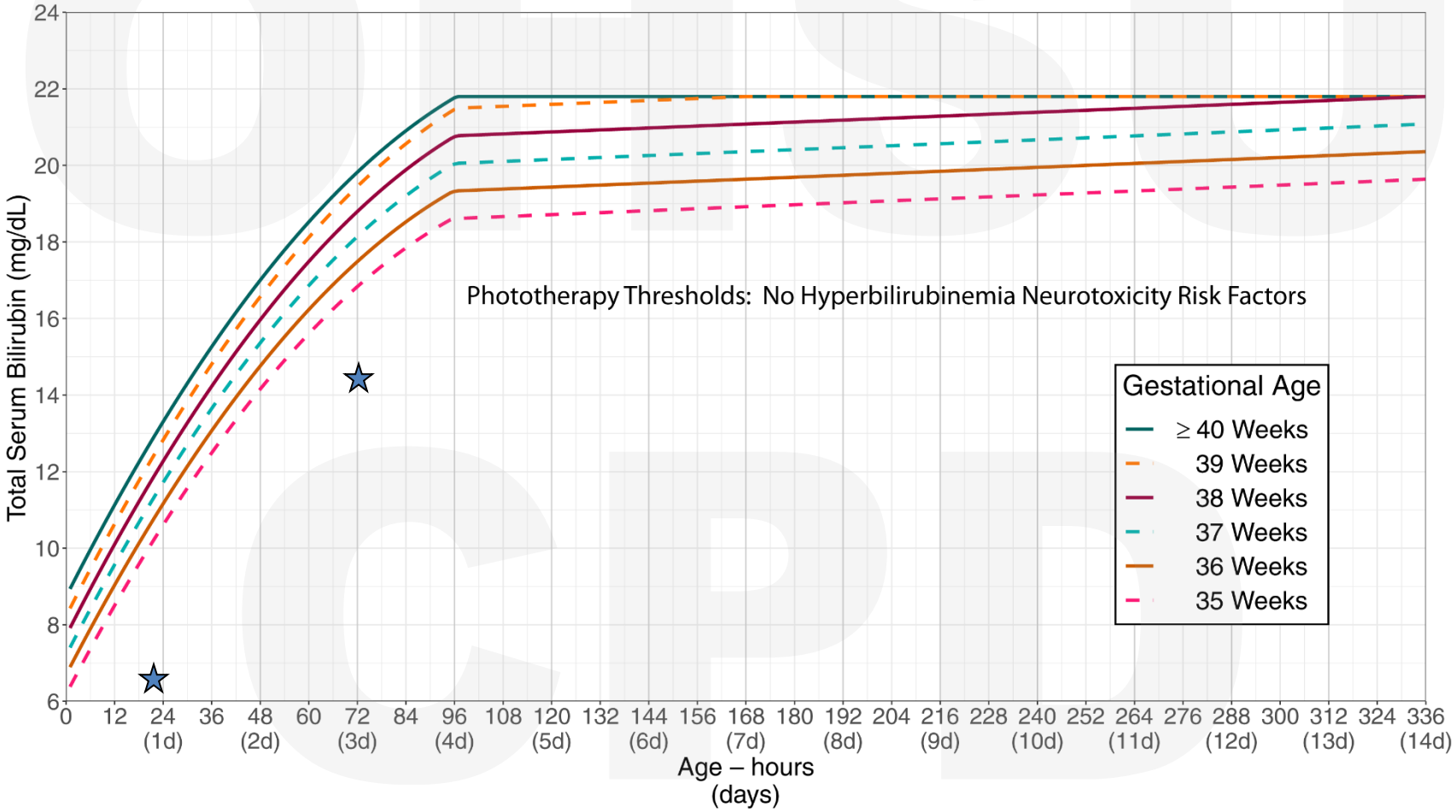
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Clinical Practice Guideline Revision: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation

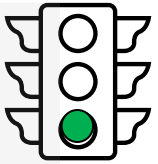


Pediatrics. 2022;150(3). doi:10.1542/peds.2022-058859

Baby Luke


Total Serum Bilirubin (mg/dL)
24
22
20
18
16
14
12
10
8
6
Phototherapy Thresholds: No Hyperbilirubinemia Neurotoxicity Risk Factors
Gestational Age
≥ 40 Weeks
39 Weeks
38 Weeks
37 Weeks
36 Weeks
35 Weeks
0 12 24 (1d) 36 48 (2d) 60 72 (3d) 84 96 (4d) 108 120 (5d) 132 144 (6d) 156 168 (7d) 180 192 (8d) 204 216 (9d) 228 240 (10d) 252 264 (11d) 276 288 (12d) 300 312 (13d) 324 336 (14d)
Age – hours
(days)

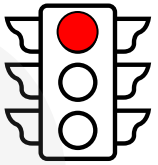
When to start phototherapy?



Generally according to thresholds

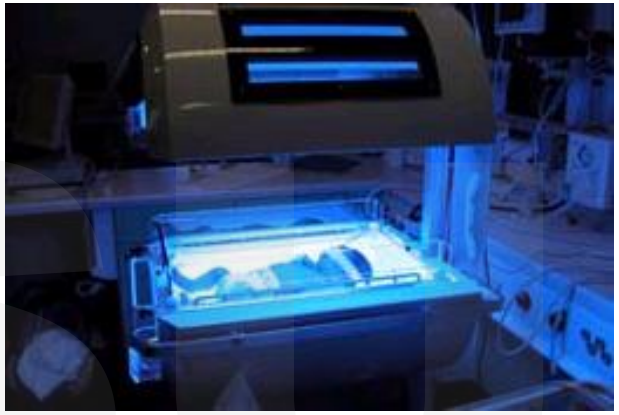
→Rate of rise may indicate an increased chance of need for phototherapy (≥ 0.3 mg/dL/hr in first 24 hours, ≥ 0.2 mg/dL/hr thereafter)

When to stop phototherapy?



Generally at 2 points below phototherapy threshold level at time of initiation.

Outcomes after Revised Hyperbilirubinemia Guidelines



In a cohort of >22 000 newborns:

-47% decrease in phototherapy, from 3.9% to 2.1% (P < .001).

-TSB measurements were reduced by 23%, from 712 to 551 measurements per 1000 newborns (P < .001), without an increase in outpatient TSB measurements.

-No increase in readmissions receiving phototherapy, and length of stay increased by only 1 hour (P < .001).

Pediatrics 2024 Apr 1;153(4):e2023063323

Angle Tolerance Testing
(Car Seat Tolerance Screening)

- **The American Academy of Pediatrics (AAP) recommends for < 37 weeks gestation**
- **The Canadian Pediatric Society (CPS) does not recommend**

Angle Tolerance (Car Seat) Testing Controversy

- Results in longer length of stay
- Test is not always reproducible
- Are results clinically significant?

Angle Tolerance (Car Seat) Testing Controversy

Car Seat Testing ←→ After Discontinuation

Primary outcome: 30 day composite rate of death, 911 call-triggered transports, or readmissions associated with respiratory disorders, apnea, apparent life-threatening event, or brief resolved unexplained events

Discontinuation of CSTS was not associated with a change in 30-day post-discharge adverse outcomes.

→Kaiser Permanente in Northern and Southern California does not perform car seat tests

→Northern California Neonatal Consortium does not perform car seat tests

J Pediatr 2023;261:113577

Baby Luke

Since he was born vaginally, his mother was discharged the day prior and has roomed in with Luke. His parents are excited to bring him home now that he is 3 days old. His temperatures have been normal for ~36 hours. He passed his car seat test and all other newborn screening tests.

-Luke is taking 25 ml of donor milk every 2-3 hours by bottle. He has lost less weight than most comparable infants at this day of life.

-His bilirubin is 14.3.

Is Luke ready for discharge?

Ready for Discharge?

Hospital Readmission among Late Preterm Infants

Late preterm infants have 2 x odds readmission than term infants.

35-week infants having the highest rate (6.5%) followed by 34- or 36-week infants (5.7%).

Reasons for readmission included jaundice (52%), infections (13%), and respiratory complications (4%).

Factors associated with greater odds of readmission included assisted vaginal birth, maternal age ≥34 years, chorioamnionitis, diabetes, and primiparity.

Hosp Pediatr 2022 Jul 1;12(7):e273–e274

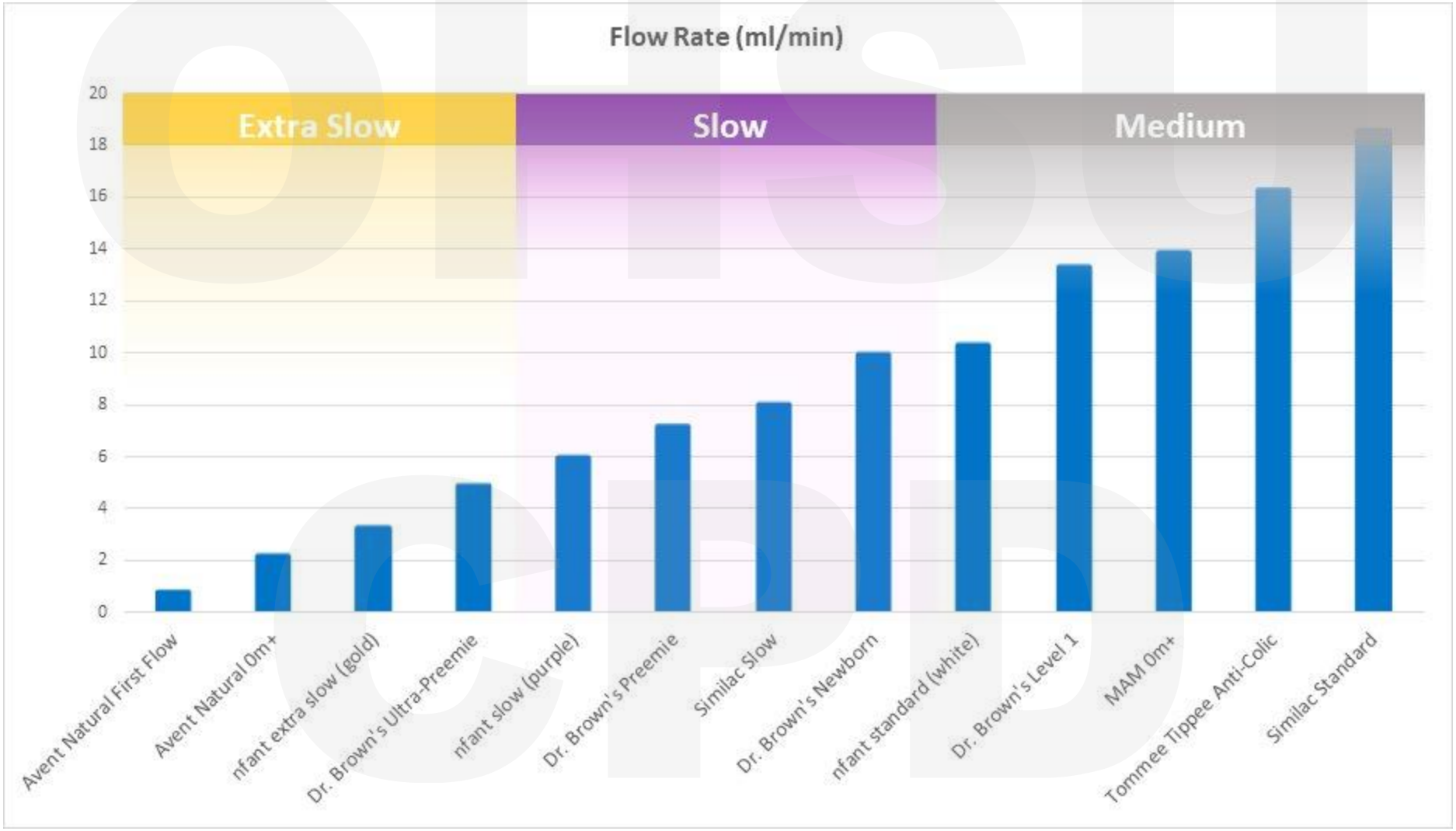
Common Outpatient Concerns

- Growth and nutrition
- Development
- (Jaundice)

Infant Bottle Feeding

Does bottle type matter?

Does nipple type matter?



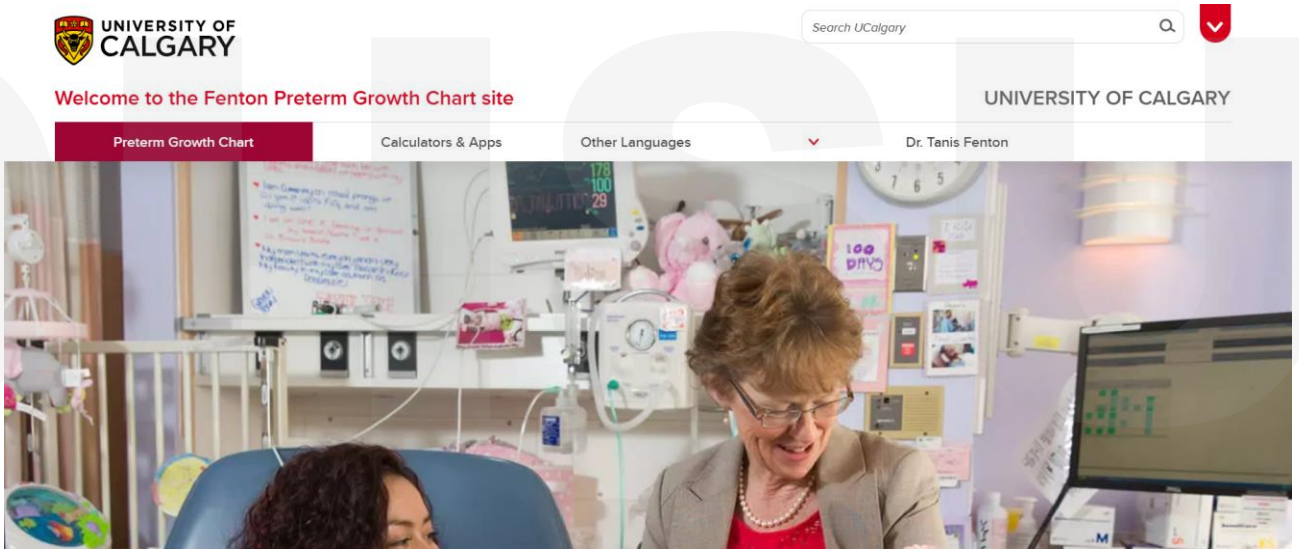
ELEVATED SIDE LYING POSITION

WHY

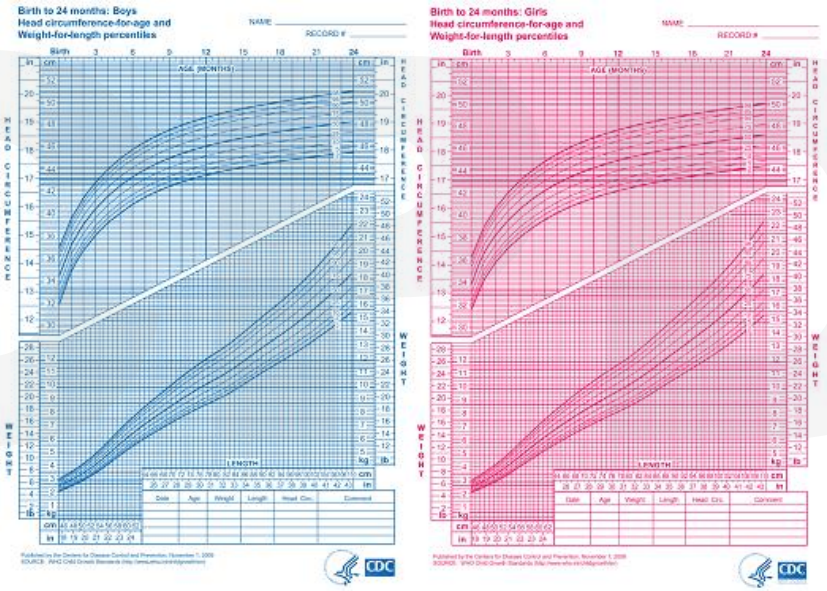
- Promotes safe feeding
- Liquid pools into the cheek
- Supports breathing and physiologic stability
- Gravity slows down the flow of the milk
- Easier for infant to self-pace and the feeder

Following Growth and Nutrition

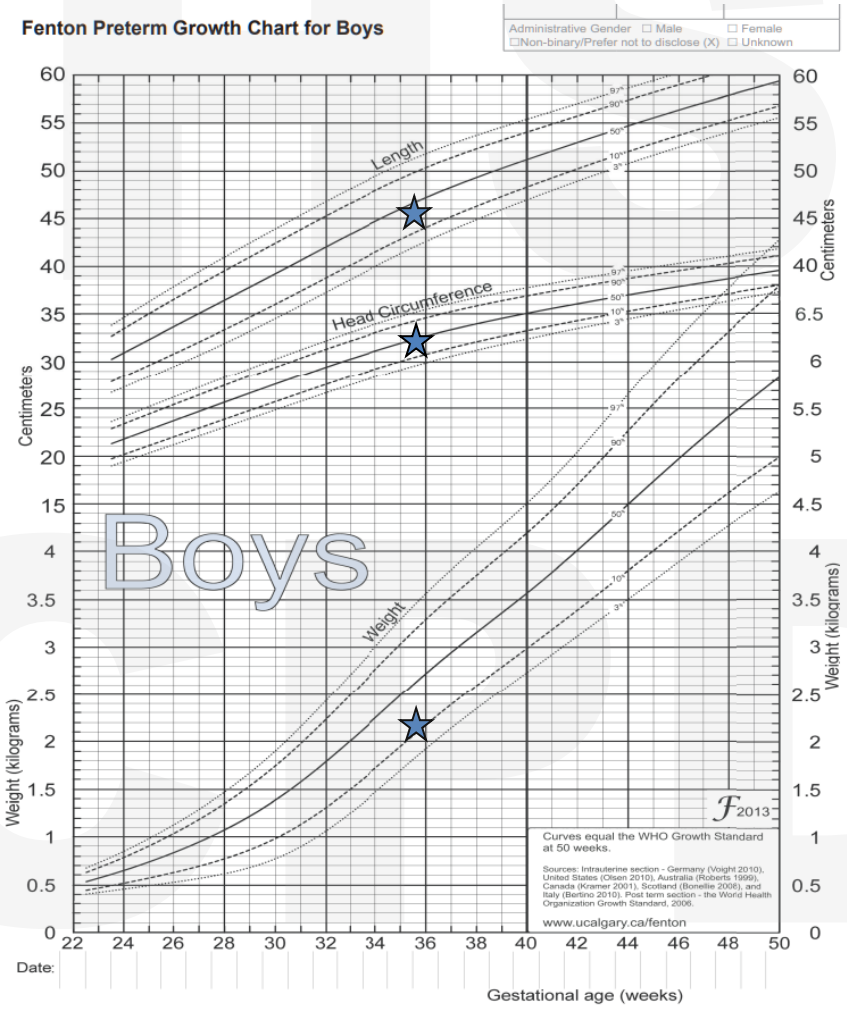
Fenton?



WHO?



Following Growth and Nutrition



How Long to Correct: Late Preterm

Intrauterine growth curves are generally accepted as the best tool for assessing the growth of preterm infants at birth and postnatally up to 50 weeks post menstrual age (PMA)

The Fenton preterm infant growth chart curves demonstrate improved and more uniform slopes across percentiles and closer alignment with fetal ultrasound estimates.

PMA = Gestational Age + Chronological Age
e.g. (36 weeks = 35 weeks + 1 week)

Fenton, T.R., *Paediatr Perinat Epidemiol*, 39: 543 555.

How Long to Correct: Very Premature

- In general, **24 months** for growth and developmental measures such as the ASQ

- A recent report suggested for extremely and very preterm children suggests age correction for all growth measures through 36 months of corrected age.

Corrected Age = Chronologic Age – Weeks Prematurity

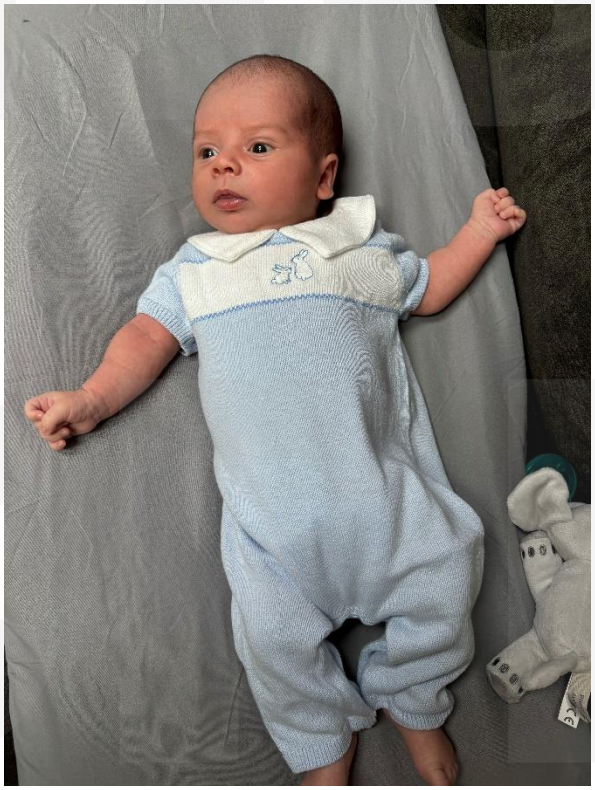
e.g. (4 months = 6 months – 2 months)

J Perinatology, pages 607–615 (2025)

Growth and Neurodevelopment

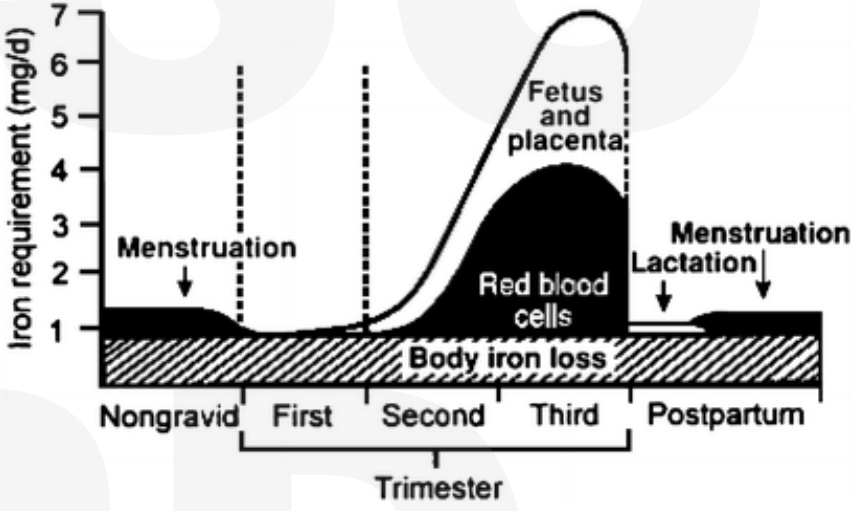
- Strong clinical evidence ties in-hospital growth (weight, length, HC) to improved neurodevelopmental outcomes
- Less is known about how growth after term postmenstrual age relates to neurodevelopmental outcomes.
- Limited evidence suggests “developmental window” where improved growth and nutrition leads to improved neurodevelopmental outcomes lasts until 3-4 months corrected age
- Evidence highlights importance of “proportional growth”

What else could be done to help Luke thrive?



Supplementation (Iron and Vit D)

- Postnatal iron supplementation at 2-4 mg/kg/d in breastfed preterm infants
- Some data that iron supplementation can result in improved developmental outcomes
- At least 400 IU/day Vit D is recommended for preterm infants after hospital discharge



BMC Pediatr 2024 Aug 20;24(1):530

Development and Health Promotion

- Reach Out and Read
- Early intervention
- NICU Follow-up clinics

IT ALL STARTS WITH THE TURN OF A PAGE

WHY DOCTORS?

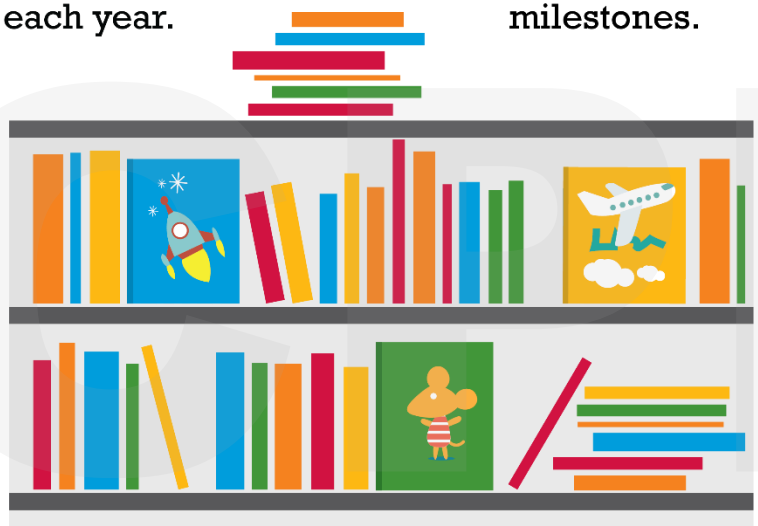
90%

90% of children visit their doctor each year.

Parents trust their child's doctor.

Rx

Doctors use books as a tool to assess developmental milestones.



THE IMPACT OF EARLY INTERVENTION

of infants and toddlers showed improvement in their development.

of infants and toddlers needed fewer services in preschool and K-12.

of families report the services help them communicate their children's needs.

of families report the services help them help their children develop and learn.

Children's Institute

Source: Oregon Part C FY2016 State Performance Plan/Annual Performance Report

Nirsevimab Effectiveness

- 87.2% against RSV Lower respiratory tract disease (LRTD)
- 98.0% (CI, 85.1%-99.7%) against hospitalized RSV LRTD
- 71.0% (CI, 65.3%-75.8%) against PCR-confirmed RSV

- Nirsevimab-immunized infants with RSV LRTD had fewer encounters and lower odds of hospitalization

- Infant RSV-associated hospitalization rates during 2024-25 were lower by 28% and 43% than in two pre-pandemic years

Pediatrics 2025 Aug 1; 156(2):e2024069510; *MMWR Weekly* / May 8, 2025 / 74(16);273–281

Take Home Points

- The late preterm infant is vulnerable during and after the birth hospitalization
- Feeding, jaundice, thermoregulation, and growth and nutrition, are areas deserving of ongoing research
- Newer guidelines and strategies of protecting infants show great promise