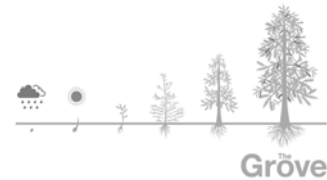


Not Too Big, Nor Too Small, Just the Right Size: Common Challenges with the Late Preterm Infant

Elizabeth Rogers, MD
Professor of Pediatrics
1 October 2021



California
Preterm Birth
Initiative



1



Do not
fear the
preterm
infant!

2

What is your
heartrate
when you are
called to a
32-week
delivery?

- **60**, cool as a cucumber
- **80**, a touch of the healthy anxiety
- **100**, that jog down to the delivery suite isn't as easy as it used to be
- **120**, I am an empath

3



Goals for today

- Lead you through care for a preterm infant
 - Counseling
 - Resuscitation
 - Admission
 - Common complications
 - Discharge home
- Keep your heartrate in typical range and your porridge just the right temperature

4

You are called to consult a patient in preterm labor at 34 weeks gestation.

- Between contractions, the pregnant patient has many questions!
 - What kind of help will my baby need at birth?
 - What support will she need after?
 - Does she have to go to the NICU?
 - When will she go home?
 - Will there be any impact on her long-term?

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Why did they call you?

- Pediatric hospitalists are increasingly called upon to attend neonatal resuscitations and to care for newborns
 - “Describe the basic physiologic differences between preterm, late preterm, and term infants.
 - Discuss common issues for preterm and late preterm infants including respiratory complications, temperature instability, feeding difficulties, hypoglycemia, infection, hyperbilirubinemia, and others.”

Journal of Hospital Medicine, April 2020.

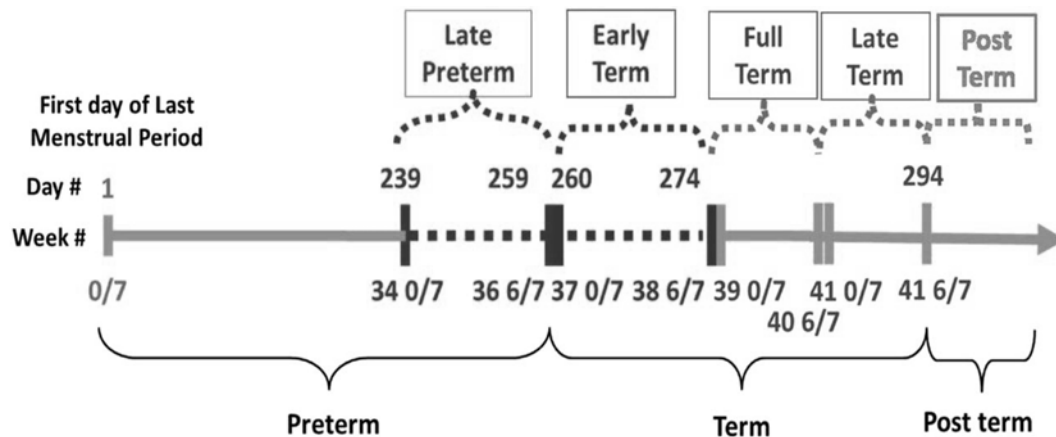
| Provider Type | Total # of Deliveries | GA > 36 Weeks | GA < 36 Weeks | Resuscitations |
|---------------|-----------------------|---------------|---------------|----------------|
| PHM | 520 | 520 | 56 | 88 |
| NN | 368 | 326 | 42 | 41 |
| ML | 86 | 79 | 7 | 11 |
| PHMF | 18 | 14 | 1 | 0 |

Table 1: Delivery Demographics Per Provider Type. Abbreviations: PHM (Pediatric Hospital Medicine), NN (Neonatology), ML (Moonlighters), PHMF (Pediatric Hospital Medicine Fellows), GA (Gestational Age)

Pediatrics, August 2019.

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Late Preterm Infants (LPI) born 34-37 weeks



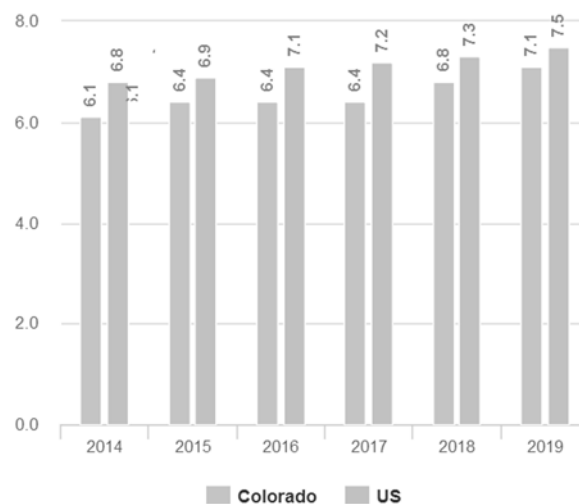
Definitions of gestational age periods from LPT to postterm. (Reprinted with permission from Engle WA, Kominiarek M. Late preterm infants, early term infants, and timing of elective deliveries. Clin Perinatol. 2008;35(2):325–341.)

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LATE PRETERM BIRTHS

Colorado and US, 2014-2019

Percent of live births

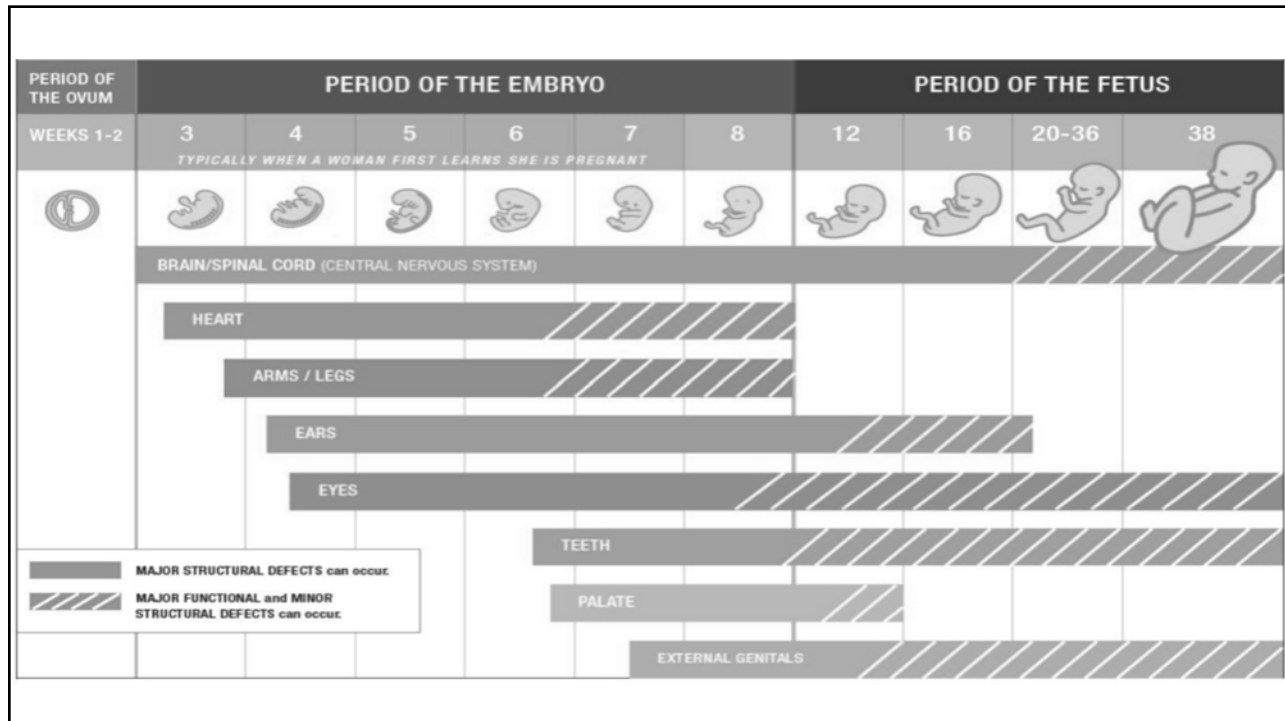


Late preterm is between 34 and 37 weeks gestation.

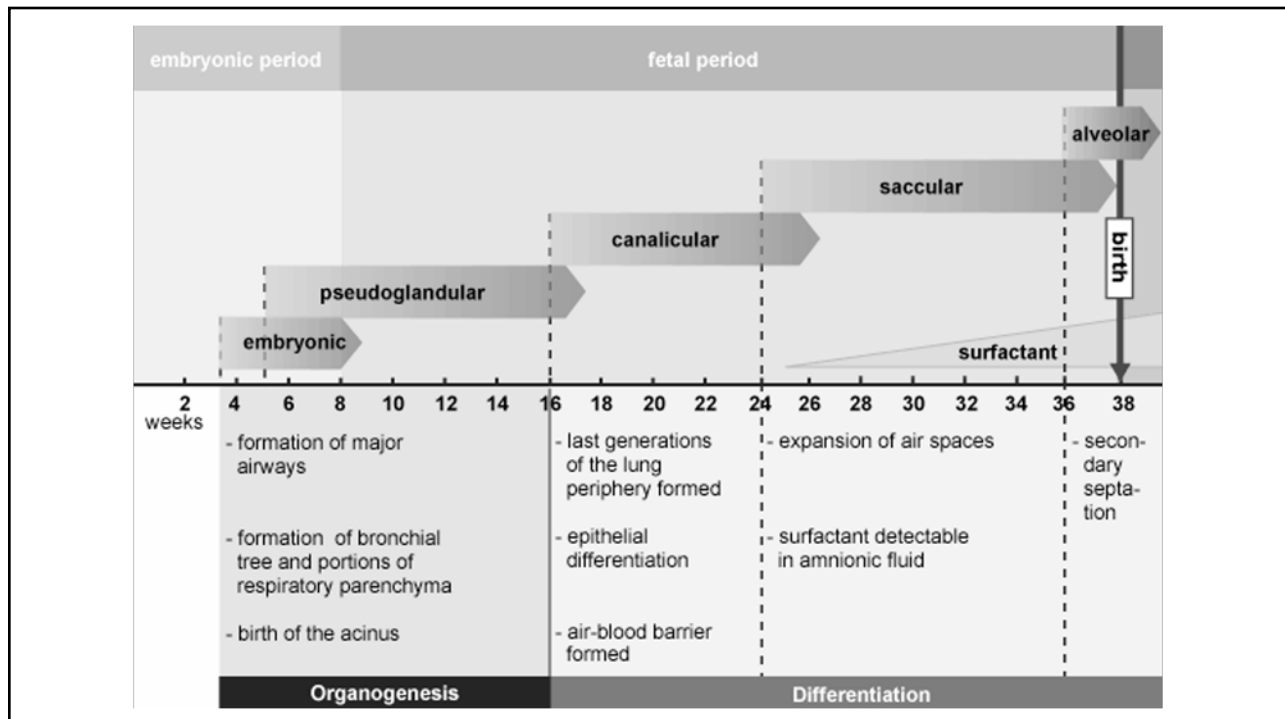
Source: National Center for Health Statistics, final natality data. Retrieved September 24, 2021, from www.marchofdimes.org/peristats.

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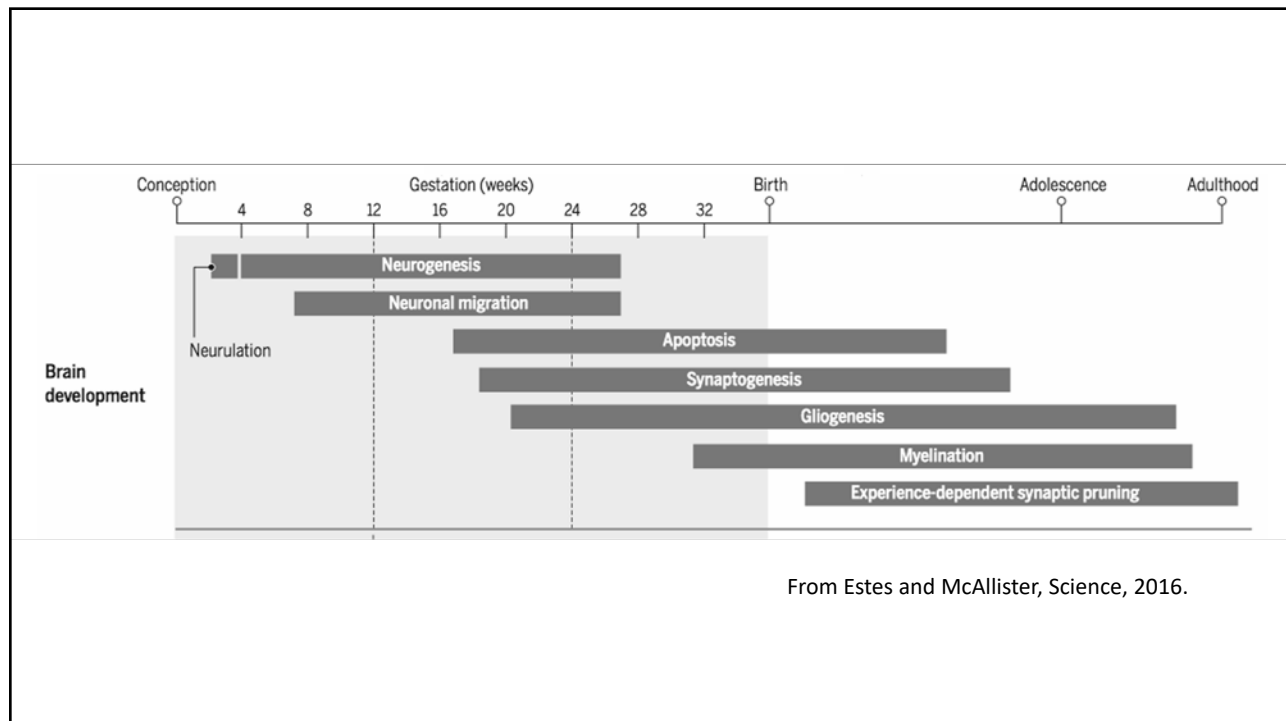
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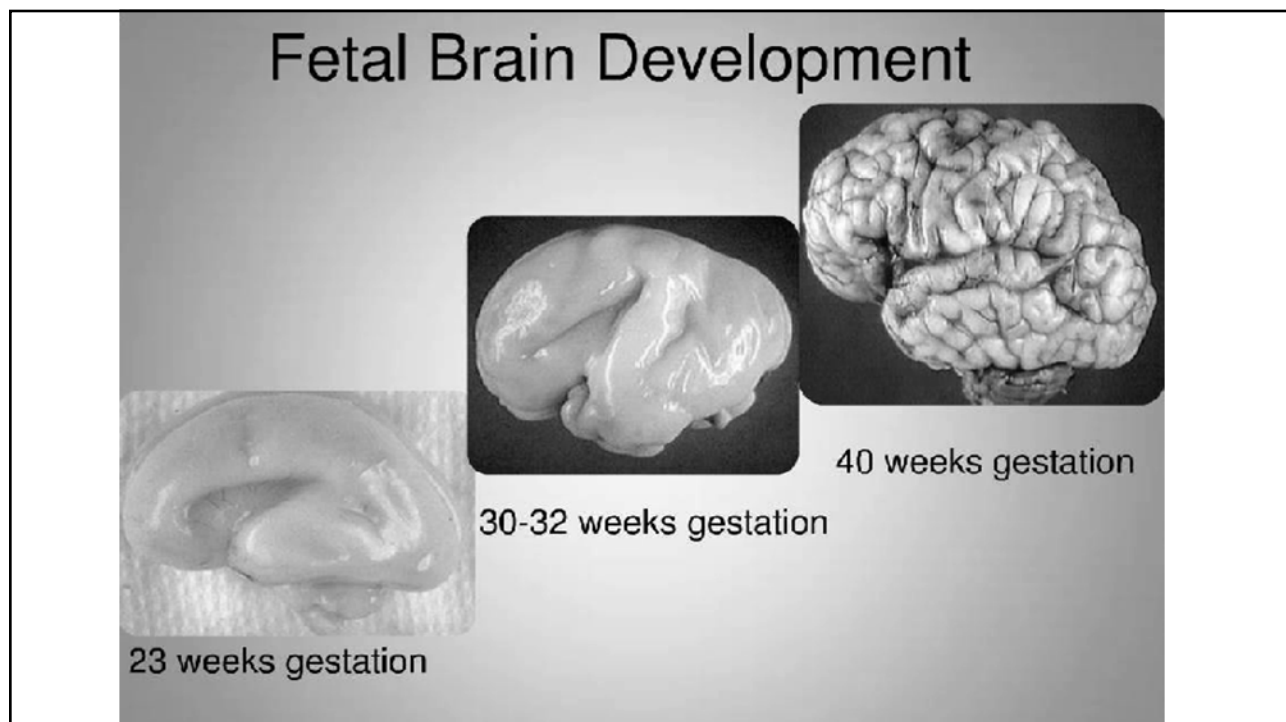
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10



11



12

Late Preterm Infants (LPI)

| <u>Respiratory Morbidities</u> | <u>Infectious Morbidities</u> | <u>Metabolic Morbidities</u> |
|---|-------------------------------|------------------------------|
| Need for significant neonatal resuscitation | Sepsis Evaluations | Hypoglycemia |
| Respiratory support | Sepsis (culture proven) | Feeding challenges |
| TTN | NEC | Hypothermia |
| PPHN | | Hyperbilirubinemia |
| Apnea of prematurity | | |

- Preterm infants are inherently physiologically immature.

- They are at higher risk for multiple morbidities as compared to term infants.

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Morbidities stratified by weeks of gestation

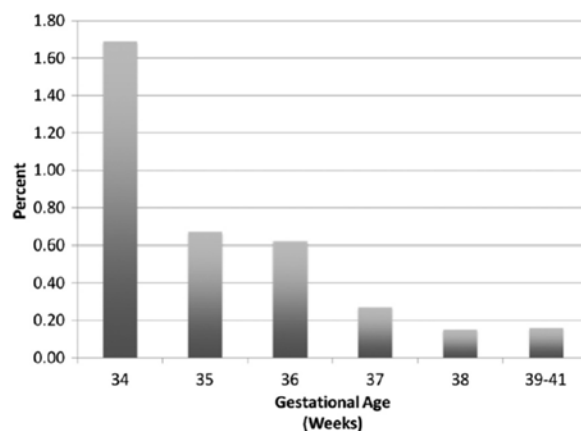


Fig. 3. Death and/or severe neurologic disorder and gestational age. (Data from Gouyon JB, Vintejoux A, Sagot P, et al. Neonatal outcome associated with singleton birth at 34-41 weeks of gestation. Int J Epidemiol 2010;39:772.)

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Morbidities stratified by weeks of gestation

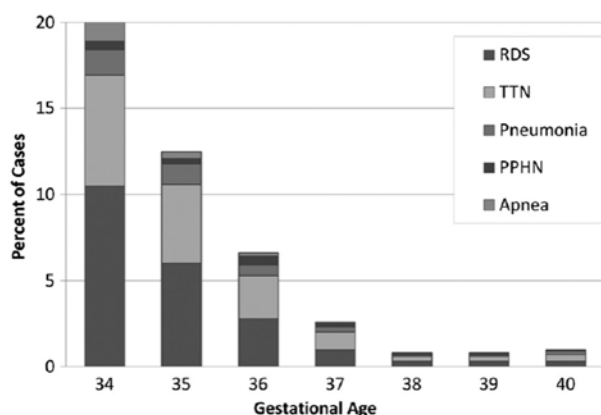


Fig. 2. Respiratory morbidity according to gestational age. n = 233,844. PPHN, persistent pulmonary hypertension of the newborn; RDS, Respiratory Distress Syndrome; TTN, transient tachypnea of the newborn. (Data from Hibbard JU, Wilkins I, Sun L, et al. Consortium on Safe Labor, Respiratory morbidity in late preterm births. JAMA 2010;304:423.)

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Table 1. Short-term outcomes of late-preterm infants per week of gestation compared to term infants

| | Late-Preterm Infants, n (AR%) | | | Full Term Infants, n (AR%) |
|---|-------------------------------|-------------------|--------------------|-------------------------------|
| Variable | 34 wk | 35 wk | 36 wk | |
| RESPIRATORY MORBIDITY | | | | |
| Mechanical ventilation or endotracheal intubation | 143/3940 (3.6%) | 121/7239 (1.7%) | 104/13,219 (0.79%) | 421/118,835 (0.35%) |
| Nasal CPAP | 366/4142 (8.8%) | 327/6145 (5.3%) | 246/11,674 (2.1%) | 452/173,577 (0.26%) |
| TTN | 397/7808 (5.1%) | 432/12,950 (3.3%) | 477/23,869 (2.0%) | 1040/297,733 (0.35%) |
| PPH | 5/561 (0.89%) | 3/852 (0.35%) | 1/1960 (0.05%) | 17/30,339 (0.06%) |
| RDS | 456/4310 (10.6%) | 383/6379 (6.0%) | 323/12,167 (2.7%) | 672/186,482 (0.36%) |
| Apnea | 93/4405 (2.1%) | 49/6591 (0.74%) | 52/12,819 (0.41%) | 104/205,442 (0.05%) |
| Pneumothorax | 34/4261 (0.80%) | 43/6329 (0.68%) | 79/12,117 (0.65%) | 188/186,332 (0.10%) |

Teune et al. Short- and long-term morbidity in late-preterm infants. Am J Obstet Gynecol 2011

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Table 1 (continued). Short-term outcomes of late-preterm infants per week of gestation compared to term infants

| | Late-Preterm Infants, n (AR%) | | | Full Term Infants, n (AR%) |
|----------------------------|-------------------------------|-------------------|---------------------|-------------------------------|
| Variable | 34 wk | 35 wk | 36 wk | |
| INFECTIOUS MORBIDITY | | | | |
| Sepsis workup | 1231/3940 (31.2%) | 1592/7239 (22.0%) | 1962/13,219 (14.8%) | 14,054/118,835 (11.8%) |
| Sepsis (culture proven) | 25/3891 (0.64%) | 24/7189 (0.33%) | 29/13,169 (0.22%) | 160/118,685 (0.13%) |
| NEC | 8/3891 (0.21%) | 4/7189 (0.06%) | 3/13,169 (0.02%) | 8/118,685 (0.007%) |

Teune et al. Short- and long-term morbidity in late-preterm infants. Am J Obstet Gynecol 2011

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Table 1 (continued). Short-term outcomes of late-preterm infants per week of gestation compared to term infants

| | Late-Preterm Infants, n (AR%) | | | Full Term Infants, n (AR%) |
|---------------------------------|-------------------------------|-----------------|-------------------|-------------------------------|
| Variable | 34 wk | 35 wk | 36 wk | |
| METABOLIC MORBIDITY | | | | |
| Hypoglycemia | 87/754 (11.5%) | 62/1164 (5.3%) | 120/2712 (4.4%) | 104/39,599 (0.26%) |
| Feeding problems | 25/49 (51.0%) | 17/50 (34.0%) | 11/50 (22%) | 8/150 (5.3%) |
| Hypothermia | 10/393 (2.5%) | 5/618 (0.81%) | 3/1467 (0.20%) | 5/7434 (0.07%) |
| Hyperbilirubinemia | 21/49 (42.9%) | 8/50 (16.0%) | 8/50 (16.0%) | 4/150 (2.7%) |
| Jaundice requiring phototherapy | 433/4203 (10.3%) | 463/7685 (6.0%) | 349/14,364 (2.4%) | 2033/150,700 (1.3%) |

Teune et al. Short- and long-term morbidity in late-preterm infants. Am J Obstet Gynecol 2011

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Heartrate check?

Turns out the patient you're counseling had been in preterm labor at 26 weeks and made it an additional 8 weeks without delivering



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TABLE 3
Frequency of death and major, intermediate, and minor morbidity

| Outcome | All, n = 8334 | Delivery gestational age, wk | | | | | | | | | | | | | | P for trend |
|---|------------------|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-------------|
| | | 23, n = 43 | 24, n = 114 | 25, n = 124 | 26, n = 169 | 27, n = 159 | 28, n = 196 | 29, n = 213 | 30, n = 262 | 31, n = 312 | 32, n = 451 | 33, n = 639 | 34, n = 1058 | 35, n = 1477 | 36, n = 3117 | |
| Death | 119 (1.4) | 19 (44.2) | 36 (31.6) | 15 (12.1) | 19 (11.2) | 13 (8.2) | 4 (2.0) | 4 (1.9) | 4 (1.5) | 3 (1.0) | 1 (0.2) | 1 (0.2) | 0 (0.0) | 0 (0.0) | 0 (0.0) | <.001 |
| Major morbidity ^a | 657 (7.9) | 19 (44.2) | 60 (52.6) | 68 (54.8) | 88 (52.1) | 64 (40.3) | 43 (21.9) | 48 (22.5) | 36 (13.7) | 22 (7.1) | 39 (8.7) | 27 (4.2) | 46 (4.4) | 42 (2.8) | 55 (1.8) | <.001 |
| Minor morbidity ^b | 3136 (37.6) | 4 (9.3) | 18 (15.8) | 39 (31.5) | 59 (34.9) | 77 (48.4) | 144 (73.5) | 147 (69.0) | 206 (78.6) | 255 (81.7) | 344 (76.3) | 406 (63.5) | 540 (51.0) | 402 (27.2) | 495 (15.9) | <.001 |
| Survival without any of above morbidities | 4422 (53.1) | 1 (2.3) | 0 (0.0) | 2 (1.6) | 3 (1.8) | 5 (3.1) | 5 (2.6) | 14 (6.6) | 16 (6.1) | 32 (10.3) | 67 (14.9) | 205 (32.1) | 472 (44.6) | 1033 (69.9) | 2567 (82.4) | |

Data are n (%).

^a Includes persistent pulmonary hypertension, intraventricular hemorrhage grade III/IV, seizures, hypoxic-ischemic encephalopathy, necrotizing enterocolitis stage III/IV, bronchopulmonary dysplasia. ^b Includes intraventricular hemorrhage grade I/II, necrotizing enterocolitis stage I, respiratory distress syndrome, hyperbilirubinemia requiring treatment, hypotension requiring treatment.

Mansuk et al. Preterm neonatal morbidity and mortality. *Am J Obstet Gynecol* 2016.

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TABLE 5

Hospital stay and postmenstrual age at discharge

| Median (IQR) | Delivery gestational age, wk | | | | | | | | | | | | | | P for trend |
|--|------------------------------|--------------------|-------------------|-------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------|
| | 23, n = 43 | 24, n = 114 | 25, n = 124 | 26, n = 169 | 27, n = 159 | 28, n = 196 | 29, n = 213 | 30, n = 262 | 31, n = 312 | 32, n = 451 | 33, n = 639 | 34, n = 1058 | 35, n = 1477 | 36, n = 3117 | |
| Length of hospital stay, d | 11.0 (2.0–120.0) | 74.5 (14.0–110.0) | 88.0 (57.0–103.5) | 78.0 (59.0–100.0) | 66.0 (51.0–85.0) | 58.0 (46.0–72.0) | 49.0 (39.0–58.0) | 40.0 (31.0–48.0) | 32.0 (24.5–39.0) | 22.0 (17.0–30.0) | 15.0 (11.0–22.0) | 10.0 (6.0–15.0) | 3.0 (2.0–7.0) | 3.0 (2.0–4.0) | <.001 |
| Change in median length of hospital stay, d ^a | — | +63.5 | +13.5 | –10.0 | –12.0 | –8.0 | –9.0 | –9.0 | –8.0 | –10.0 | –7.0 | –5.0 | –7.0 | 0.0 | |
| Length of hospital stay in survivors, d | 120.0 (51.0–120.0) | 101.5 (58.0–120.0) | 91.0 (73.0–108.0) | 82.0 (66.0–105.0) | 68.0 (59.0–87.0) | 58.0 (47.0–72.0) | 50.0 (40.0–58.0) | 40.0 (32.0–48.0) | 32.0 (25.0–39.0) | 22.0 (17.0–30.0) | 15.0 (11.0–22.0) | 10.0 (6.0–15.0) | 3.0 (2.0–7.0) | 3.0 (2.0–4.0) | <.001 |
| Postmenstrual age at discharge in survivors, wk | 40.6 (39.4–40.7) | 39.6 (37.9–40.6) | 38.5 (37.1–40.0) | 38.1 (36.6–40.2) | 37.3 (36.1–39.0) | 36.9 (35.6–38.9) | 36.6 (35.4–37.7) | 36.3 (35.3–37.4) | 36.0 (35.1–37.0) | 35.7 (35.0–36.9) | 35.7 (35.0–36.6) | 35.9 (35.3–36.6) | 36.1 (35.9–36.4) | 37.0 (36.7–37.1) | <.001 |
| Length of hospital stay among deceased neonates, d | 1.0 (0.0–5.0) | 5.5 (1.0–21.5) | 16.0 (5.0–25.0) | 10.0 (1.0–18.0) | 2.0 (0.0–14.0) | 18.0 (8.5–28.0) | 6.0 (3.0–7.5) | 9.0 (4.0–13.0) | 7.0 (3.0–11.0) | 1.0 (1.0–1.0) | 5.0 (5.0–5.0) | n/a | n/a | n/a | .47 |

IQR, interquartile range; n/a, not applicable.

^a Median length in current week minus median length of stay in preceding week.

Maruck et al. Preterm neonatal morbidity and mortality. Am J Obstet Gynecol 2016.

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SUPPLEMENTARY TABLE B
Outcomes among those with minor^a morbidity



| Outcome | Delivery gestational age, wk | | | | | | | | | | | | | | P for trend |
|--|------------------------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 23, n = 4 | 24, n = 18 | 25, n = 39 | 26, n = 59 | 27, n = 77 | 28, n = 144 | 29, n = 147 | 30, n = 206 | 31, n = 255 | 32, n = 344 | 33, n = 406 | 34, n = 540 | 35, n = 402 | 36, n = 495 | |
| Intraventricular hemorrhage grade I/II (a minor morbidity) | 1 (25.0) | 4 (22.2) | 14 (35.9) | 12 (20.7) | 14 (18.2) | 20 (13.9) | 23 (15.7) | 41 (19.9) | 35 (13.7) | 31 (9.0) | 16 (3.9) | 13 (2.4) | 4 (1.0) | 3 (0.6) | <.001 |
| Necrotizing enterocolitis stage I (a minor morbidity) | 0 (0.0) | 0 (0.0) | 4 (10.8) | 4 (6.8) | 5 (6.7) | 8 (5.6) | 4 (2.8) | 5 (2.4) | 3 (1.2) | 6 (1.7) | 5 (1.2) | 6 (1.1) | 1 (0.3) | 3 (0.6) | <.001 |
| Respiratory distress syndrome (a minor morbidity) | 4 (100.0) | 10 (55.6) | 21 (53.9) | 32 (54.2) | 38 (49.4) | 72 (50.0) | 62 (42.2) | 85 (41.3) | 76 (29.8) | 77 (22.4) | 96 (23.7) | 119 (22.0) | 78 (19.4) | 77 (15.6) | <.001 |
| Hyperbilirubinemia requiring treatment (a minor morbidity) | 3 (75.0) | 14 (77.8) | 34 (87.2) | 53 (89.8) | 72 (93.5) | 133 (92.4) | 141 (95.9) | 194 (94.2) | 244 (95.7) | 322 (93.6) | 377 (92.9) | 505 (93.5) | 368 (91.5) | 436 (88.1) | .12 |
| Hypotension requiring treatment (a minor morbidity) | 0 (0.0) | 6 (33.3) | 4 (10.3) | 3 (5.1) | 4 (5.2) | 1 (0.7) | 6 (4.1) | 5 (2.4) | 9 (3.5) | 8 (2.3) | 11 (2.7) | 15 (2.8) | 12 (3.0) | 22 (4.4) | .08 |

Data are n (%).

^a Includes intraventricular hemorrhage grade I or II, necrotizing enterocolitis stage I, respiratory distress syndrome, hyperbilirubinemia requiring treatment, hypotension requiring treatment.

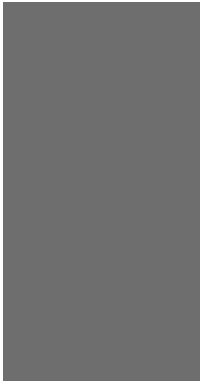
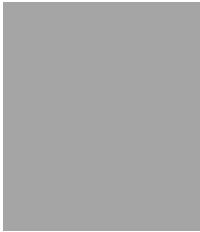
Maruck et al. Preterm neonatal morbidity and mortality. Am J Obstet Gynecol 2016.

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The patient is grateful for your anticipatory guidance and stays pregnant a bit longer.

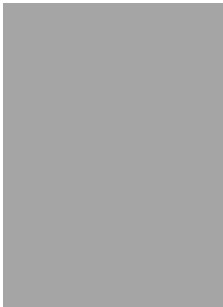
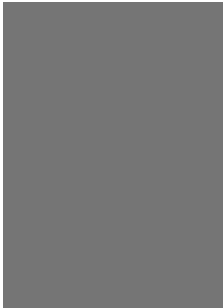
You are called for her imminent delivery at 35 0/7 weeks.

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Need for Resuscitation

- 10% of all neonates will require some form of assistance at birth
- 1% require extensive resuscitation
- 17.5%-50% of LPI will require resuscitation (Boyle, 2017; Almeida, 2007)

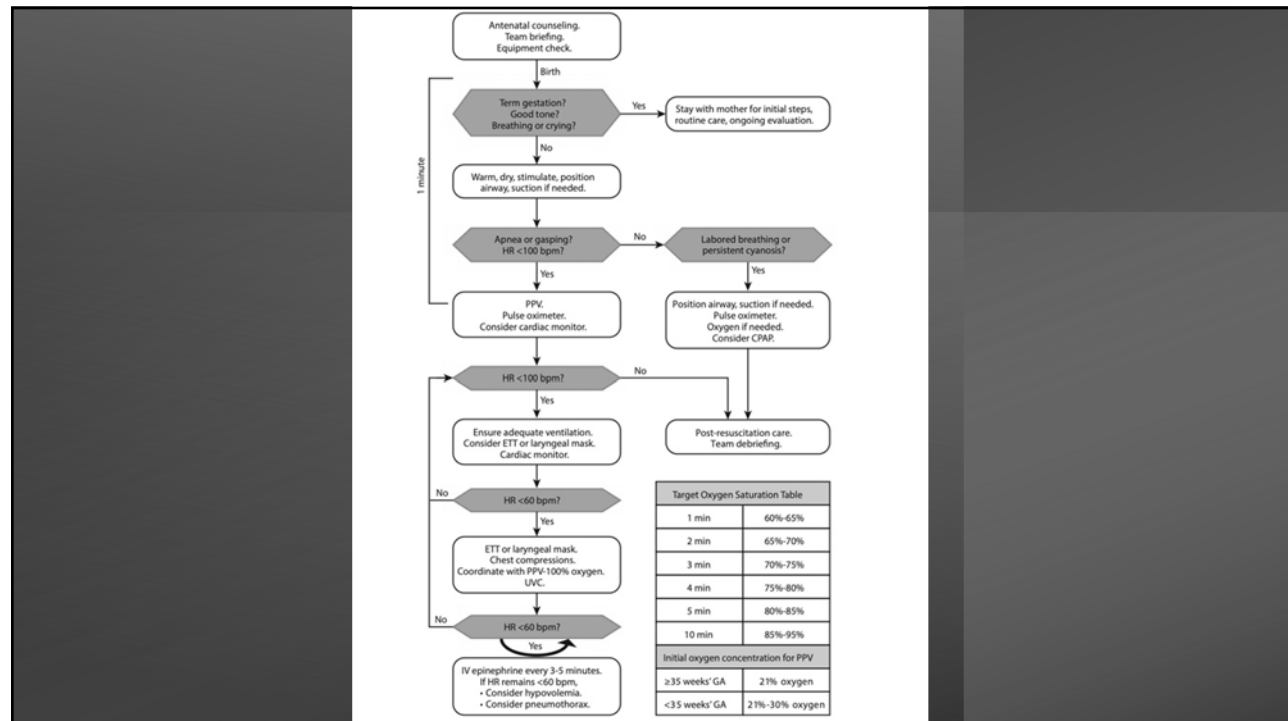



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Standard resuscitation

- Infant assessed, preferably on her mother
- Provided stimulation, drying, and warmth
- Assigned APGAR scores at 1 and 5 minutes
- Facilitated skin to skin care on mother or swaddle and hand infant to parents

25



26

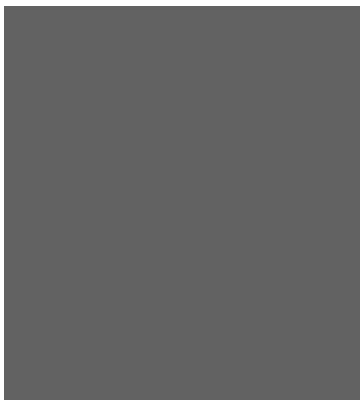
| | Actions |
|----------|---|
| M | Adjust Mask to assure good seal on the face |
| R | Reposition airway by adjusting head to “sniffing position |
| S | Suction mouth and nose of secretions, if present |
| O | Open mouth slightly and move jaw forward |
| P | Increase Pressure to achieve chest rise |
| A | Consider Airway alternative (endotracheal intubation or laryngeal mask airway) |

27

True Story

- Woman presents to ED with abdominal pain, vomiting, r/o AGE or bowel obstruction
- Urine collected for pregnancy test
- While awaiting results, goes to restroom
- Delivers infant in the toilet of the ED
- Call to on-call pediatric hospitalist: “Preterm baby delivered in the ED- come STAT”

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Considerations for resuscitation of preterm infants:

- Delayed cord clamping
- Thermoregulation
- Establishing adequate respirations

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Delayed Cord Clamping

- 20 small RCTs, including 10 focused on preterm, support delayed cord clamping for uncomplicated term and preterm birth
- 30-180 seconds
- Decreases intraventricular hemorrhage, anemia and need for blood transfusions, and clinically significant hypotension

30

Thermoregulation

Cold Stress

- Increases apnea
- Decreases surfactant function
- Increases metabolic acidosis, lowers pH, may reduce pulmonary artery relaxation
- Associated with increased mortality

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Preterm Neonates are at High Risk for Hypothermia

- Immature epidermal barrier, high evaporative heat loss
- Limited subcutaneous fat
- Increased surface area/weight ratio
- Ineffective non-shivering thermogenesis

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Establish Respirations

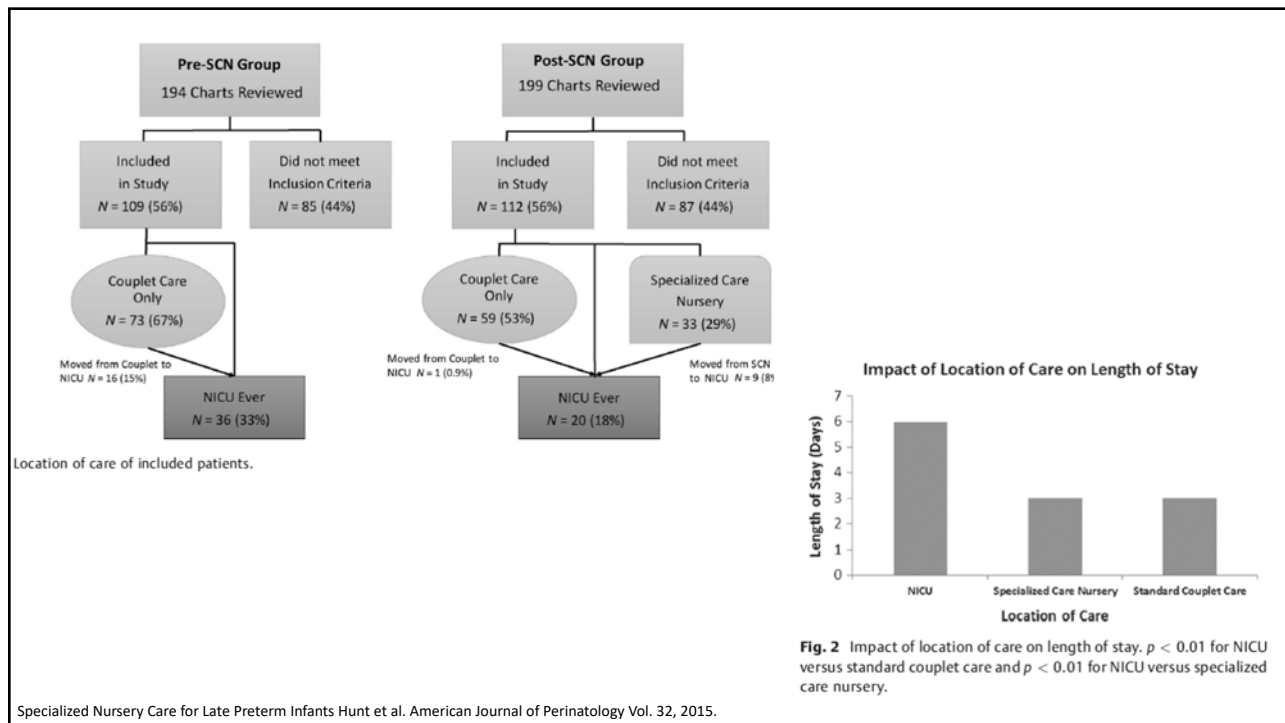
- Prevent lung collapse: Continuous Positive Airway Pressure (CPAP)
- Oxygen use:
 - Attach oximeter preductally
 - Blend O2 and air as needed to use as little O2 as necessary
 - Must have oximeter, blender, and compressed air available
- Intubate as necessary for inadequate effort, consider surfactant administration

33

Phew!

- She received CPAP in the delivery room for 20 minutes to support transition, since has been in RA
- She is skin to skin with her mother
- Does she need to be admitted in the Intensive Care Nursery?

34



35

Table 4 Maternal report of hospital breastfeeding practices stratified according to LPIs not cared for in NICU and those cared for in NICU

| | LPIs NOT cared for in NICU Weighted % (95% CI) | LPIs cared for in NICU Weighted % (95% CI) | p-value |
|--|---|---|-----------|
| Hospital staff gave Mom information about breastfeeding | | | 0.1028 |
| Yes | 96.4 (92.3-98.4) | 98.8 (98.0-99.3) | |
| No | 3.6 (1.7-7.7) | 1.2 (0.7-2.0) | |
| Infant stayed in the same room as Mom at the hospital | | | 0.0000*** |
| Yes | 94.9 (90.7-97.3) | 22.8 (17.8-28.8) | |
| No | 5.1 (2.7-9.4) | 77.2 (71.3-82.2) | |
| Hospital staff helped Mom learn how to breastfeed | | | 0.8598 |
| Yes | 87.0 (81.5-91.1) | 86.5 (81.7-90.1) | |
| No | 13.0 (8.9-18.5) | 13.5 (9.9-18.3) | |
| Mom breastfed in the first hour after infant was born | | | 0.0000*** |
| Yes | 78.9 (73.0-83.7) | 19.1 (14.5-24.6) | |
| No | 21.1 (16.3-27.0) | 81.0 (75.4-85.5) | |
| Mom breastfed infant in the hospital | | | 0.0000*** |
| Yes | 96.5 (93.8-98.1) | 81.6 (76.1-86.0) | |
| No | 3.5 (2.0-6.2) | 18.4 (14.0-23.9) | |
| Infant was fed only breast milk at the hospital | | | 0.3847 |
| Yes | 50.9 (43.1-58.7) | 46.5 (40.4-52.6) | |
| No | 49.1 (41.3-57.0) | 53.5 (47.4-59.6) | |
| Hospital staff told Mom to breastfeed whenever infant wanted | | | 0.0000*** |
| Yes | 82.3 (76.1-87.2) | 57.5 (51.4-63.3) | |
| No | 17.7 (12.8-23.9) | 42.5 (36.7-48.6) | |
| The hospital gave Mom a breast pump to use | | | 0.0000*** |
| Yes | 67.9 (60.6-74.4) | 91.9 (86.6-95.2) | |
| No | 32.1 (25.6-39.5) | 8.1 (4.8-13.4) | |
| The hospital gave Mom a gift pack with formula | | | 0.1962 |
| Yes | 60.1 (53.0-67.6) | 53.5 (47.4-59.5) | |
| No | 39.9 (32.4-46.8) | 46.5 (40.5-52.6) | |
| The hospital gave Mom a telephone number to call for help with breastfeeding | | | 0.3964 |
| Yes | 94.5 (91.5-96.6) | 92.8 (88.7-95.4) | |
| No | 5.5 (3.4-8.6) | 7.3 (4.6-11.3) | |
| Hospital staff gave infant a pacifier | | | 0.0000*** |
| Yes | 58.4 (48.2-67.9) | 93.1 (87.9-96.2) | |
| No | 41.6 (32.1-51.8) | 6.9 (3.8-12.1) | |

Reference population is LPIs not cared for in NICU
 *Defined as breastfeeding for ≥ 10 weeks after delivery among those who initiated breastfeeding; survey responses obtained earlier than 10 weeks excluded from this portion of the analysis
 ***Indicates $p < 0.05$

- Mothers of NICU LPIs were equally likely to initiate breastfeeding, but less likely to continue breastfeeding at 10 weeks, compared to mothers of non-NICU LPIs.
- Mothers of NICU LPIs were less likely to breastfeed in the hospital, less likely to be told to feed infants on demand, and more likely to be given a breast pump during hospitalization.

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UCSF Practice Change as of April 2021

| | <u>Prior Practice</u> | <u>Change</u> |
|--|--|--|
| Newborn Nursery (NBN) | ≥36 weeks, >2200g, no need for resp support, IV, or frequent vitals | ≥35 weeks, >2000g, no need for resp support, IV, or frequent vitals |
| Intensive Care Nursery (ICN), staffed by NBN Attending on the Pedi-Med Service | ≥34 weeks, >1800g Common indications: PTX, sepsis r/o, hypoglycemia requiring IV, nasal cannula | ≥34 weeks, >1800g Common indications: PTX, sepsis r/o, hypoglycemia requiring IV, nasal cannula |
| Intensive Care Nursery (ICN), staffed by ICN Attending | All other infants | All other infants |

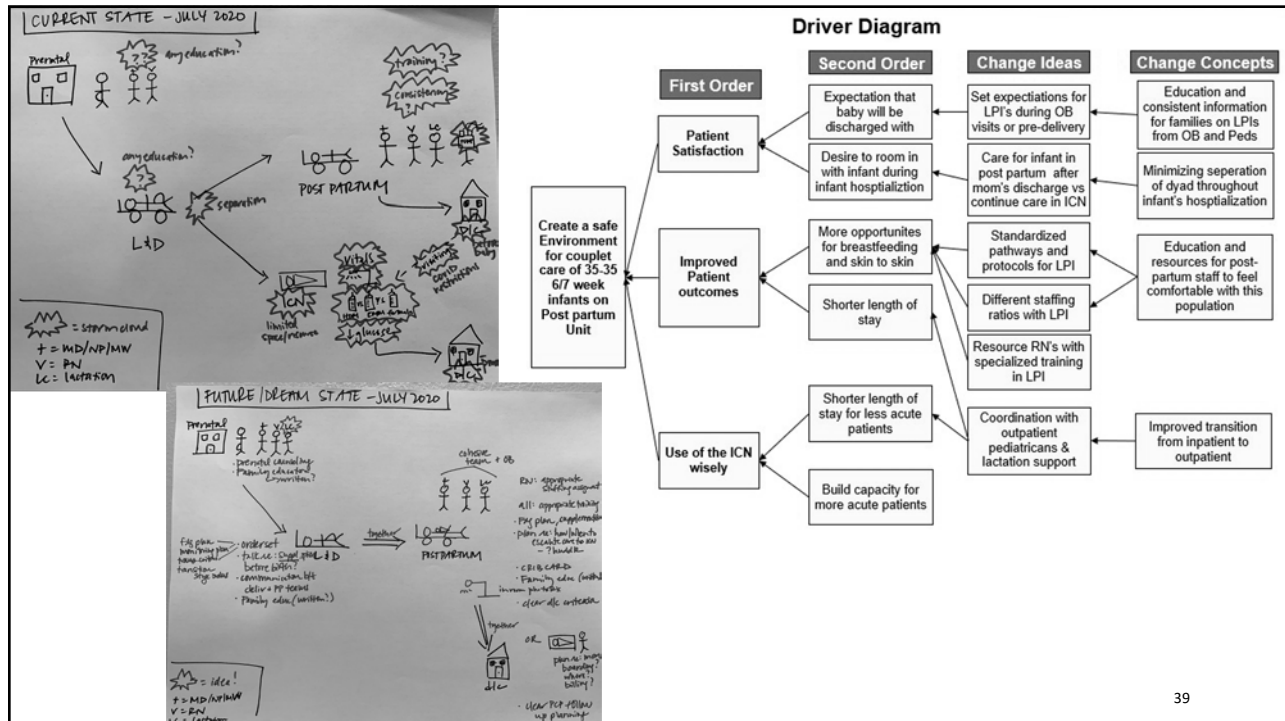
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Reasons for Change

Benefits of LPI (>35wks) rooming-in with mothers in NBN include:

- Improving physiologic stability (temp, HR, RR, BG) by:
 - Promoting mother-infant bonding
 - Early and prolonged skin to skin (STS) care
- Promoting successful breastfeeding
 - Initiating breastfeeding early, early/prolonged STS, promoting mother-infant bonding
- Avoid non-essential ICN admissions
- Decrease medical interventions
- Shorten length of stay

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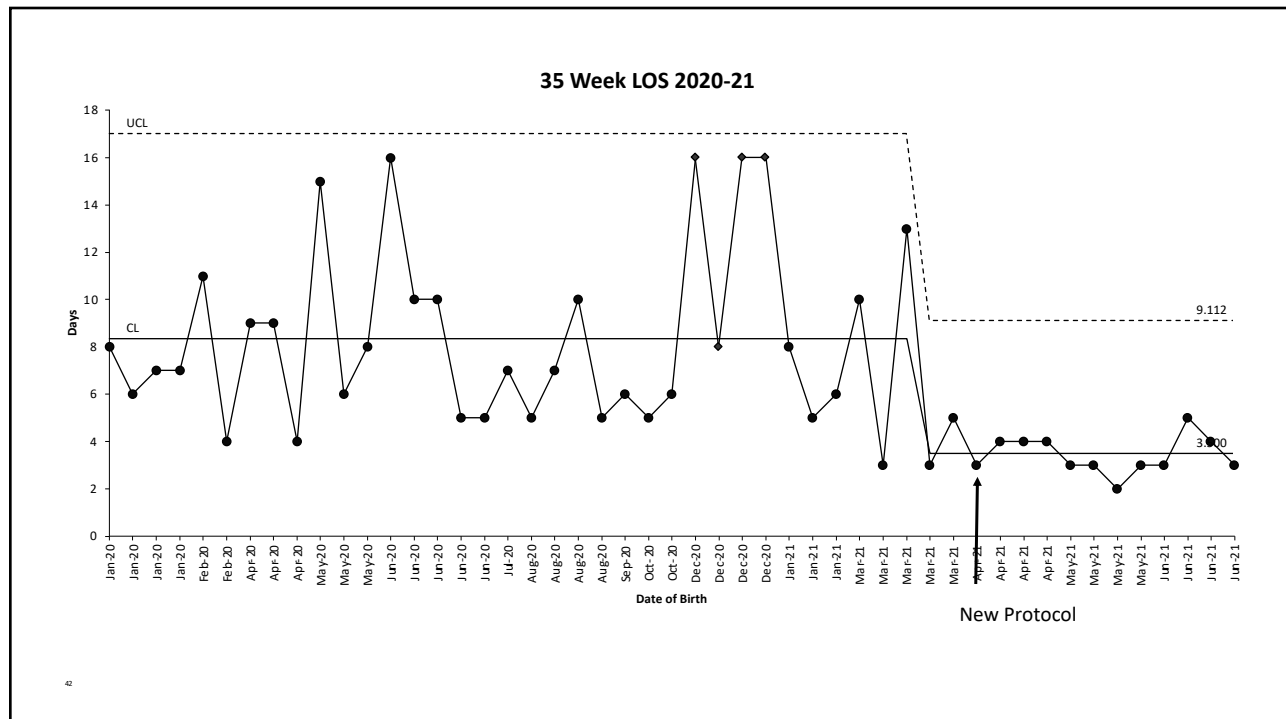
Table 2. Proposed practice for LPI >35 weeks GA

| | |
|--------------------|---|
| Delivery Room | <ul style="list-style-type: none"> Monitor for signs of respiratory distress NRP Guidelines followed if resuscitation is needed Thermoregulation measures: hat and skin to skin or radiant warmer Vital signs (heart rate, respiratory rate, and temperature) measured within the first hour of birth |
| Admission Decision | <ul style="list-style-type: none"> Room in with mother if >35 weeks and > 2000g and asymptomatic, no oxygen requirement To be assessed by a Provider within 1 h of life for morbidities requiring ICN care Nursing assignment 1:3 or less Vitals at 1, 2, 4 and 6h then q4h for first 24 hours, then q6h Admit to NICU if significant resuscitation in the delivery room (<u>i.e.</u> positive pressure ventilation, chest compressions, medications) or clinical concerns, observe patient with continuous vital sign monitoring for at least 6 hours |
| Thermoregulation | <ul style="list-style-type: none"> Encourage skin to skin Temperature measurement at 1, 2, 4 and 6h then q4 for first 24 hours and then q6h If temperature is <36.5°C, swaddle infant and cover head with a hat. In 30 minutes, if temperature remains <36.5°C, place infant skin to skin or under radiant warmer and notify MD. If still <36.5°C, admit infant to higher level of care, if in Well Baby Nursery, for further evaluation and management. Delay first bath for first 24 hours |

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| | |
|----------------------|--|
| Respiratory Distress | <ul style="list-style-type: none"> During the first 2 hours after delivery infants may have abnormal respiratory rates (rate 25-100 breaths per minute). Normalization is expected after this transitional period (respiratory rate 40-60 breaths per minute). Monitor for signs of respiratory distress throughout the birth hospitalization. If signs of respiratory distress arise, notify MD and with consideration to move infant to higher level of care. Apnea with pause in breathing >20 seconds also requires closer cardiorespiratory monitoring and transfer to higher level of care. |
| Glycemic Control | <ul style="list-style-type: none"> Late preterm infants born to mothers who are on medication for diabetes (type I, type II, or gestational) will follow the policy for infants of diabetic mothers Encourage feeding within 1 hour of birth and measure glucose 30 minutes after feeding Follow Hypoglycemia protocol for Infants >34 week |
| Hyperbilirubinemia | <ul style="list-style-type: none"> Assess risk factors for hyperbilirubinemia, including ABO incompatibility and presence of maternal antibody for each infant. If maternal blood type is Rh negative or O Rh positive, determine infant blood type. Monitor clinical signs of jaundice regularly. Within the first 24 hours, obtain transcutaneous or serum total bilirubin. Treat hyperbilirubinemia with phototherapy per the NCNC guidelines. |
| Feeding | <ul style="list-style-type: none"> Initiate breastfeeding without intervention, maximize skin-to-skin and maternal-infant bonding. Supplement if- <ul style="list-style-type: none"> Hypoglycemia Hyperbilirubinemia related to poor feeding Weight loss >3% in 24 hours Weight loss >5% in 48 hours Weight loss >7% in 72 hours Transfer to ICN IF- <ul style="list-style-type: none"> Poor/ absent feeding cues Non-vigorous/ stress behaviors |

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35-Week Couplet Care

Outcome & Balancing Measures

| | Pre (Jan-March 2021) | Post (April-June 2021) |
|---------------------|----------------------|------------------------|
| N (35 week infants) | 8 | 12 |
| Any time in ICN | 8 (100%) | 7 (58%) |
| >4 hours in ICN | 8 (100%) | 4 (33%) |
| Average LOS | 6.6 days | 3.4 days |
| LOS Range | 3-13 days | 2-5 days |
| Phototherapy | 1 | 1 |
| IV Abx | 1 | 0 |
| D10 | 1 | 0 |
| Resp Support | 3 | 3 |
| Readmissions | 0 | 0 |

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To the newborn nursery
it is!

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Common Complications

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Feeding Challenges

o **Support for Breastfeeding**

- o **Skin-to-Skin:** Provide opportunity for skin-to-skin time after birth in all late preterm infants who are clinically stable and maternal post-partum status permits. Encourage first breastfeeding attempt within first hour after birth if possible.
 - Resource-intensive but many maternal & neonatal benefits (e.g. neonatal glucose stability)
- o **Lactation Consultation:** Should be offered to ALL mothers of late preterm infants.
 - Encourage breastfeeding attempts q 2–3 hours (8–12 times / 24 hour period), for 15–20 minutes / session
 - Mothers may skip a few breastfeeding / pumping sessions per 24 hour period in order to obtain sufficient rest
- o **Milk Expression:** Educate & encourage mothers to hand express or pump at least 8 times / 24 hour period, for 10–20 minutes / session
 - All LPIs (34–36wks): initiate milk expression within 4 hours after birth
- o **Assessment of Breast Milk Transfer (for infants receiving supplementation):**
 - Latch scoring / subjective nursing and lactation assessment of breastfeeding success
 - After day 3 (or when mother's volume of milk has increased / mother's breasts are softened after feedings), consider weighing diapered infant before and after breastfeeding + subtract transfer amount from the total supplemental feeding guideline for that day
- o **Assessment of Hydration Status:** daily weights, weighing / counting diapers, clinical assessment
- o **Duration of Supplementation:** Supplementation of breastfeeding is needed until LPI can feed effectively, empty mother's breasts, mothers' milk is abundant, and infant is maintaining/gaining weight (lactation specialists may assist with defining "successful / effective breastfeeding")

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○ **LPI Nutritional Needs / Goals**

○ Estimated Needs:

34-36 wks: 120 kcal/kg/day; 3.1 g prot/kg/day
 37-38 wks: 115 kcal/kg/day; 2.5 g prot/kg/day
 < 3kg: 120-130 kcal/kg/day; >3 g protein/kg/day
 > 3 kg: 110-120 kcal/kg/day; >2 g protein/kg/day

○ Expected Weight Gain (after diuresis):

34-38 wks: 30-35 g/day
 0-3 months CGA: 25-35 g/day
 3-6 months CGA: 15-20 g/day

NOTE: For CATCH-UP GROWTH, increase expected weight gain, energy and protein goals by 10-20%

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LPI Supplemental Feeding Guidelines

NOTE: an individual infant may be considered in a higher or lower gestational age feeding category based on provider assessment of infant's maturity and clinical status or based on maternal post-partum status

| | 34 – 34 6/7 weeks | | 35 – 35 6/7 weeks | 36 – 36 6/7 weeks |
|--------------------------------------|--|-----------------------|--|--|
| DEFINITIONS | SGA <1800gm | AGA >1800gm | SGA <2000gm (SEE 34wk AGA) AGA >2000gm | SGA <2200gm (SEE 35wk AGA) AGA >2200gm |
| ADMISSION | ICN, monitors | | <ul style="list-style-type: none"> ○ ICN/SCN, may leave for feedings ○ Transition to rooming in when clinically stable | Remain with mother, rooming in |
| ASSESSMENT | Daily: <ul style="list-style-type: none"> • Calculate wt loss from birth • Calculate wt gain once at nadir • Intake and output | | <ul style="list-style-type: none"> • Jaundice assessment • Lactation success (mom/baby) | |
| BREASTFEEDING SUPPLEMENTATION | DAY 1: Initiate breastfeeding, maximize skin-to-skin & maternal-infant bonding time (challenge = physical separation of mother & baby) DAY 2: Supplement ALL infants | | DAY 1: Initiate breastfeeding without intervention, maximize skin-to-skin & maternal-infant bonding time Supplement IF: <ul style="list-style-type: none"> • Poor / absent feeding cues (mouthing, rooting, waking for feeds) • Non-vigorous / stress behaviors (As, Bs &Ds, color change, flaccid, hiccups, unable to stay awake to feed) • Hypoglycemia (<50 mg/dl) • Hyperbilirubinemia related to poor intake • Weight loss >3% in 24hrs • Weight loss >5% in 48hrs • Weight loss >7% in 72hrs | DAY 1: Initiate breastfeeding without intervention, maximize skin-to-skin & maternal-infant bonding time Supplement IF: <ul style="list-style-type: none"> • Poor / absent feeding cues (mouthing, rooting, waking for feeds) • Non-vigorous / stress behaviors (As, Bs &Ds, color change, flaccid, hiccups, unable to stay awake to feed) • Hypoglycemia (<50 mg/dl) • Hyperbilirubinemia related to poor intake • Weight loss >3% in 24hrs • Weight loss >5% in 48hrs • Weight loss >7% in 72hrs |
| METHOD OF SUPPLEMENTATION | May include supplemental nursing system (SNS), finger feeding (FF), bottle feeding, cup feeding, nasogastric or orogastric tube (NG/OG), IV fluids, parenteral nutrition per hospital policy & staff expertise • Non-bottle feeding (SNS/FF) optimal for establishing early breastfeeding; logistics TBD @ each institution | | | |
| RATIONALE FOR SUPPLEMENTATION | <ul style="list-style-type: none"> • 50% require gavage feeds¹ • 51% have feeding problems² • Full feeds by ~10 days of life³ | | <ul style="list-style-type: none"> • 27% require gavage feeds¹ • 34% have feeding problems² • Full feeds by ~6 days of life³ | |

1. Stellwagen, L and Boles E. CPQCC Care and Management of the Late Preterm Infant Toolkit: Section IV: Nutrition and Feeding of the Late Preterm Infant February 2013.
 2. Lubow et al. Am J Obstet Gynecol 2009;20(5):e30-33.

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NOTE: an individual infant may be considered in a higher or lower gestational age feeding category based on provider assessment of infant's maturity and clinical status or based on maternal post-partum status

| | 34-34 6/7 wks SGA <1800 g | 34-34 6/7 wks AGA >1800 g | 35 – 35 6/7 weeks | 36 – 36 6/7 weeks |
|---|---|---|---|---|
| IV CRITERIA: | <ul style="list-style-type: none"> • PIV, UVC or PIVC • BW >1500gm: D10W @ 60ml/kg/day • BW <1500gm: TPN • Wean IVF/TPN as increase enteral feeding + stable glucose | <ul style="list-style-type: none"> • If IVF needed: • PIV • D10W @ 60ml/kg/day • Wean IVF as increase enteral feeding + stable blood glucose | <ul style="list-style-type: none"> • If IVF needed: • PIV • D10W @ 60ml/kg/day • Wean IVF as increase enteral feeding + stable blood glucose | <ul style="list-style-type: none"> • If IVF needed: • PIV • D10W @ 60ml/kg/day • Wean IVF as increase enteral feeding + stable blood glucose |
| NG / OG | Place NG or OG tube if poor / absent feeding cues, non-vigorous, hypoglycemia, or unable to meet volume goals | | | |
| TYPE | <ul style="list-style-type: none"> • Expressed breast milk • Preterm Formula 20 kcal/oz | <ul style="list-style-type: none"> • Expressed breast milk • Preterm Formula 20 kcal/oz | <ul style="list-style-type: none"> • Expressed breast milk • Standard Term Formula | <ul style="list-style-type: none"> • Expressed breast milk • Standard Term Formula |
| FORTIFY | <ul style="list-style-type: none"> • Fortify @ 60 ml/kg/day: • MBM 24 kcal/oz with HMF • Preterm Formula 24 kcal/oz | <ul style="list-style-type: none"> • Fortify IF poor intake / poor wt gain at goal volume feeds: • MBM 24 kcal/oz with HMF • Preterm Formula 24 kcal/oz | <ul style="list-style-type: none"> • Fortify IF poor intake / poor wt gain at goal volume feeds: • MBM 24 kcal/oz with HMF • Preterm Formula 24 kcal/oz | <ul style="list-style-type: none"> • Fortify IF poor intake / poor wt gain at goal volume feeds: • MBM 24 or Term Formula 22/24 kcal/oz • Preterm Discharge Formula (PDF) 22 kcal/oz |
| SUPPLEMENTAL ENTERAL VOLUMES (NOTE: volumes = total feeding goals; modify volume of supplementation based on assessment of intake from breastfeeding) | <ul style="list-style-type: none"> • DAY 1: breastfeeding ad lib • DAY 2: 20-40 ml/kg/day OR 5-10 ml/feeding • DAY 3: 60-80 ml/kg/day OR 15-20 ml/feeding • DAY 4: 100-120 ml/kg/day OR 20-25 ml/feeding • DAY 5: 140-160 ml/kg/day OR 30-35 ml/feeding • DAY 6 (GOAL – fortified): 160 ml/kg/day OR 35 ml/feeding <p>NOTE: Advance supplementation ONLY if feedings are tolerated (heme (-) stools, stable abd girth / no visible bowel loops, residual <1/3 of feed, no persistent emesis)</p> | <ul style="list-style-type: none"> • DAY 1: breastfeeding ad lib • DAY 2: 20-40 ml/kg/day OR 5-10 ml/feeding • DAY 3: 60-80 ml/kg/day OR 15-20 ml/feeding • DAY 4: 100-120 ml/kg/day OR 25-30 ml/feeding • DAY 5: 140-160 ml/kg/day OR 35-40 ml/feeding • DAY 6 (GOAL): 160 ml/kg/day OR 35 ml/feeding (fortified) to 180 ml/kg/day OR 45 ml/feeding (unfortified/no BF) <p>NOTE: Advance supplementation ONLY if feedings are tolerated (see adjacent box for details)</p> | <ul style="list-style-type: none"> • DAY 1: breastfeeding ad lib • DAY 2: 20-40 ml/kg/day OR 5-10 ml/feeding • DAY 3: 60-80 ml/kg/day OR 15-20 ml/feeding • DAY 4: 100-120 ml/kg/day OR 25-30 ml/feeding • DAY 5: 140-160 ml/kg/day OR 40-45 ml/feeding • DAY 6 (GOAL): 160 ml/kg/day OR 45 ml/feeding (fortified) to 180 ml/kg/day OR 50 ml/feeding (unfortified/no BF) <p>NOTE: Advance supplementation ONLY if feedings are tolerated (see adjacent box for details)</p> | <ul style="list-style-type: none"> • DAY 1: breastfeeding ad lib • DAY 2: 20-40 ml/kg/day OR 5-10 ml/feeding • DAY 3: 60-80 ml/kg/day OR 15-20 ml/feeding • DAY 4: 100-120 ml/kg/day OR 25-30 ml/feeding • DAY 5: 140-160 ml/kg/day OR 40-45 ml/feeding • DAY 6 (GOAL): 160 ml/kg/day OR 45 ml/feeding (fortified) to 180 ml/kg/day OR 50 ml/feeding (unfortified/no BF) <p>NOTE: Advance supplementation ONLY if feedings are tolerated (see adjacent box for details)</p> |

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NOTE: an individual infant may be considered in a higher or lower gestational age feeding category based on provider assessment of infant's maturity and clinical status or based on maternal post-partum status

| | 34 – 34 6/7 weeks | 35 – 35 6/7 weeks | 36 – 36 6/7 weeks |
|---|---|--|--|
| DISCHARGE READINESS | <ul style="list-style-type: none"> • >48 hrs of successful feeding (8 good feedings/day; feeding volume sufficient) • Weight loss stabilized in infants ≥ 35-36 wks and weight gain demonstrated at goal feedings in infants < 35-36 wks • Temperature stability (≥ 36.5 C) in open crib >24 hrs • Family competent to continue feeding plan (i.e. waking baby if necessary; recognize/respond to early feeding cues) • F/U appointment within 2 days • Discharge lactation plan in place • Nutritional supplements Rx • WIC referral completed PRN | | |
| DISCHARGE (NOTE: Transition feeding plan 1-2 days prior to nursery discharge) | <p>BREASTFEEDING:</p> <ul style="list-style-type: none"> • Minimum 8-10 feeds/day • BF ad lib + minimum 2 supplemental bottle feedings until 48wks CGA or 12wks post-discharge • Supplemental feeds: MBM 24 OR PDF 24 <p>FORMULA FEEDING:</p> <ul style="list-style-type: none"> • PDF 22 or 24 • Continue PDF 22 or 24 until 48wks CGA or 12wks post-discharge <p>PMD VISITS:</p> <ul style="list-style-type: none"> • Review rate of weight gain and detailed lactation and feeding history; lactation consult/increased supplementation PRN <p>AFTER 12 WEEKS:</p> <ul style="list-style-type: none"> • Review rate of weight gain and catch up growth; if not caught up to >10%ile for length for actual age then consider continued supplementation or PDF | <p>BREASTFEEDING:</p> <ul style="list-style-type: none"> • Minimum 8-10 feeds/day • BF ad lib + minimum 2 supplemental bottle feedings until 48wks CGA or 12wks post-discharge • Supplemental feeds: MBM 24 OR PDF 24 <p>FORMULA FEEDING:</p> <ul style="list-style-type: none"> • PDF 22 • Continue PDF 22 or 24 until 48wks CGA or 12wks post-discharge <p>PMD VISITS:</p> <ul style="list-style-type: none"> • Review rate of weight gain and detailed lactation and feeding history; lactation consult/ increased supplementation PRN <p>AFTER 12 WEEKS:</p> <ul style="list-style-type: none"> • Review rate of weight gain and catch up growth; if not caught up to >10%ile for length for actual age then consider continued supplementation or PDF | <p>BREASTFEEDING:</p> <ul style="list-style-type: none"> • Minimum 8-10 feeds/day • BF ad lib • Supplemental feedings (IF needed): <ul style="list-style-type: none"> ◦ MBM or Term Formula ◦ MBM 24 or PDF 22 (IF used in nursery for poor wt gain) <p>FORMULA FEEDING:</p> <ul style="list-style-type: none"> • Term Formula <p>PMD VISITS:</p> <ul style="list-style-type: none"> • Review rate of weight gain and detailed feeding history; consider lactation consult/ supplementation PRN |
| GROWTH CHART | WHO plotted for corrected GA IHDP curves NOT recommended | WHO plotted for corrected GA IHDP curves NOT recommended | WHO plotted for corrected GA IHDP curves NOT recommended |

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Discharge Readiness

- Feeding well and gaining weight
- Stable temperatures in open crib
- No episodes of apnea/bradycardia for minimum of 5 days
- Newborn metabolic, hearing, congenital heart disease screens completed
- Parental education completed

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Readmissions

- Median LOS in LPIs was 4 days
- Early discharge <4 days associated with higher readmission rate
- Most common causes of readmission were hyperbilirubinemia and poor feeding

TABLE 3 Late-Preterm Infants and Rates of Readmission to the Hospital After the Birth Hospitalization

| Description of Comparison Groups by Study | Readmitted to Hospital ^a | | Required Hospital Care ^b | | Adjusted OR (95% CI) |
|---|-------------------------------------|-----|-------------------------------------|-----|-----------------------------|
| | No. | % | No. | % | |
| All NICU survivors from 6 Kaiser Permanente hospitals, N = 6054 (Escobar et al ¹⁰) | | | | | |
| <33 wk, all LOS | 20 | 3.4 | — | — | 1.88 (1.10–3.21) |
| 33–36 wk, LOS < 96 h | 31 | 5.7 | — | — | 2.94 (1.87–4.62) |
| 33–36 wk, LOS ≥ 96 h | 26 | 2.2 | — | — | 1.13 (0.69–1.84) |
| Term, LOS ≥ 96 h | 32 | 2.8 | — | — | 1.31 (0.83–2.05) |
| Term, LOS < 96 h | 56 | 2.2 | — | — | Reference |
| One half of all births >34 wk born in UK northern region, N = 11406 (Oddie et al ¹¹) | | | | | |
| 35–37 wk | 37 | 6.3 | — | — | 1.72 (1.15–2.57) |
| >40 wk | 57 | 2.4 | — | — | 0.70 (0.51–0.95) |
| 38–40 wk | 178 | 3.4 | — | — | Reference |
| All newborns surviving to discharge at 7 Kaiser Permanente hospitals, N = 33 276 (Escobar et al ¹⁰) | | | | | |
| <34 wk (100% in NICU) | 26 | 3.0 | — | — | 0.96 (0.57–1.62) |
| 34–36 wk, in NICU ≥ 24 h | — | — | — | — | 0.89 (0.54–1.46) |
| 34–36 wk, in NICU < 24 h | — | — | — | — | 1.31 (0.41–4.21) |
| 34–36 wk, never in NICU | — | — | — | — | 3.10 (2.38–4.02) |
| All 34- to 36-wk infants | | | | | |
| ≥37 wk, in NICU ≥ 24 h | 94 | 4.4 | — | — | 0.79 (0.52–1.21) |
| ≥37 wk, in NICU < 24 h | — | — | — | — | 1.43 (0.73–2.81) |
| ≥37 wk, never in NICU | — | — | — | — | Reference |
| All ≥37-wk infants | 618 | 2.0 | — | — | Reference |
| All Massachusetts newborns discharged early after vaginal delivery, N = 25 324 (Tomashek et al ¹²) | | | | | |
| 34–36 wk | 35 | 3.5 | — | — | 1.8 (1.3, 2.5) ^c |
| 37–41 wk | 489 | 2.0 | — | — | Reference |
| 34–36 wk | — | — | 43 | 4.3 | 1.5 (1.1, 2.0) ^c |
| 37–41 wk | — | — | 648 | 2.7 | Reference |

OR, odds ratio; CI, confidence interval; LOS, length of stay; UK, United Kingdom; —, data not reported.

^a Readmitted to hospital within 2 weeks after birth hospitalization discharge (Escobar et al¹⁰) and within first 28 days of life (Oddie et al¹¹ and Tomashek et al¹²).

^b Required hospital care includes hospital inpatient readmission and observational stay visit during neonatal period.

^c Shown as relative risks with confidence limits.

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What about *really* long term?

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Neurodevelopmental Outcomes

- Neurologic abnormalities (cerebral palsy, coordination)
- Intellectual disability
- Executive functioning, motor planning, and higher order processing
- Emotional disorders
- Behavioral disorders
- Speech/Language disorders
- Sensory Processing/Autism spectrum disorders

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Cerebral palsy

- Nonprogressive motor impairment resulting from injury to the **developing CNS** characterized by abnormal control of movement and posture
- **33-50% of CP** cases are attributable to prematurity, <15% due to neonatal encephalopathy
- **Increasing** prevalence of CP with **decreasing** infant mortality
- **3X** incidence among infants born **34-36 weeks** compared to term controls

Vincer et al, *Pediatrics*, 2006.

Petrini et al, *J Pediatr*, 2008.

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Cognitive Development

- **20-50%** of infants < 28 weeks have cognitive impairment
- **60%** of survivors with moderate-severe impairment at 23 weeks
 - Hintz, 2011
- Infants born **32-36 weeks** have 2X increased risk compared to term controls at 2 years corrected age
 - Johnson, 2015

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Neurobehavioral Disorders

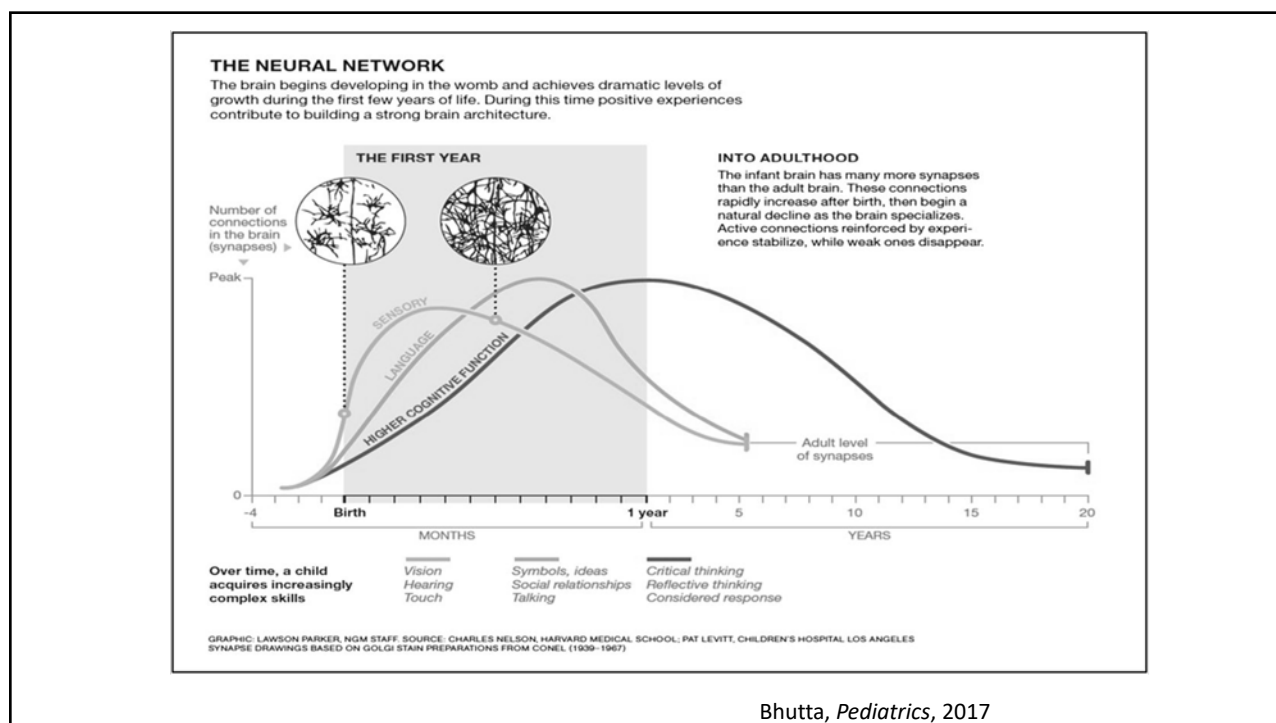
- **20-30%** of premature infants develop **ADHD** vs. 3-10% of infants at born at term
 - Millichap, *Pediatrics*, 2008.
- **OR 2.1** for infants < 28 weeks in Sweden for ADHD requiring medication, stepwise decrease but still significant effect through 36 weeks compared to term
 - Lindstrom, *Pediatrics*, 2011.

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Sensory Processing/Autism Spectrum

- Increased rates of **positive screens and diagnoses** for ASD for infants born <28 weeks
- **5% vs 1%** of full term population at ages 16-21 in prospective cohort
 - Limperopoulos, *Pediatrics*, 2008.
Pinto-Martin, 2011. Guy, *JPeds*, 2015.
- **32-36 week** infants have **RR 4.5** (95% CI 1.5-13.6) for positive M-CHAT screen
- Phenotype may be different than classic autism
- Likely due to higher rates of sensory processing disorders

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Goals for today

- Lead you through care for a preterm infant
 - Counseling
 - Resuscitation
 - Admission
 - Common complications
 - Discharge home
- Keep your heartrate in typical range and your porridge just the right temperature

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Do not fear
the
preterm
infant!

Thank you!