

# Feeding The Late Preterm Infant



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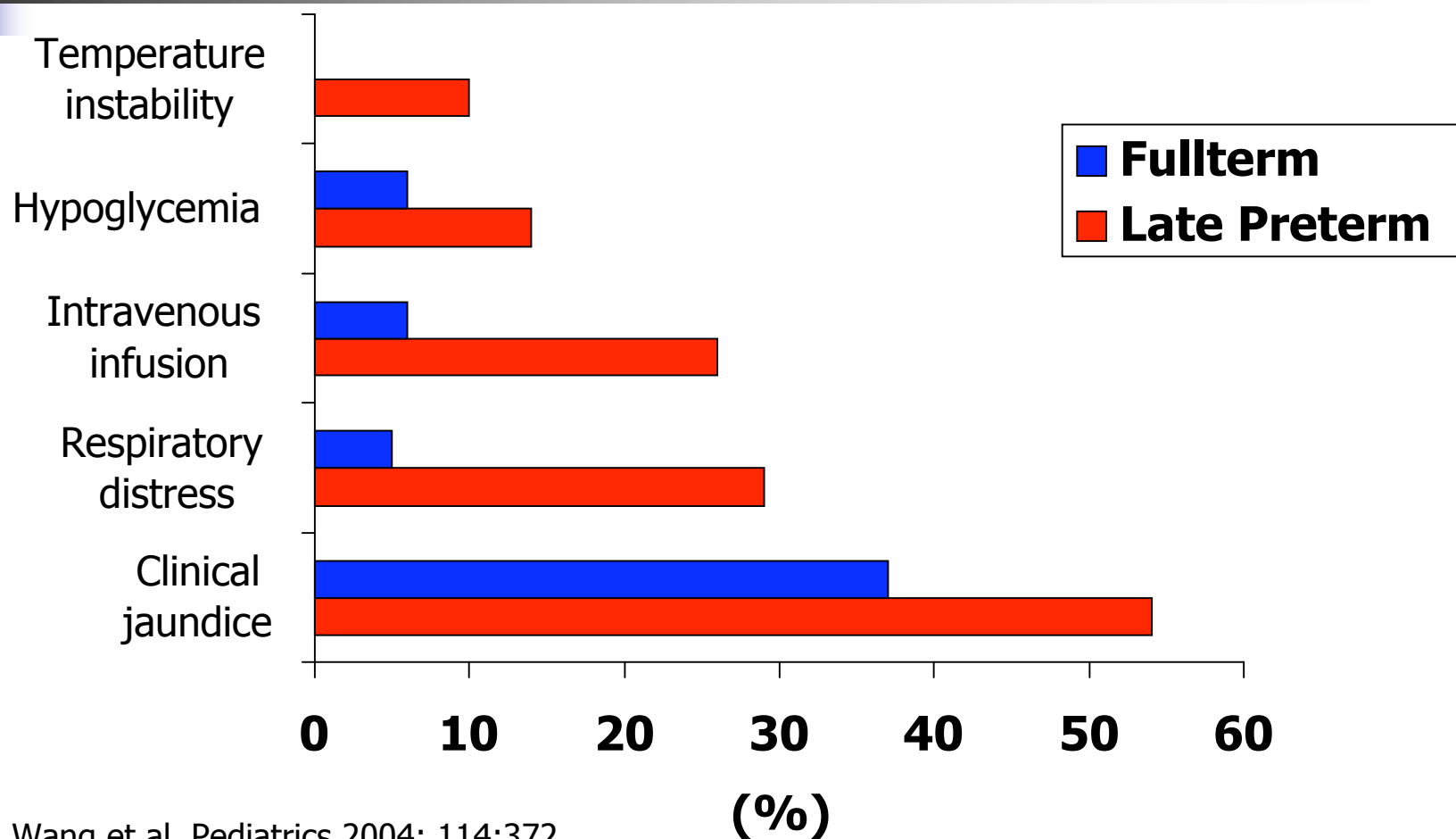


# The Late Preterm Infant

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- High morbidity
- High rate of hospital readmission
- Excluded from randomized trials
  - ❑ Most preterm studies < 1250 g infants
  - ❑ Nutritional studies

# Clinical Outcomes of Late Preterms



Wang et al, Pediatrics 2004; 114:372

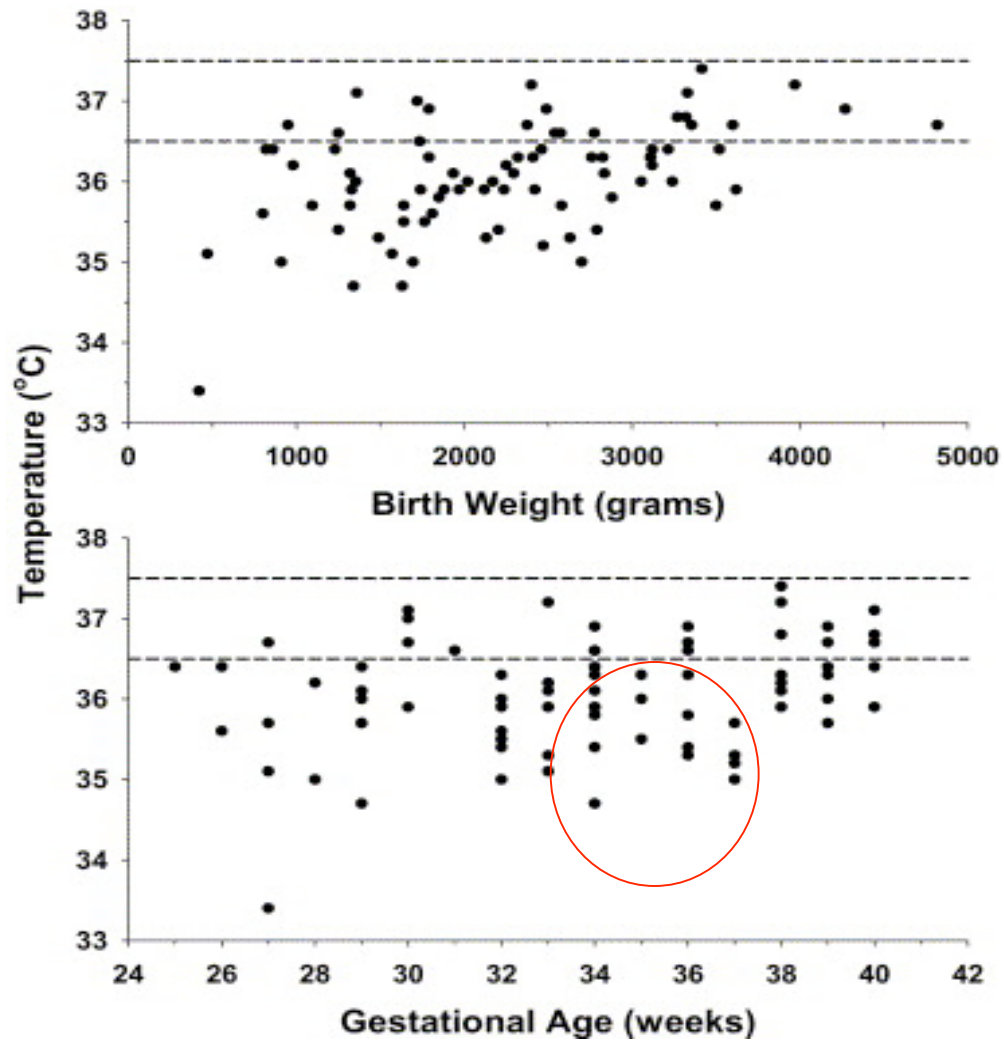


# Thermoregulation Issues

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- Large surface area to body weight ratio: more heat loss
- Immature response to cold stress
  - ❑ Small size
  - ❑ Immature gestation
    - Less white adipose fat for insulation
    - Less brown fat for thermogenesis
    - Immature hypothalamus
    - Immature hormonal control of brown fat metabolism
      - prolactin, cortisol,  $T_3$ , norepinephrine, leptin
- Energy needs greater to maintain thermoregulation
- Temperature instability
  - ❑ 35-36 wk = 10%
  - ❑ Term = 0%

# Thermoregulation Issues





# Hypoglycemia and Late Preterms

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➤ Incidence

- ❑ 35-36 wk = 18%
- ❑ Term = 4%
- ❑ Odd's Ratio = 3.30 (1.1; 12.2)

➤ Physiology

- ❑ Low supply of fat substrate
- ❑ Gluconeogenesis inadequate
- ❑ Glycogenolysis ineffective
  - Glycogen stores exhausted
- ❑ Large brain to body weight ratio
- ❑ High energy demand for thermoregulation
- ❑ Low milk intake



# Nutrition Problems

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- Feeding problems
  - ❑ Late Preterm = 32%
  - ❑ Term = 7%
  
- Lack of sustained vigor
- Suck-swallow-breathe immaturity
- GI motility – immature
  
- Breastfeeding



# Jaundice and Late Preterms

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- Immature glucuronosyltransferase
- Decreased milk intake
- Jaundice as a cause for delayed discharge
  - ❑ 35-36 wk = 16%
  - ❑ Term = 0.03%
- Jaundice as a cause for readmission
  - ❑ 34-36 wk = 46%
  - ❑ Term = 27%
- Bilirubin encephalopathy
  - ❑ Most common in late preterm infants



# Risk Factors for Hyperbilirubinemia

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- Predischarge TSB in high-risk zone [ $>95^{\text{th}}$  percentile]
- Jaundice  $<24$  h
- Blood group incompatibility with +Coombs or other hemolytic disorder
- Late Preterm infants (34-36 wk)
- Impaired lactation and/or excessive infant weight loss
- History of previous sibling needing phototherapy
- Bruising or cephalhematoma
- East Asian race



# Kernicterus Registry

## Incidence & Patient Profile

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- 125 cases in US, 1979 – 2002
- “healthy at discharge”
- Sources – parents, MDs, RNs, literature, med-legal
- 69% male
- Nearly all breastfed [follow-up scheduled for 2 weeks]
- 97% discharge <72 h (58% < 48 h)
- 25% Late Preterm infants
- LGA with kernicterus
  - ❑ 35% Late Preterm infants were LGA\*
  - ❑ 25% Term infants were LGA\*

Bhutani, Semin Perinatol 2006; 30:89-97

\*p <0.01

LGA – bruising; no other etiology

AGA – G6PD

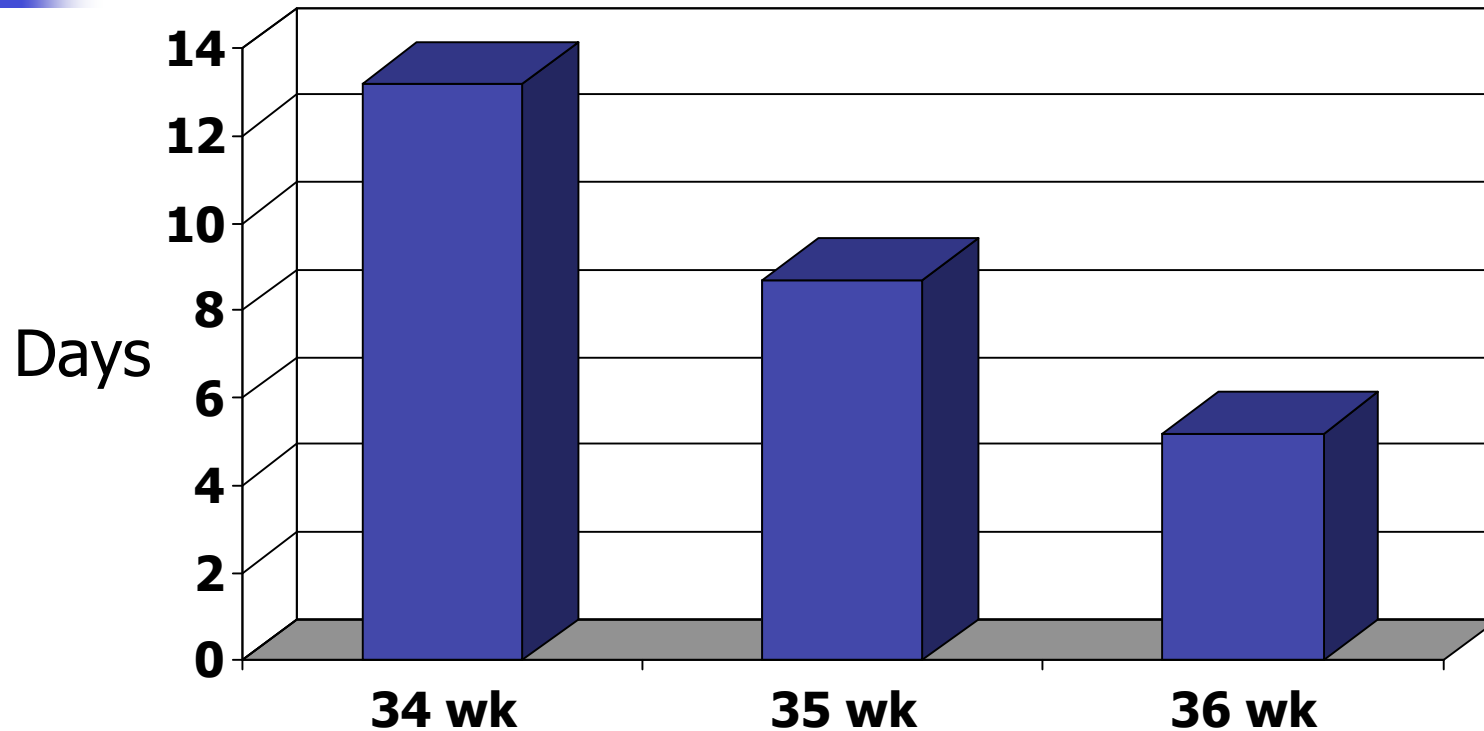


# Late Preterm Infants and Kernicterus

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- Largest group on Kernicterus Registry
  - ❑ Late Preterm Infants
- Suboptimal milk intake
- Bilirubin binding to albumin less than term infants
- Delayed follow-up visits
- Signs of kernicterus may be more subtle
  - ❑ Hypertonia, irritability
  - ❑ Posturing, arching, seizures

# Average Length of Hospital Stay



2008 NSLIJ NICUs, n = 540 (23% of all admits)



# Delayed Discharge of Late Preterms

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➤ Jaundice

- ❑ Late Preterm 8/49 (16%)
- ❑ Term 1/36 (0.03%)

➤ Feeding problems

- ❑ Late Preterm 22/29 (76%)
- ❑ Term 2/7 (29%)



## Readmission Rates Reduced If Prior NICU Stay

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Adjusted Odd's Ratio (95% CI)

**34-36 wk, never in NICU      3.10 (2.38; 4.02)**

34-36 wk, in NICU  $\geq$  24 h      0.89 (0.54; 1.46)

34-36 wk, in NICU < 24 h      1.31 (0.41; 4.21)

All newborns surviving to discharge at CA Kaiser hospitals,  $N = 33,276$   
Adjustment for maternal age, infant gender, race, SGA, SNAP score, site  
Escobar et al, Arch Dis Child 2005; 90:125  
Pediatrics 2007;120(6):1390



# Newborn Nursery or NICU?

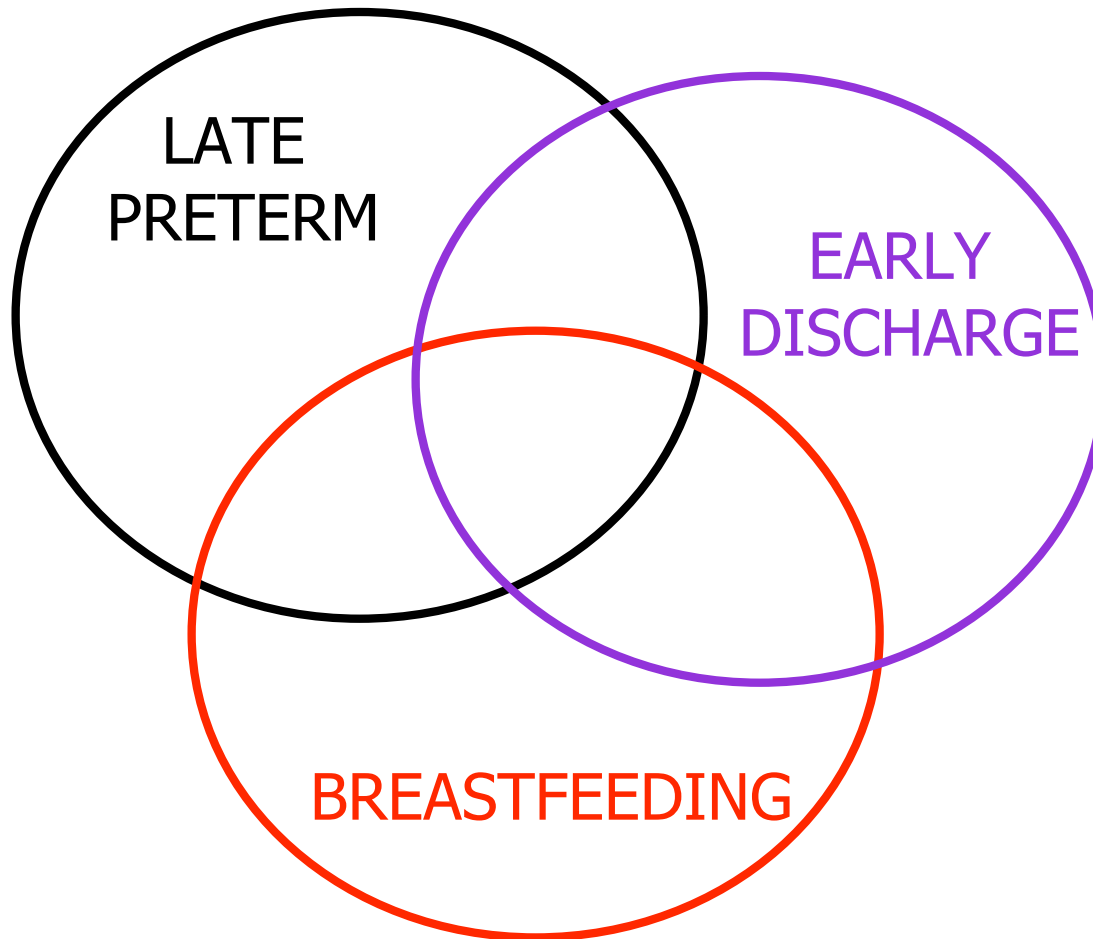
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- Admission to the Newborn Nursery
  - ❑  $\geq 36$  weeks gestation
  - ❑  $\geq 2250$  grams birth weight ( 5 lbs.)
- Admission to the NICU
  - ❑  $< 36$  weeks gestation
  - ❑  $< 2250$  grams birth weight
  - ❑ Infants presenting with problems
    - Presumed sepsis, respiratory distress, etc.



# Who Gets Readmitted?

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Semin Perinatol 2006; 30:54  
Pediatrics 2007;120(6):1390



# Readmission Diagnoses

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- Dehydration, Weight Loss
- Hyponatremia
- Severe Hyperbilirubinemia



# Cost of Readmission for Late Preterm Infants 1992-2000

	34 wk	35 wk	25-35 wk
Total, n	60,737	101,785	263,883
Readmission, n	7,936	13,102	38,455
Readmission, %	13.1	12.9	14.5
Hospital stay, days	44,378	67,477	247,504
Average stay, days	5.6	5.2	6.4
Cost, \$ millions	64.3	92.9	370
Cost, % total	17%	25%	-

California, all newborns surviving to discharge 1992-2000  
 Data from linked birth & death certificates and discharge database  
 Cost computed from hospital charges [cost-to-charge ratio]  
 Underwood, J Perinatol 2007;27:614



# Proposed Minimal Criteria for Discharge of Late Preterm Infants

- Accurate gestational age assessment
- **Timing based on feeding competency, thermoregulation, and resolution of medical/social problems**
- Timing of discharge unlikely prior to 48 h
- Follow-up medical care with MD, 24-48 h after discharge
- **At least 1 stool [probably should be 2 or more]**
- **Competent oral feeding**
- **Weight loss <7% before discharge [daily weights]**
- **Formal [serial] evaluations of breastfeeding documented**
- **Feeding plan understood by family; parent understands how to monitor adequacy of milk intake**
- Risk of severe hyperbilirubinemia determined and discussed
- Prenatal maternal labs – wnl
- Birth dose hepatitis B vaccine given or arranged
- NYS newborn screen repeated if initial before 24 h of milk feeding
- Car seat oximetry
- Hearing test
- Routine counseling for hand hygiene, temperature control, sleep, siblings, safety, exposures, emergencies

Adapted from Engle et al, Pediatrics 2007;120(6):1390



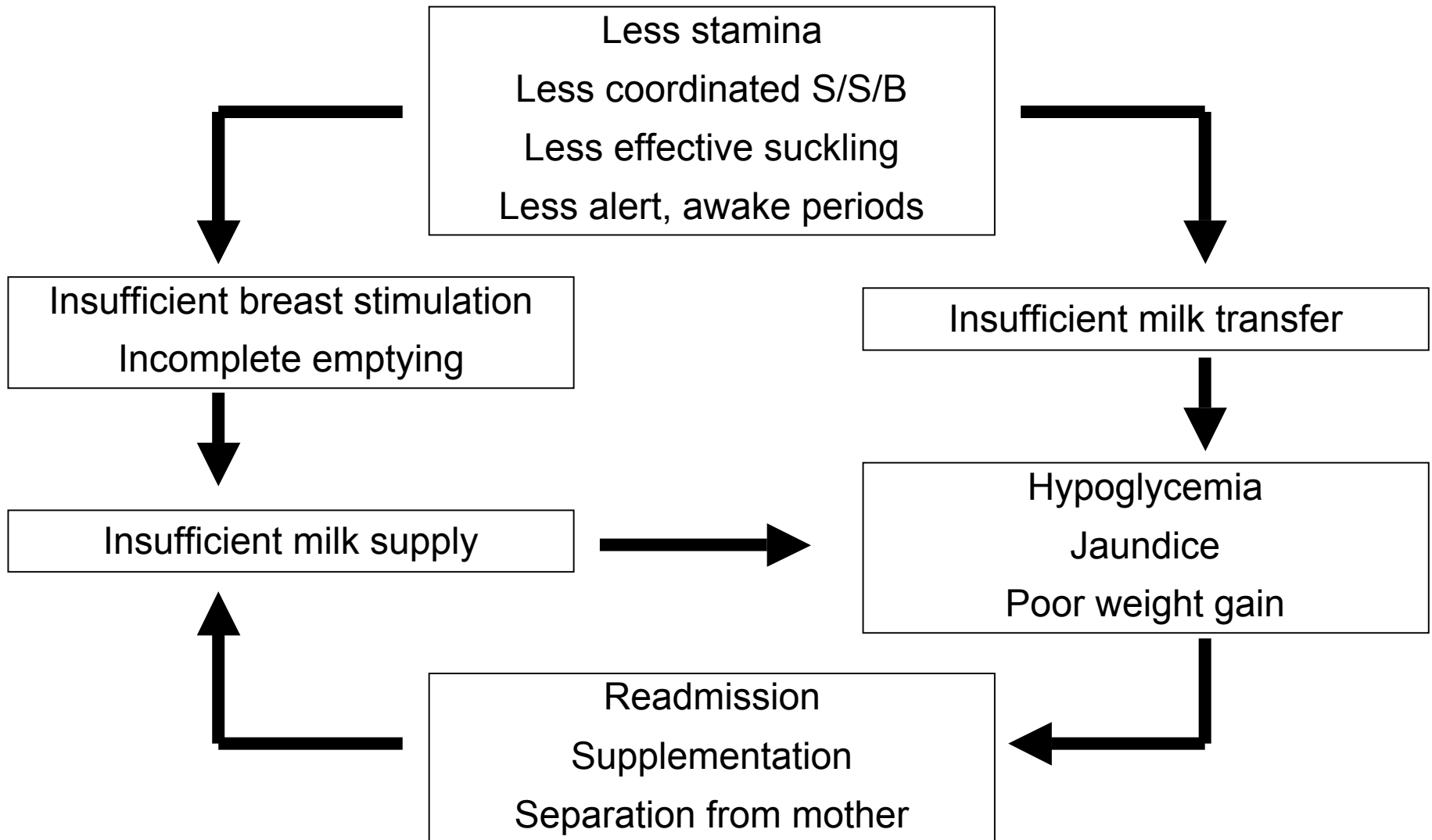
# Late Preterm Infant Risk Factors

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- Initially, may feed well with small volumes
- Unable to take larger volumes after discharge
  - ❑ Great Pretenders
- Skin-to-skin in delivery room not done
- Separation from mother
- Delayed initiation of feeding
- Infrequent feeding
- Sleepy, non-demanding behavior, needs to be awakened for feedings

*Adapted from Tomashek et al; Sem Perinatol 2006; 30:61*

# Late Preterm Infant: Breastfeeding Cascade





# Delayed Lactogenesis II

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- Delayed copious milk secretion
- Factors contributing to preterm birth all are associated with delayed lactogenesis II
  - ❑ Cesarean delivery
  - ❑ Pregnancy-induced hypertension
  - ❑ Diabetes
  - ❑ Obesity
  - ❑ Treatment for preterm labor
- Secondary Insufficient Milk Syndrome
  - ❑ Lactogenesis occurs
  - ❑ Failure of the infant to take adequate milk leads to failure of mother to make adequate milk

Walker M, JOGNN 2008: 37 (6)



# Breastfeeding-Associated Hyponatremia

➤ No of patients	70
➤ Birth weight	2.5 – 4.2 kg
➤ Weight loss, %	3 – 29%
➤ Weight loss > 10%	73%
➤ Gestational age	35 – 42 wks, predominantly < 38 wk
➤ Age admitted	2 – 16 days
➤ First-born	87 %
➤ Vaginal delivery	90 %
➤ Discharge within 48 h	90 %
➤ Max serum Na, mEq/L	150 – 177
➤ Complications, %	20

Pittsburgh 1997-2001

Mortiz, et al. Pediatrics 2005; 116; 343-347



# Characteristics of Cases

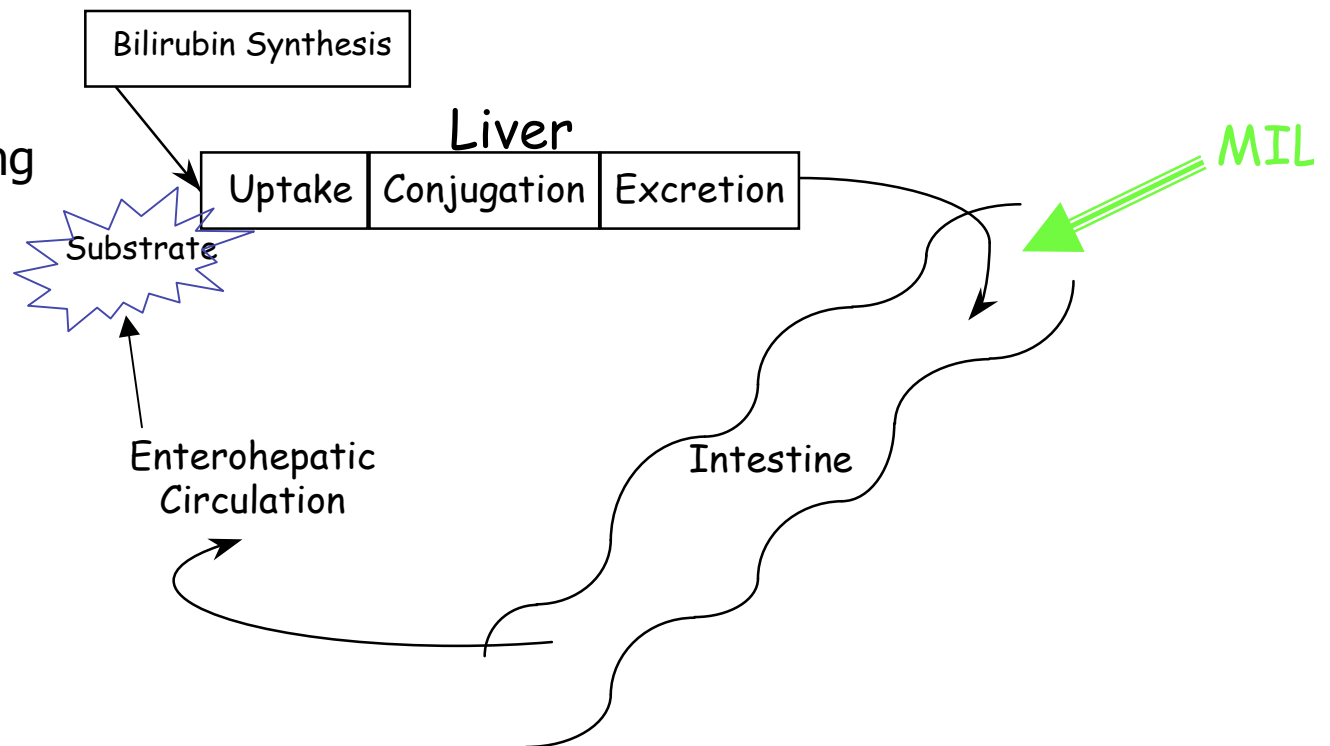
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- Risk factors
  - ❑ Late Preterm Infants
  - ❑ Infrequent feeding
  - ❑ Non-demanding infant (“happy-to-starve”)
  - ❑ Excess weight loss before hospital discharge
  - ❑ Other
    - Poor suck; oral-motor anomalies
    - Breast anatomical problems
- Mothers primiparous, educated, motivated to breastfeed
- Reluctant to feed supplement
- Not seen by a physician or knowledgeable health care provider

Adapted from Neifert, *Ped Clin No Amer* 2001; 48:273

# Breastfeeding Jaundice

- Also called "breast-non-feeding jaundice"
- Early-onset, first week, not hemolytic
- Exaggeration of physiologic jaundice
- Inadequate milk intake
  - Late initiation
  - Separation
  - Infrequent feeding
  - Not *ad libitum*
- Enterohepatic recirculation
- Impaired lactation performance





# Management of Breastfeeding Jaundice

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- Establish effective lactation
- Increase feeding frequency
  - ❑ Block enterohepatic recirculation of bilirubin
- Give MILK
  - ❑ Calories, gastrocolic stimulation
  - ❑ Expressed breastmilk, donor milk, or formula
- Avoid water feedings
- Avoid glucose water feedings
- Anticipate problems



# Feeding Problems of Late Preterms

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- Suck - ineffective
- Latch – difficult
  - ❑ May benefit from nipple shield
- Does not open mouth wide with stimulus
- Abnormal tongue movements
- Can't attain grasp
- Low suck frequency
- Can't sustain negative pressure
  - ❑ Insufficient suckling to initiate milk ejection response
  - ❑ Doesn't nurse long enough to provide sufficient flow to constitute a complete feed
- Behavioral states less defined
  - ❑ Tires easily
  - ❑ Quiet or active alert
  - ❑ Crying, deep sleep
  - ❑ Light or active sleep, drowsy



# Management Overview

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- Skin to skin contact in delivery room
- Avoid maternal infant separation
- Rooming-in
- Early unrestricted breastfeeding
- Learn baby's feeding cues
- Mother has access to baby in the NICU
- Formal evaluation and assessment of breastfeeding
- Develop individualized care plan
- Follow-up



# Breastfeeding Management

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- Decrease feeding stressors
- Avoid feeding positions that cause excessive trunk or neck flexion
  - ▣ Associated with apnea and/or bradycardia and/or desaturation
    - Cradle hold
- Avoid head flexion
- Avoid breast pressure on infant chest in football hold

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# Optimize Breastfeeding

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- Provide head, neck support & cheek, jaw support
- Keep body at the breast level, avoid stretch
- Recognize feeding cues
  - ❑ Increased REM movements
  - ❑ Wide-open eyes – looking about
  - ❑ Baby moves head back and forth
  - ❑ Arms and legs begin to wiggle
  - ❑ Mouth opens in searching behaviors
  - ❑ Active rooting and suck
  - ❑ **CRYING IS A LATE HUNGER CUE**
    - Baby cannot concentrate
    - Leads to latch difficulty and breast refusal
- Strategies for awakening the infant

Mother keeps  
diary of  
infant's  
feeding and  
elimination



# Nipple Shields

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- Help stabilize the breast in the baby's mouth
- May compensate for sub-optimal sucking pressures
- May use until term corrected age when feeding is more consistent
- Mother must double pump after shield use
- Assessment and initiation by trained lactation personnel
- Follow-up after discharge to wean off nipple shield



# Elements of an Effective Feeding

- The baby is awake and stays awake throughout the feeding
- Latches on to the breast and stays on, creating suction
- Suckles vigorously, both non-nutritive and nutritive suckles
- Demonstrates swallowing that can be seen and heard
- The baby lets go of the breast by himself
- The baby is relaxed and content after feeding
- Report of maternal uterine contractions



# Is Baby Getting Enough Milk?

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- All elements of an effective feeding
  - ❑ Many late preterm infants are outliers: they are not able to consistently feed effectively until they reach term age
- Monitor urine and stool output
- Monitor weight gain and loss
- Check mother's LOG
- Pre- and post-feeding weights



# Issues

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➤ Monitor

- ❑ Prevent excessive weight loss
  - Losses  $>7\%$  of birth weight
- ❑ Prevent exaggerated jaundice
- ❑ Prevent hypoglycemia

➤ Promote effective milk transfer



# Supplementation

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- Many late preterm infants need to be supplemented after breastfeeding with expressed breastmilk or formula until they are able to consistently
  - ❑ Demonstrate all elements of an effective feeding
  - ❑ Have normal elimination patterns
  - ❑ Stabilize weight loss, begin to gain weight



# Lactation Service Discharge Feeding Plan For Late Preterm Breastfeeding Infants

- Awaken infant to feed every 3 h
- Offer breast at each feeding.
- If baby latches and suckles, let baby nurse 10-15 min at each breast.
- After every breastfeed offer supplemental breastmilk or formula
  - ❑ Specify volume\* \_\_\_\_\_
- Double pump after every feeding for 15 –20 minutes.
- Maintain feeding LOG.
- See pediatrician within 1-2 days after discharge.

**\*5 – 10 ml per feed on day 1; 10 – 20 ml per feed day 2; 20 - 30 ml per feed day 3; then base on ability/milk production**

Academy of Breastfeeding Medicine Protocol #10  
In Lawrence, "Breastfeeding A Guide for the Medical Profession" Elsevier, 2005; 1094-9  
Hubbard, Contemp Peds 2007; 1-9.



# Late Preterm “Pretenders”

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- Pretend to be sucking adequately but intake is low
- Intake does not increase over time in hospital
- 40 mL test
  - ❑ Must consume 40 mL to be discharged



# Feeding Decisions: 34-36 wk

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- Expressed Human Milk
  - ❑ Breastfeeding/bottle/cup
  - ❑ ± Term Formula 20 or 24 kcal/oz
- Term Formula 20 or 24 kcal/oz
- Supplements
  - ❑ Iron, 2 mg/kg/day
  - ❑ Multivitamins, 1 mL/day



# Discharge Planning

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- Provide a clear discharge feeding care plan
- Community follow up with
  - ❑ Pediatrician
  - ❑ Lactation Consultant
  - ❑ Visiting Nurse



# Home Visit for Late Preterm Infants

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Adjusted Odd's Ratio (95% CI)

Scheduled home visit within 72 h of discharge  
= reduced readmission rate

AOR = 0.66 (0.51; 0.84)

All newborns surviving to discharge at CA Kaiser hospitals,  $N = 33,276$   
Adjustment for maternal age, infant gender, race, SGA, SNAP score, site  
Escobar et al, Arch Dis Child 2005; 90:125

# Readmissions and ED Visits From Discharge To 10 Days

	Home Visit, <i>n</i> (%)	No Home Visit, <i>n</i> (%)	<i>P</i>
Total patients	326 (11.0)	2641 (89.0)	--
Readmissions	2 (0.6)	73 (2.8)	.0141
ED visits	0 (0)	92 (3.5)	<.0001
Readmission or ED visit	2 (0.6)	144* (5.5)	<.0001

\* 21 infants were readmitted from the ED and were counted only once

Paul, Pediatrics 2004; 114:1015



## Average Reimbursement From Payers

	Cost, \$
Inpatient day	1163.00
Inpatient stay	3722.00
ED visit	423.00
Home health visit	85.00

Paul, Pediatrics 2004; 114:1015



# Summary

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- Late preterm infants are immature!



# Summary: Neonatologist

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- Late preterm infants are immature!
- Admit to NICU Nursery
- Treat respiratory disease
- Monitor for apnea
- Determine risk for severe hyperbilirubinemia
- Special breastfeeding protocol
- Ensure good feeding ability and intake
- Delay discharge until feeding adequately
- Research needed, overlooked group!



# Summary: Pediatrician

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- Late preterm infants are immature!
- Communicate care plan
- Frequent follow-up post-discharge
  - ❑ 1 – 2 days post discharge
  - ❑ Afterwards
- Monitor weight gain
- Breastfeeding
  - ❑ Triple feeding technique
- Monitor jaundice
- Research needed, overlooked group!

# References

1. American Academy of Pediatrics, Committee on Fetus and Newborn (2008). Hospital discharge of the high-risk neonate. *Pediatrics* 122, 1119-1126.
2. Bhutani, V. K., Johnson, L. (2006). Kernicterus in late preterm infants cared for as term healthy infants. *Semin. Perinatol.* 30, 89-97.
3. Engle, W. A., Tomashek, K. M., Wallman, C., Committee on Fetus and Newborn (2007). "Late-preterm" infants: a population at risk. *Pediatrics* 120, 1390-1401.
4. Engle, W. (2009). Infants born late preterm: definition, physiologic and metabolic immaturity, and outcomes. *NeoReviews* 10, e280-e286.
5. Lupton, A., Jackson, G. L. (2006). Cold stress and hypoglycemia in the late preterm ("near-term") infant: impact on nursery of admission. *Semin. Perinatol.* 30, 24-27.
6. Meier, P. P., Furman, L. M., Degenhardt, M. (2007). Increased lactation risk for late preterm infants and mothers: evidence and management strategies to protect breastfeeding. *J Midwifery Wom Health* 52, 579-87.
7. Paul, I. M., Phillips, T. A., Widome, M. D., Hollenbeak, C. S. (2004). Cost-effectiveness of postnatal home nursing visits for prevention of hospital care for jaundice and dehydration. *Pediatrics* 114, 1015-1022.
8. Shapiro-Mendoza, C. K., Tomashek, K. M., Kotelchuck, M., et al. (2008). Effect of late-preterm birth and maternal medical conditions on newborn morbidity risk. *Pediatrics* 121, e223-e232.
9. Underwood, M. A., Danielson, B., Gilbert, W. M. (2007). Cost, causes and rates of rehospitalization of preterm infants. *J Perinatol* 27, 614-619.
10. Wang, M. L., Dorer, D. J., Fleming, M. P., Catlin, E. A. (2004). Clinical outcomes of near-term infants. *Pediatrics* 114, 372-376.
11. Walker, M. (2008). Breastfeeding the late preterm infant. *JOGGN* 37, 692-701.