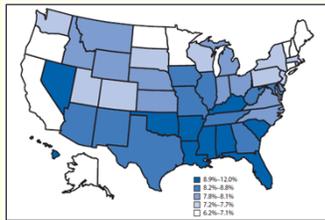


Breastfeeding the Late Preterm Infant

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Stats for Late Preterm Infants

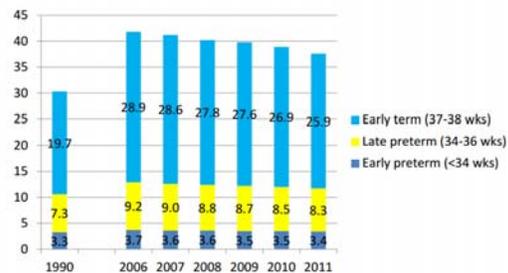
- 2013 late preterm birth rate dropped to 7.99%
- Range: 6.2% in Vermont to 11.6% in Mississippi



More stats

- > 477,000 late preterm births/year
- Another 700,000 births each year occur at 37 and 38 weeks of gestation that are called early term infants
- > 30% experience feeding difficulties

Figure 1. Births at <39 weeks of gestation:
United States, 1990 and 2006-2011



SOURCE: CDC/NCHS, National Vital Statistics System.

Nomenclature

- <34 weeks = preterm
- 34 0/7 to 36 6/7 weeks = late preterm
- 37 0/7 to 38 6/7 weeks = early term
- 39 0/7 to 40 6/7 weeks = full term
- 41 0/7 to 41 6/7 weeks = late term
- 42+ post-term

Not out of the woods yet

- Babies born between 37 weeks and 39 weeks are not exempt from the problems of prematurity
 - 2 to 4-fold risk of complications such as respiratory distress, NICU admission, sepsis, or hospitalization for more than 5 days (Tita et al, 2008).

Increased morbidity and mortality

- Newborn morbidity rate doubled in infants for each gestational week earlier than 38 weeks with the risk intensified when an infant was exposed to maternal hypertensive disorders of pregnancy (Shapiro-Mendoza et al (2008)
- Each weekly increase in gestational age is associated with a decreasing risk of death, with infants born at 37, 38, and 42 weeks showing an increase in mortality rates compared with babies born at 40 weeks. (Young et al, 2007).
- LPIs are at a twofold higher risk for sudden infant death syndrome
 - 1.4 cases per 1000 at 33-36 weeks gestation compared with 0.7 per 1000 at >37 weeks gestation (Kramer et al, 2000; Malloy & Freeman, 2000).

Clinical Outcomes of Near Term Infants Wang et al. Pediatrics 2004; 114:372-376

- Compared 90 late preterm (35-37 weeks) and 95 term infants
- Temperature instability
 - 10% in near term, 0% full term
- Respiratory distress
 - 28.9% in near term, 4.2% full term
- Clinically jaundiced
 - 54.4% in near term, 37.9% full term
- Hypoglycemia
 - Seen 3 times as often in near term cohort

Outcome during initial birth hosp.	Late preterm morbidity	Term morbidity	OR (95% CI)
Feeding difficulties	32.2%	7.4%	
Hypoglycemia	15.6%	5.3%	3.3 (1.1-12.2)
Jaundice	54.4%	37.9%	1.95 (1.04-3.67)
Temp. instability	10%	0	
Apnea	4-12%	0	12 (4.5-24.3)
Respiratory distress	3.6-29%	0.6-4.2%	9.2 (2.9-37.8)
IV infusion	26.7%	5.3%	6.5 (2.3-22.9)
Sepsis evaluation	36.7%	12.6%	4 (1.8-9.2)
Mech ventilation	3.4%	0.9%	

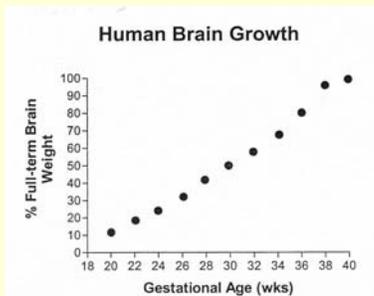
Engle, Tomaszek, Wallman & COFN. AAP Clinical Report, Pediatr 2007;120:1390-1401.

Breastmilk protection

- Provision of human milk is important to infants born preterm as these babies have a lower antioxidant capacity.
- May be why they are so vulnerable to diseases and conditions associated with oxidative stress such as necrotizing enterocolitis, chronic lung disease, retinopathy of prematurity, periventricular leukomalacia, and intraventricular hemorrhage.
- Breastmilk is much higher in antioxidant capacity than infant formula and helps neutralize oxidative stress on young babies (Ezaki et al, 2008).

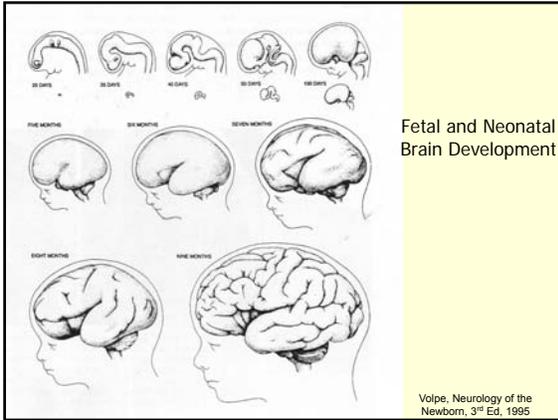
Importance of the last 6 weeks

- Brain weights at 34 and 36 weeks are 65% and 80% of brain weights at term affecting such functions as arousal, sleep-wake behavior, and the coordination of feeding with breathing.
- 1/3 of brain growth occurs in the last 6-8 weeks of gestation
- The immature brainstem adversely impacts upper airway and lung volume control, laryngeal reflexes, and the chemical control of breathing and sleep mechanisms, with 10% of these infants experiencing significant apnea of prematurity (Darnall et al, 2006).



Brain weight at different ages from 20-40 wks gestation. At 34 weeks, the overall brain weight is 65% of term weight.

HC Kinney. Semin Perinatol 2006;30:80-88.







Breastmilk as brain food

- Myelination is markedly underdeveloped, and neuronal connections and synaptic junctions are not at their full complement
- Breastmilk is a rich source of components designed specifically to promote myelination and increased development of brain synapses such as sialic acid-containing oligosaccharides
- Formula-fed babies receive only 20% of the sialic acid that a breastfed baby receives and do not synthesize the difference
- Late-preterm birth is associated with subtle deficits in cognitive functioning as early as age 2 years of age.

For every 10-mL/kg per day increase in breast milk ingestion:

- Mental Development Index increased by 0.53 points
- Psychomotor Development Index increased by 0.63 points
- Behavior Rating Scale percentile score increased by 0.82 points
- Likelihood of rehospitalization decreased by 6%
- Infants receiving the most breastmilk would enjoy a 5 point elevation in IQ or conversely, infants fed no breastmilk could experience a 5 point IQ deficit. (Vohr et al (2006))

Immature behaviors

- Diminished muscle tone makes LPIs more prone to positional apnea due to airway obstruction.
- Immature autonomic system may demonstrate exaggerated responses to stressful stimuli with rapid or lower heart rates, abnormal breathing, skin mottling, frequent startling, regurgitation, or simply shutting down.
- Ability to self regulate may be limited and they be irritable, difficult to console, or not very responsive to their parents' overtures.

Neurologic Immaturity

- Immature state regulation
- Difficulty achieving the "latchable" state
- Low tone = poor latch, reduced intake per suck, inadequate milk transfer
- May require more support and positioning adjustments at breast
- Less mature suck pattern

Cardiorespiratory Instability

- Reduced clearance of normal lung fluid (TTN)
 - Especially in elective repeat cesarean without labor
- Large head + decreased tone = positional respiratory instability in some breastfeeding positions and in a car seat
- Increased risk for centrally mediated apnea as central nervous systems are developmentally immature with fewer sulci and gyri in the brain and less myelin.

Temperature Instability

- Poor temperature regulation
- Skin-to-skin care
 - Newborns placed skin-to-skin remain warmer during the first 3 hours following birth compared with newborns swaddled in mother's arms or receiving nursery care (Bystrova et al, 2003)
 - achieve thermoregulation and do so more rapidly than newborns placed under a radiant warmer



Metabolic Instability

- Reduced glycogen and brown fat stores
- Hyperinsulinism may be encountered in infants of diabetic mothers and babies whose mothers are obese and insulin-resistant
- Reduced ketone body compensatory mechanisms especially if given formula which blunts ketone response
- Little energy reserve
- Reduced ability to conjugate and excrete bilirubin
- The more preterm the baby, the longer and more prolonged is meconium passage

Heading off hypoglycemia

- Especially if the mother is diabetic, breastfeeding attempts should occur:
- within 1 hour after birth
- once every hour for the next 3 to 4 hours
- every 2 to 3 hours until 12 hours of age
- at least 8 times each 24 hours in hospital stay
- Frequent breastfeeding is important for late preterm infants who lack stamina and demonstrate inefficient feeding skills.
- Unless swallowing takes place and is documented during these feeding sessions, late preterm infants may actually receive little colostrum, exacerbating hypoglycemia

Delayed lactogenesis II

- Compromises the availability of milk
 - Ineffective suckling further down-regulates milk volume
- Diabetes
- Obesity
- Cesarean delivery
- May see prolonged colostrual phase

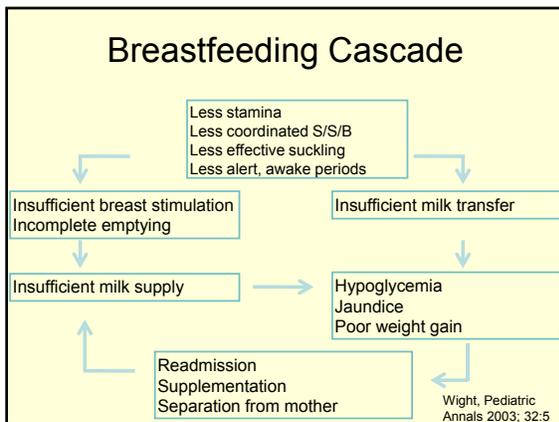
Feeding Problems

- Feeding problems are the predominant reason for delay in discharge
 - Discharge home for near term infants was delayed by suboptimal feeding in nearly 25% of these infants
 - Close attention crucial in avoiding readmission for jaundice and dehydration
 - Ineffective breastfeeding can cause jaundice and jaundice can be a sign of ineffective breastfeeding

Inadequate Milk Intake

- Depressed sucking pressures
 - Baby uses suction to draw nipple into mouth
 - Needs -50 to -60 mm Hg during pauses to keep nipple in mouth; can explain why baby keeps slipping off breast
 - Depends on expression to extract milk
- Tire easily at breast/reduced endurance
- Reduced intake per feed
- Insufficient feeds per 24 hours
- Reduced maternal milk supply
- Disorganized suck
- Long periods of sleep
- Maternal health problems/separation
- Babies do not consume milk from the breast simply because it is there

Breastfeeding Cascade



Geddes et al. Tongue movement and intra-oral vacuum in breastfeeding infants.

Early Human Development, 84, 471-477.

- Vacuum plays an important role in removing milk from the breast
- Intraoral pressure was lower in younger babies
- LPIs may encounter difficulty with sufficient milk transfer as their ability to generate high enough vacuum levels may be compromised by
 - low muscle tone
 - rapid decrease in tone during a feeding
 - poor seal on the breast
 - difficulty in maintaining the nipple in an optimal position.

General breastfeeding plan for LPI

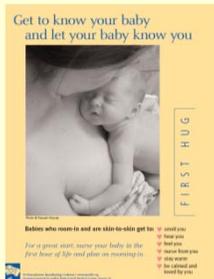
- Place baby skin to skin on your chest
- Watch for rapid eye movements under the eyelids (the baby will wake easily)
- Feed your baby frequently
- Within 1 hour after birth
- Once every hour for the next 3 to 4 hours
- Every 2 to 3 hours until 12 hours of age
- At least 8 times each 24 hours during the hospital stay

Utilize behavioral feeding cues

- Move baby to breast when baby shows feeding cues
 - Sucking movements of the mouth and tongue
 - Rapid eye movements under the eyelids
 - Hand-to-mouth movements
 - Body movements
 - Small sounds

Immediate Postpartum Care

- Skin-to-skin contact
 - Physiologic stability
 - Provides warmth
 - Proximity to breasts
 - Improves oxygenation
 - Decreases crying
 - Does not interrupt initial breast-seeking behaviors
 - Avoids hypoglycemia



Decrease stressors

- Gentle handling, suctioning only if necessary
- Dim lights
- Reduce noise
- Limit visitors
- Avoid separation for routine procedures



Interruptions

Morrison et al. JOGNN 2006; 35:709-716

- Averaged 54 interruptions over a 12 hour period
- Interruptions were frequent, erratic
- Mothers reported feeling rushed when breastfeeding because they were unsure when the next person would enter the room
- Interruptions took precedence over breastfeeding
- Mothers would cease breastfeeding immediately when interruptions occurred
- Mothers had little time to rest, take care of themselves, or feed the infant

Positioning Late Preterm Infants

- Position infant for maximal lung expansion, head slightly extended for open airway
- Assure that the head is stable, in straight alignment with neck and hips









Biological Nurturing

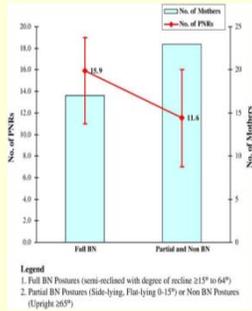


- Extended holding in postures where mother leans back, babies lie prone in close frontal apposition with maternal body contours
- Release primitive neonatal reflex-like movements
- Release of these reflexes aids in breastfeeding
- Primitive neonatal reflexes is a collective name given to >50 unconditioned reflex responses, spontaneous behaviors to environmental stimuli
 - Rooting, sucking, swallowing
 - Head, cheek, tongue, lip reflexes
 - Hand-to-mouth, stepping, crawling



Biological Nurturing

- Greater number of PNRs observed when mothers were in full BN postures
- Changing to full BN postures reduced feeding problems at breast
- Ventral positioning was more physiological than traditional positions for breastfeeding
- Babies often appeared to be asleep but were actively feeding
- Babies may not need to be fully awake for feeding



Ineffective Latch

- Low tone
- Does not draw nipple/areola deep into mouth
- Younger infants exert lower vacuum
- Vacuum is primary force used to remove milk from the breast



Compensate for vulnerabilities

- Assisting with latch
- Skin-to-skin
- Behavioral feeding cues
- Encouraging wide open mouth
- Incentives at the breast
- Nipple tug
- Finger feeding





Helping with Latch

- Nipple shield
 - 20mm size
 - 16mm may be too small and 24mm may be too large
 - Teat height should not exceed distance from infants lips to juncture of hard and soft palate
- Compensates for relatively weak suck
- Properly fitted
- Reverse pressure softening for edematous areola





Alternate Massage/ Breast Compressions

- Breast is massaged and compressed during pauses between sucking bursts
- Creates improved pressure gradient between breast and baby's mouth
- Can increase volume and fat content of feeds



In-hospital feeding plan

- Place baby skin to skin on your chest
Watch for rapid eye movements under the eyelids
Feed your baby frequently
- within 1 hour after birth
 - once every hour for the next 3 to 4 hours
 - every 2 to 3 hours until 12 hours of age
 - at least 8 times each 24 hours during the hospital stay
- Move baby to breast when baby shows feeding cues
- Sucking movements of the mouth and tongue
 - Rapid eye movements under the eyelids
 - Hand-to-mouth movements
 - Body movements
 - Small sounds

Make sure you know how to tell when your baby is swallowing

- baby's jaw drops and holds for a second
- you hear a "ca" sound
- you feel a drawing action on the areola and see it move towards your baby's mouth
- you hear the baby swallow
- you feel the swallow when you place a finger on the baby's throat
- your nurse hears the swallow when a stethoscope is placed on the baby's throat

Use alternate massage if your baby doesn't swallow after every 1 to 3 sucks.

Massage and squeeze the breast each time she stops between sucks. This helps get more colostrum into her and keeps her sucking longer.

If your baby does not swallow when at the breast, hand express colostrum into a teaspoon and spoon feed 2 teaspoons to your baby using the above guidelines



Improving milk output by more effective breast emptying

- Before milk comes in, hand expression may more effectively remove colostrum
- Once milk comes in, combination of pump vacuum, breast compression, and hand expression may yield more milk



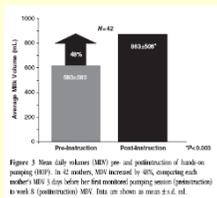
Morton et al. J Perinatology 2009;29:757-764
If separated or baby does not latch

- Begin pumping within first 6 hours
- x8/day for 15 minutes
- Hand express colostrum as frequently as possible in first 3 days
- Use maximum comfortable vacuum



Improving milk output

- Double pump
- Add breast compression while pumping and massage firm areas
- When milk flow stops, massage breasts and remove residual milk by pump or hand expression
- Milk volume increased 48%



Triple combination yields more milk

- Removes a greater fraction of milk
- Milk flow reverses when milk ejection finishes
- Breast compression may increase intraductal pressure
- Presents a more efficient pressure gradient
- <http://newborns.stanford.edu/Breastfeeding/MaxProduction.html>



More effective pumping tips

Parker, et al. J Perinatology 2012; 32:205-209

- Mothers initiated milk expression within 60 minutes of birth (group 1) or 1 to 6 hours (group 2) following delivery
- Milk volume and timing of lactogenesis stage II was compared between the 2 groups
- Group 1 produced significantly more milk than group 2 during the first 7 days and at week 3
- Group 1 also demonstrated a significantly earlier lactogenesis stage II.

Warming the breasts

- Warming tissues is a known therapeutic intervention that increases local blood flow and metabolism in tissues, facilitating excretion of tissue waste materials and phagocytosis, and enhancing tissue nutrition (Barret et al., 2010).
- Warm compresses have long been recommended to aid the let down reflex.
- Kent et al (2011) found that warmed pump flanges resulted in a larger amount of available milk removal.



Warming the breast

- Yigit et al. (2012) studied whether warming the breast prior to pumping would increase the volume of milk expressed from a warmed breast compared with the other breast which was not warmed.
- Mothers placed a warm compress (40.5C/104.9F) on one breast prior to pumping
- The amount of milk obtained from the warmed breasts was significantly higher than that obtained from the non-warmed breasts
- Warming probably has an enhancing effect on the milk ducts or milk flow, allowing more milk to be pumped, rather than increasing actual breastmilk production.



Properly fitted pump flange

- Nipples swell during pumping
- Standard pump kits provide flanges whose nipple tunnel opening is 24mm to 25mm, but many mothers benefit from a larger opening of 27mm to 30mm





Power Pumping

- First milk ejection releases up to 45% of total volume expressed
- elicit multiple “first” let-downs
 - double pump for 10 minutes, 5-15 minute break, then double pump another 10 minutes
- Tricks the breast into performing several “first” milk ejections
- Mothers who are exclusively or predominantly pumping should target an output of 3500mL/week (500mL/day) by the end of the second week

Figure 1
Sample crib card for LPI care plan

My name is _____

Help me stay warm by

- Keeping my hat on at all times
- Holding me skin-to-skin OR
- Swaddling me in several dry blankets
- Checking my temperature before each feeding

My feeding plan

- Breastfeed me every 2 to 3 hrs. for _____ min on each breast.
- I need at least 8 to 10 feedings in 24 hours.
- My mom pumps after I eat.
- Pump both breasts at the same time for _____ min.
- Also give me breast milk and/or _____ mL every _____ hours.

By: tube at breast tube with syringe

- No pacifiers please!
- My mother prefers to bottle feed me.
- Feed me _____ mL every _____ hours.

Completed by _____ Date _____

Stellwagen LM, Hubbard E, Wolf A. The late preterm infant: a little baby with big needs. Contemporary Pediatrics November 1, 2007

Breastfeeding Teaching

- Jaw support/Dancer hand position
- Sublingual pressure
- Signs of swallowing
- Monitoring of wet diapers and stooling
- Pre- and post breastfeeding weights
- Criteria for supplementation
- What to supplement
- How to supplement
- How much to supplement
 - 3-5ml/kg/feeding, or
 - 5-10ml per feeding on day 1
 - 10ml-20ml day 2
 - 20ml-30ml day3

Supplementation

- Hand express colostrum into a spoon and spoon feed baby
 - Teaspoon is 5ml
- If using a pump, place the Ameda diaphragm between valve and collection bottle



Alternative feeding methods

Morton et al. Five steps to improve bedside breastfeeding care.
Nursing for Women's Health 2014; 17:478-488



Photo courtesy of Dr. Jane Morton, Research@Salisbury

Methods of supplementation to breastfeeding

Figure 2a-c

Figure a: A 5- or 10-mL syringe containing expressed breast milk and/or formula can be attached to a 12" feeding tube. The end of which should be inserted along the infant's jawline. After the tube has been inserted properly into the breast, the syringe should be slowly pushed when the infant suckles.

Figure b: During "cup feeding," the infant is supported in a slightly upright position. A small cup containing expressed or pumped milk is placed at the infant's mouth opening. The cup is then tilted so that the baby can slowly sip.

Figure c: For "finger feeding," expressed breast milk is placed in a 5- or 10-mL syringe which is then attached to a 12" feeding tube. The end of the tube should be supported in a gloved finger when introduced into the infant's mouth. As the infant sucks on the finger, the syringe plunger can be slowly pushed.

Stellwagen LM, Hubbard E, Wolf A. The late preterm infant: a little baby with big needs. Contemporary Pediatrics November 1, 2007

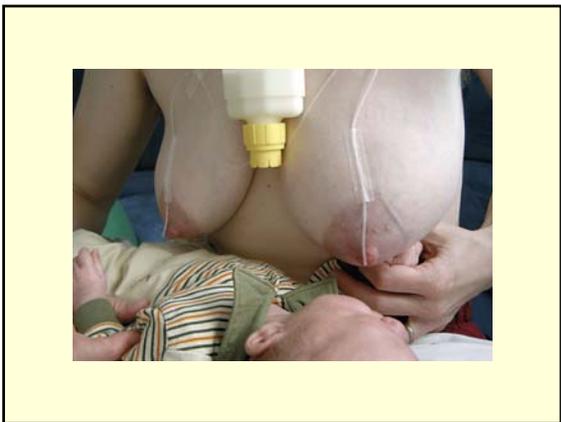
Cup feeding helps increase breastfeeding likelihood

- 32-35 weeks
- 268 bottle supplemented, 254 cup supplemented
- Cup feeding increased exclusive breastfeeding on discharge and at 3 and 6 months
- Did not increase length of hospital stay
- Yilmaz et al. J Hum Lact published online 17 January 2014. DOI: 10.1177/0890334413517940

Muscles, cups, and bottles

- Allows the infant to pace his feeding, minimizes the risk of aspiration, reduces energy expenditure while feeding, and removes the risk of desaturation
- Surface electromyography shows higher masseter muscle activity in infants who are breastfed and cup fed
- Masseter activity is reduced and buccinator muscle activity is increased in bottle-fed infants
- Gomes et al. Indian J Pediatr 2013 [Ahead of print]







Commercial tube feeding devices



Medela



Maternal Concepts



LactAid



Hazelbaker Finger Feeder



Supplementing with a Bottle

- Bottles weaken the masseter muscle and the suck
- Preterm infants frequently remove milk from a bottle, not by exerting vacuum, but by compressing the nipple
- Orthodontic nipples compromise central grooving of the tongue

If using a bottle to supplement

- Infant may not be able to generate the force necessary to compress and extend an artificial nipple, which forces the tongue down, hindering its movements
- Flow rate should not overwhelm baby
- Orthodontic nipple can produce forward tongue movement & must refill, leaving baby with no milk during some sucking efforts
- Paced bottle-feeding
- Nipple should be soft, pliable, short, rounded
- Choose nipples with a gradual transition from shaft to base
- Infant's lips should not be stretched too tight, should not gap at the corner, and should not touch the collar on the bottle

Supplementing without stress

- If the infant is holding his breath, looking distressed, sputtering or coughing then the flow needs to be slowed such that a comfortable ratio of sucking to swallowing is seen and the baby inhibits breathing only when swallowing (Wolf & Glass, 2008)

Triple Feeding

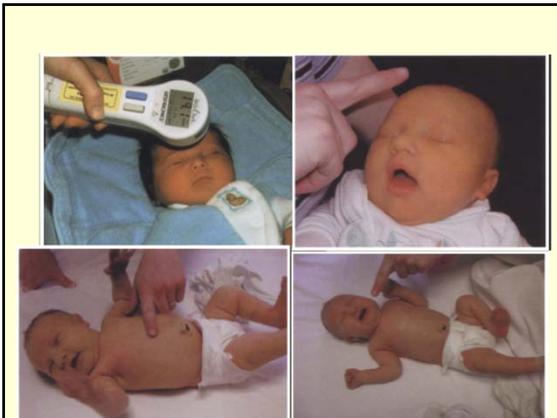
- Feed baby at breast
- Supplement with previously pumped milk
 - at breast with tube feeding device
- Pump to remove residual milk
- Baby may not be able to maintain mother's milk supply alone
- Inadequately drained breasts result in
 - Reduced milk supply
 - Milk stasis
 - Engorgement
 - Mastitis

Discharge Criteria

- Temperature stability in an open crib
- Bilirubin stable or decreasing
- Weight stable or increasing
- Evidence of effective milk transfer
- Mother's milk supply initiated
- Anticipatory guidance regarding nipple soreness, lactogenesis II, effective milk transfer, normal weight patterns
- Sleepy non-demanding baby does not indicate that baby is getting enough

Discharge plan

- May do well in hospital but be unable to sustain adequate intake post discharge
- May not have the stamina to engage in complete feedings
- Frequent weight checks
 - May rent scale for in-home use
 - Calculate necessary intake
- Referral to lactation consultant
- Mother decreases pumping after:
- Infant wakes predictably to feed
- Stays awake longer at breast
- Draws nipple further into shield or mouth
- Gains appropriate weight from feeds at breast
- Discontinue nipple shield
- Weight q3 days after each change



Resources

- The late preterm infant: A little baby with big needs
- http://health.ucsd.edu/specialties/obgyn/maternity/newborn/nicu/spin/staff/Documents/ContemporaryPediatricsThelatepretermnfant_AlittlebabywithbigneedsCME.pdf

Resources

- Late Preterm (Near-Term) Infant: What Parents Need to Know
http://www.awhonn.org/awhonn/content.do?name=02_PracticeResources/2C3_Focus_NearTermInfant.htm
- Stokowski LA. Newborn jaundice. *Advances in Neonatal Care* 2002; 2:115
- The Diaper Diary (for keeping track of output) and Pumping Milk for Your Premature Baby
<http://www.lactnews.com/>