Supporting Premature Nutrition Program: The UCSD SPIN Program
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Conflict of Interest Disclosures
• Medical Advisory Board
  • Medela
• Speakers Bureau
  • Nestle Nutrition
  • Nutricia
  • Abbott Nutrition
  • Mead Johnson Nutrition
  • Medela
• Shares
  • PediaSolutions

BABY FRIENDLY HOSPITAL INITIATIVE
- Started in 1991 after Innocenti Declaration
- Evidence based Ten Step plan for quality improvement
- Multidisciplinary approach
- Education for parents
- Education of all staff
- Minimize formula company exposure
- Initial self assessment
- QI process

UCSD was home to the birth of BFHI concept (Audrey Naylor) but it took another 15 years to get designation

Planning the SPIN program
- Born Summer 2007
- SPIN name adopted
- Set timeline
- Met frequently
- Agreement on goals
- Division of labor
- Equipment needs
- Neonatology support
- Administrative support
  - 2 FTE: Lactation and MALT Tech
- Program roll-out March 2008

THE SPIN TEAM
Medical director
Lactation director
NICU F/U Neo
NICU CNS
Lactation OT
NICU Dietician
Research RN
NICU Staff RN
**SPIN PROGRAM MISSION STATEMENT**

To create a Center of Excellence in neonatal nutrition focused on the provision, analysis, and research of human milk to improve nutritional and long-term health outcomes of premature babies

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**SPIN Program**

- Inpatient Care
- PNC Outpatient Clinic
- SPIN Program
- Education Outreach
- Research

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**Benefits of human milk in the premature infant born at less than 1500 grams**

- Less NEC
- Less infection
- Quicker attainment of full feeds
- Shorter NICU stay
- Higher IQ
- Less hospital readmission

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**The SPIN Program Ten Steps**

1. Have a NICU nutrition/human milk policy
2. Educate all mother/baby staff in SPIN 10-steps
3. Educate NICU families about optimal premature infant nutrition
4. Prevent extrauterine growth restriction
5. Standardize enteral feeding procedures
6. Target 100% human milk nutrition
7. Maximize mothers’ milk production
8. Optimize milk quality and safety
9. Encourage skin-to-skin care and breastfeeding
10. Plan a nutritional discharge from NICU

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**Team Building to Make More Milk**

- NUTRITION
- LACTATION

**IMPORTANT TO BRIDGE TWO DISCIPLINES**

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**NEC rate at UCSD NICU: 2006 vs 2008/9**

In 8 years we have had no more than 4 cases of surgical NEC
Standardizing care is better care

- Why should we standardize?
  - reduce variability
  - generate a steadier average
  - obtain interpretable results
  - “In the absence of evidence practice varies widely”

- What should we standardize?
  - nutrient delivery
  - energy targets
  - nutrient targets
  - growth goals

Standardized feeding protocol

- Any plan is better than no plan
- In the absence of strong evidence, practice variability increases
- Standardized care is better care
- Eliminate the outliers (attending-of-the-day!)
Retrospective evidence for protocol feeding

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<th>Risk ratio (95% CI)</th>
<th>% Weight</th>
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<tr>
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<td>0.23 (0.09 to 5.60)</td>
<td>21.7</td>
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<td>12.1</td>
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<tr>
<td>6</td>
<td>0.03 (0.00 to 0.23)</td>
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<tr>
<td>Overall</td>
<td>0.13 (0.03 to 0.50)</td>
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Key Elements to a Great Feeding Protocol

- Established consensus from medical faculty
- Visible, nurse-driven advancement
- Linear advancement
- Trophic feeding for extremely preterm infants
- Incorporate timing of fortification and vitamins

What is the correct rate of feeding?

- Should all preemies be fed the same rate?
  - Literature supports very fast rate of feeding up to 35mL/kg/day
- How much trophic feeding is good?
  - Berseth et al. study suggests that 10 days was better
- When is the earliest day to start feeding?
  - Little data to support day 1 feeding
- When not to feed?
  - More theoretical basis to stop feeds

MILK “TRAFFIC” CHAIN

- Mother pumps
- Milk in bottle
- Milk in storage container
- Milk in NICU freezer
- Milk in cooler for transport
- Milk in home freezer
- Milk thawed
- Milk measured
- Milk fortified
- Milk in tubing
- Milk drawn into syringes

MORE MILK MEANS MORE RESPONSIBILITY

Routine Human Milk Analysis in the NICU

- Human milk is best, but:
  - Varies in composition by
    - mothers
    - time of day, week, month
    - timing of pumping
    - delivery system
  - Current fortification methods are BLIND!
  - Error margin at least 50%
Caloric variability of human milk

Human milk protein declines with time

Ideal Features of a Milk Analyzer

- Point-of-care
- Accurate
- Measures Protein, Fat, and Carbohydrates
- Uses only a small volume of milk
- Affordable
- Fast
- Small footprint

Custom Fortification of Human Milk

Spectroscopic milk analysis

- Pros
  - Precise and accurate
  - Bedside application
  - Addresses individual macronutrients

- Cons
  - Very expensive
  - Requires regular personnel
  - Cannot differentiate types of proteins
  - Cannot readily test fortified milk

Adjustable fortification method (Using BUN)

- Pros
  - Simple biochemical measure that has been shown to improve weight gain

- Cons
  - Indirect measure of needs

Target fortification of breast milk: how often should milk analysis be done?

- Per feed or even daily measurements may be impractical due to excess workload, adding 5-10 min per sample including measurement and calculations
- Stable correction of macronutrient contents possible with 2x/week measurements of daily pooled milk
- No answer yet for what is more physiologic: feed-to-feed variability or stable intake over each day

Nutrient content: individual vs pooled approach

Calories vary by 29%

Stellwagen et al 2013 Breastfeeding Medicine 8:205-9
Is pooled milk better than standard methods?

- Bacterial counts over $10^5$ were more common in individual samples
  - Individual 14%
  - Pooled 9%
- 83% of pooled milk had same or less bacteria
- Mothers preferred 1 liter bottle
- Should make tracking mom’s 24-hour milk volume easier

Benefits of pooling human milk

- 24 hour pooling of mother’s milk:
  - Provides a more consistent calorie product for baby
  - Allows for more accurate fortification
  - Permits measuring, labeling, fortifying, drawing up feeds from one container
  - May minimize milk fat loss
  - May allow for more fresh milk use

Stellwagen et al 2013 Breastfeeding Medicine 8:205-9

Factors in nutrient loss in human milk

- oxidation
- refrigeration
- freezing
- heating
- photo-degradation
- adherence to the tubing system

Improving Milk Processing in NICU: Milk Technician

- Milk technician-position: dietary tech
  - Collect morning milk order
  - Use standard recipe to mix 24 hour feedings
  - Milk feeding put in syringes, or large bottle once orally feeding
  - Milk analysis will be incorporated into practice to further improve optimal milk product
- Benefits of milk tech:
  - Ease RN workload
  - Consistent preparation
  - Minimize milk transfers
  - Encourage use of fresh milk

Loss of triglycerides and carotenoids in human milk after processing

- Assessment of milk factors with heating, freezing, and tube feeding
- Triglycerides and carotenoids were stable with freezing, refrigeration, microwave heating
- Tube feeding led to 33% loss in triglycerides
  - Represents 11 Kcals/100 mls of milk
  - And 16% of calories
  - Despite measures to decrease fat loss
  - Carotenes also fell significantly during tube feeding
  - Infant formula did not show fat loss with tube feeding

Tacken 2009

Container Transfer

- 40ml of milk placed into a sterile urine container. Fat content was measured
- Milk poured into second container after 10 minutes dwell time. Fat content was re-measured
- Procedure repeated with up to 3 pours
Transfer Between Containers Results in Fat Loss

Inversion

• Experimental setup was identical to the nasogastric tubing experiment except that the pump was repositioned by hand every 30 seconds for the duration of the run.

Effect of Inversion of Syringe on Fat Loss

Lactation support
Maternal support in the hospital

- Encourage all mothers to pump
- Standardize approach to pumping mother
- Provide up to date education
- Early initiation of pumping
- Hospital grade pump
- Proper flange fit

How to approach the reluctant mother

Start with general discussion of nutrition for preemies
Try and include partner
If possible, first discussion before baby is born
Discuss infection, NEC, brain and body growth
So you can see that we need your milk for your baby

We would like you to pump for your baby
We will help you
We will get you (or give you) a pump
Avoid discussing breastfeeding in these early stages
Over time we aim for pumping until the baby goes home

Log book to track first week, no volume concerns yet
When milk volume picks up, mothers start to record and add 24-hour volume

Pump provision

- Hospital grade pump
- Rental
- Loaner
- WIC
- Working mother pump
- Low income mothers
- WIC-N-Style
- Medical assistance pump
- As a back up for home pump

No mother discharged without an electric pump!
Use the milk!
- If mother sees her milk is being used she is more likely to keep pumping
- Minimize NPO time
- Address concerns about milk quality

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Breast milk expression and maintenance in mothers of VLBW infants: supports and barriers
- Postnatal interviews of pumping mothers in NICU
- Struggle to start pumping in hospital when ill
- Don’t remember pumping instructions
- Had trouble obtaining an adequate pump
- Fatigue and lack of support for ongoing pumping
- Travel and work difficulties
- Trouble staying on pumping schedule

How to help the mother with a low milk supply
1. Pump type
2. Procedure for pumping
3. Pain
4. Pills
5. Power pumping
6. Schedule
7. Six or more
8. Stress
9. Sleep + eat/drink
10. Skin-to-skin

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Early pumping strategy for higher milk production
- Increase frequency if <6 times per day
- Increase time (even 5 minutes per session)
- Do evening long pump session
- Medela Plus card
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Lactation support
- Ideally mothers should initiate pumping or breastfeeding within 2h after vaginal delivery and 4h after cesarean section
- Peak lactation volumes may be influenced by very early pumping/expressing milk within the first hour of life

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Herbals? Teas? Acupuncture? Do they work?

- Traditionally used
- Scant evidence
- Placebo effect
- Couldn’t hurt?

http://www.motherlove.com/

Galactagogues (Dopamine Antagonists): Do they work?

The best way to increase milk supply is to never let it get low

What milk to use first?

1. Colostrum should be used first
   - First 2-4 weeks
   - Higher protein
   - More immunologic properties
   - Label early milk
2. Fresh milk
3. Frozen milk
Fresh or frozen?

**Benefits of fresh milk**
- Live cellular elements
- Better fat preservation (MFG)
- Bacteria counts fall over 4 days
- Better for baby

**Benefits of frozen milk**
- Minimize CMV
- Longer storage time
- Bacteria counts stable
- Easier for NICU

Refrigerator storage of expressed human milk in the neonatal intensive care unit

- Expressed milk refrigerated at 4°C and sampled for 4 days (96 hours)
  - Assessed for pH, WBC count, osmolality, bacterial counts, sIgA, lactoferrin and fat
  - pH fell from 7.2-6.7
  - WBC fell by 16%
  - Total protein fell by 5%
  - Gram+ bacterial colony counts fell
  - 3-fold increase in free fatty acids, from active lypolysis
  - No changes in Osm, sIgA, fat, gram- bacteria, lactoferrin
  - Cold human milk retains optimal nutrient profile and a safe content for 96 hours after expression

Suggested plan for fresh milk use

- Mom pumps and pools 24 hours of milk
- She is told how much milk is needed for 24 hours of feeds
- Mother pours off extra milk and freezes it at home
- She brings in fresh milk daily
- Milk tech fortifies in bottle
- Syringes or bottles are filled from bottle

CMV transmission in breastmilk

- Most women are CMV positive (80%)
- Post-delivery large amounts of virus are present in milk for 4-6 weeks
- Premature infants can rarely become ill with CMV illness
- Freezing diminishes viral content by killing live WBC
- Pasteurization prevents viral transmission
- No consensus exists on how to deal with this issue

Mother’s rules for transport

- Use cooler
- Blue ice (2-3 is best)
- Bring milk directly to unit
- Tell mom to keep her hospital bin full so we never run out

Storage of milk
Milk handling at home

- Storage containers a problem...
- How to store all that milk?
- Recommend deep freezer for large milk volumes

Alterations in host defense properties in human milk following prolonged storage or pasteurization

- Mother’s milk stored for 4 weeks at -20 deg C or pasteurized donor milk compared to fresh mother’s milk
- Frozen milk:
  - Lysozyme dec 32%
  - sIgA dec 51%
- Pasteurized milk:
  - Lysozyme dec 60%
  - sIgA dec 60%
- Bacterial pathogens proliferated more rapidly in frozen or pasteurized milk (2-5 fold)
  - Akinbi 2010

Mother’s rules for milk storage

- Rule of 3’s for milk storage:
  - 3 hours at room temperature
  - 3 days in the refrigerator
  - 3 months in the deep freezer
  - 12 months in the deep freeze
- Provide coolers and blue ice

NICU freezer

- Optimal milk storage:
  - Store all mother’s milk in hospital
  - Closed bins
  - Large freezers
- Reality:
  - Parents are going to keep some milk at home
  - Freezers take a lot of room
  - Closed bins hard to fit in freezer

Better Freezers- Little Rock AK ‘milk lab’

- Label freezer for storing human milk
- Use emergency power circuit
- Use alarm thermometers
- Adjust unit to facilitate automatic closing
- Clean unit on regular basis
- Have a clear milk storage policy

Freezers

- HMBANA Jones 2011
Processing milk

Where do you process your human milk?
- Bedside in the NICU like we used to do?!
- Milk lab
- Formula prep area

Thawing milk
- What method is best?
  - Water bath
  - In fridge
  - Dry heater
- Does it affect milk components?
- Best practical way to thaw

Effects of pasteurization, freezing/thawing, and feeding on milk macronutrients
- 57 raw milk samples, 228 samples for feeding analysis
  - Holder pasteurization
  - Frozen at -20 C
  - Slow thaw: 10 minute immersion in 40 degree waterbath
  - Quick thaw: 45 sec microwave
  - Gavage infusion 10 mls syringe and 4 FR ng tube
  - Continuous infusion same set up plus 40 cm tubing and 1 hour run

Vieira 2011 (Milko-Scan Minor)

Macronutrient concentration decrease in mg%

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<th></th>
<th>Lactose</th>
<th>Fat</th>
<th>Protein</th>
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<tr>
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<td>2.17</td>
<td>1.03</td>
</tr>
<tr>
<td>Pasteurized</td>
<td>6.28</td>
<td>2.05</td>
<td>0.99</td>
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<td>1.91</td>
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<td>Quick thaw gavage</td>
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<td>P-value</td>
<td>0.629 (ns)</td>
<td>&lt;0.001</td>
<td>0.046</td>
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P-value: 0.629 (ns) <0.001 0.046
New options for thawing at bedside

Human milk fortification for premature infant

- Who prepares milk?
- What fortification product do you use?
- Donor milk?
- What recipes do you use?
- How to make it safe?

Donor heat treated human milk

- Used as a 'bridge' when mother's milk not sufficient or available
- Pasteurized, cultured
- No reported infection in over 20 years
- Not reimbursed (in California) by insurance in hospital
- Need tissue bank license in some states (NY, MD, CA)
- Consent process

DONOR MILK CONSENT
Feeding milk

Oral Feeding Systems

TJC Sentinel Event - April 3, 2006 Tubing misconnections—a persistent and potentially deadly occurrence

Nutrient loss with tube feeding

○ Fat loss in tubing
○ Fortifier loss in syringe
○ Measures to minimize loss and improve safety:
  ○ Change tubing q4 hr
  ○ Point syringe up
  ○ Use short tubing
  ○ Use bolus feeds when possible
  ○ Deliver feeding over shorter time interval

Safety

Making human milk use safer; many questions remain

○ How to optimize:
  ○ Storage
  ○ Ease mother’s work load
  ○ Safety
  ○ Nutritional content
  ○ Calorie delivery
  ○ Exclusive human milk feeding rates

NICU RN Workflow

○ Correct milk/correct baby
○ RN Double check
○ Bar coding systems
○ Misadministration policy
Bar coding breastmilk

Dougherty 2009

Baby to breast

- This was harder than we thought!
- Increased lactation support
- Improved charting for LCs
- Skin to skin made standard of care, exclusions clarified
- Oral feeding progression defined
- Breast before bottle
- Assessment of infant readiness and quality score of feeding being implemented
- Our goal is infant driven feeding

How to get babies to breast?

- What are our skin-to-skin rules?
- Do all nurses encourage S2S?
- At what GA is NNBF/BF optimal and safe?
- How do we encourage NNBF?
- Do we have baby BF before the bottle?
- How can we get babies to BF more at discharge?
- How to help OT/PT and Lactation with feeding progression?
- Can we practice Cue based feeding?
- Can we decrease feeding aversion?
- What are feeding norms at NICU discharge in the US?

Daily skin-to-skin

- Parents encouraged ask for daily S2S
- Family centered care
- Infant health benefits
- Improved mother’s milk production
- Better transition to breast?
- Exclusions
- Medically unstable
- On blood pressure support
- Breathing tube/CPAP is not a valid reason to withhold S2S

Step 1 Crib Card

To my parents

STEP 1: Skin-To-Skin (S2S) Time
- Please hold me S2S every day
- I will stay warm against your skin
- Hold me close and keep smooth, soft, and away from air flow
- Hold me upright and keep head still for me
- Record the time I spend S2S on the log sheets
- If you notice I’m trying to suck or leak for your breast, I will be ready for Step 2!
- Date if first S2S time
- Date of Lactation consultant for Step 1
- Key next, thank you for partnering with us!

From

Your milk is my most important medicine!

Infant Driven Feeding

- 5 Step process from S2S to ad lib feedings
- Provider writes order to start the process
- Nurse moves baby through process based on infant readiness
- We are still working on this one
- Concerns about feeding aversion
- Videos on web site for each step
Always breast before bottle

Most of our preemies still go home primarily fed pumped milk by bottle
- Immature BF skills
- Mother can’t visit enough to exclusively BF
- Fortification methods discourage exclusive BF
- PINC clinic set up to address this issue
- Something to work on!

Baby to breast summary
- Skin-to-skin as unit standard
- Define progression to oral feeding
- Feeding team members work together with family
- Oral feeding safety should drive the process
- Assessment of infant readiness
- Quality of feeding assessed
- Feeding stopped when quality not optimal
- Can we minimize feeding aversion common in NICU graduates by feeding them differently?
- Can we get mothers to stay and work on breastfeeding as discharge nears?

Research in Human Milk
- Human milk oligosaccharides (Bode lab)
- Human milk and impact on microbiome (Knight lab)
- Pooling mother’s milk
- Human milk analysis
- Delivery of human milk
- Thickening milk for GERD
- Commercial human milk fortifiers, both bovine based and human milk based
- Outpatient PINC clinic survey and focus groups

The Freezer Overfloweth
- Top producer = 2.7 L per day!!!

Recommendation For Initiation Of Premature Infant Nutrition Program
- Form multidisciplinary group
- Leadership must support process
- Enlist support of medicine, nursing, nutrition, OT/PT, lactation
- Conduct self-assessment
- Decide on goals
- Create timeline for new initiatives
- Meet regularly and update staff about activities
- Patience with process of change
- Collect data about outcomes