**SAM: PREVENT MALNUTRITION**

- Sam was a 550 gm 23 5/7 weeker
- Parenteral support for first 5 weeks
- PDA medical and surgical treatment
- Jejunal obstruction, surgery with ostomy
- Enteral feeding advancement
- Reanastomosis surgery

**Better care through standard care**

- Why should we standardize?
  - reduce variability
  - generate a steadier average
  - obtain interpretable results
- What should we standardize?
  - nutrient delivery
  - energy targets
  - nutrient targets
  - growth goals

**Strategies**

- Standardized early parenteral nutrition
- Standardized feeding protocol with programmed fortification
- Early and exclusive human milk exposure
- Human milk analysis research
- Standardized response to growth

**Workshop: Preventing extrauterine growth failure**

- Jae H. Kim, MD, PhD, FAAP
- Neonatologist and Pediatric Gastroenterologist
- University of California, San Diego

**The Growth Pattern of a Premie**
Nutritional Survey
- 775 surveyed, with 176 (23% response rate)
- Most started PN day 1 with protein 2g/kg/day
- 91% increased protein daily
- More than half use stock solutions
- Intravenous lipids started day 1
- 80% used bolus enteral feeding
- MCT was the most common additive for supplementation but single additive use decreasing
- Carnitine added to PN 65% of time


Standardized stock solutions provide the earliest delivery of parenteral protein
- Immediately
  - 2.5% amino acid solution in glucose D5W or D10W
  - Delivers 2 g/kg/day of AA with TFI of 80 mL/kg/day
- As soon as possible
  - TPN with 3 g/kg/day of AA
  - Other elements that could help are calcium
  - Avoid early electrolytes

‘IMPLEMENTING FEEDING GUIDELINES FOR NICU PATIENTS <2000 G RESULTS IN LESS VARIABILITY IN NUTRITION OUTCOMES’
- Infants BW < 2000 gms in Utah
- 58 infants in early 2005 (standard feeding progression)
- 68 infants in early 2006 (protocol driven feeding progression)
- Feedings were started on average day 1
- 91% received some MBM in 2005
- 74% received some MBM in 2006
- Standardized feeding guideline led to:
  - Less TPN days
  - Fewer NPO days
  - Less variability in day of first feeding
  - Quicker advancement to 80 mL/kg/day feeds
  - Decreased staff time in order writing process
  - No increase in NEC, SIV, mortality or LOS

Street JL et al. JPEN 2006:30:515-518

AGGRESSIVE ENTERIC FEEDS
- Priming feeds started with human milk
- Standardized feeding protocols
- Feeding intolerance defined
- Minimize stops and starts
- Early/standardized fortification
- Process driven by RN

KEEPING GROWTH FRONT AND CENTER
- Review weight and measuring technique
- Adopt up to date growth chart
- Chart is reviewed by medical team
- Weekly SPIN rounds to discuss nutrition-growth-milk production-oral feeding progression
- Ongoing feeding volume calculated daily by RN
- Dietician drives growth/nutritional assessment
- Lactation monitors/supports mother
- OT and LC guide and assist in oral feeding progression

STANDARDIZED MEASUREMENT
How to best measure and weigh the premature infant?
Growth Chart Comparisons

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Shiny and Shimmer</th>
<th>Breed and Build</th>
<th>Growth Failure</th>
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<tbody>
<tr>
<td>Statin</td>
<td>Recompacted in</td>
<td>Sampled from</td>
<td>Uncompacted in</td>
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<td>Cross-sectional</td>
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<tr>
<td>Comments</td>
<td>Shiny and Shimmer</td>
<td>Breed and Build</td>
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</tbody>
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VARIABILITY OF HUMAN MILK COMPOSITION

- Mother's milk is not all 20 cal/oz (average=19.5 kcal/oz)
- Fat drives calories
- Lactose and protein are inversely correlated
- Near infrared milk analyzer
- Assessment of: protein, fat, lactose, and calories
- Small volume of milk
- Milk content varies greatly, from 15-30 cal/ounce
- Potential for individual fortification

51.2% fell either below 18 kcal/oz or above 22 kcal/oz
31% of the samples below 18 kcal/oz
14% were below 16 kcal/oz

Growth Failure in Preterm Infants

- Cumulative losses by hospital discharge
  - reduced body stores of nutrients
  - increased zinc, iron, copper needs
  - reduced bone density
  - increased Ca, P needs
  - an accumulated energy deficit

Standardize response to growth failure

- Reactive
  - Poor growth < 4-7 days → increase nutrients
  - 3-4 such increments would represent 12-28 days of poor growth on top of the deficit already incurred
- Preemptive
  - Attempt to approximate caloric and nutrient needs and prescribe before wt loss occurs
Loss of nutrients with transfer of milk
- Syringe pumps and feeding tubing are the most important source of nutrient loss
- Minimize transfer from containers
- Continuous syringe pumps with inverted delivery
- Give maximum fluid volume tolerated

Factors in nutrient loss in human milk
- oxidation
- refrigeration
- freezing
- heating
- photo-degradation
- adherence to the tubing system

Human milk protein declines with time

Is 20 kcal/oz the real target?
- 227 term milk samples from mothers aged 27.8±4.7 years
- Measurement by bomb calorimetry
- Calculation (prot:fat:carb = 4.22:3.16:3.87 kcal/g)
- Measured energy was significantly lower than that of the calculated energy (58.1±8.1 vs. 68.5±10.6 kcal/100 g, P<0.05).

Nonprotein nitrogen accounts for about 20% of the total nitrogen

Assumption on protein

Infant formula
- Nutritional Protein
- Non-protein Nitrogen
- Bioactive Proteins

Human milk
- Nutritional Protein
- Non-protein Nitrogen
- Bioactive Proteins
Human milk alone is insufficient to meet the growth of the preterm infant

Growth of Human Milk-Fed Infants after Discharge
- Greater percent growth restricted at hospital discharge compared to at birth
- Growth lags behind that of formula-fed LBW infants

Bone Mineralization
- Infants fed exclusively HM after discharge show signs of mineral deficiency compared to formula-fed infants
  - decrease in bone mineral content of radius
  - lower serum phosphorus
  - higher alkaline phosphatase

References: