



## Nutritional Management of the Pediatric Patient

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# OVERVIEW

- Identify the risks of malnutrition
- List the benefits of early nutrition intervention in the pediatric patient
- Discuss the components of a nutritional assessment
- Describe the applications of nutrition support in the pediatric patient

# Consequences of Malnutrition

- Exacerbated disease process
- Reduced immunocompetence
- Impaired wound healing
- Reduced response to therapy
- GI compromise
- Delayed / stunted growth
- Permanent Developmental Delay

# Growth Failure/Failure to Thrive (FTT)

- Wt for Age and/or Wt for Length/Ht <5<sup>th</sup> %ile
- Wt for Age falls more than 2 major %iles over 3-6 months timeframe
- Critical to evaluate for cause(s) of FTT and correct if possible
- Team approach important as FTT is often multi-factorial and crosses disciplines

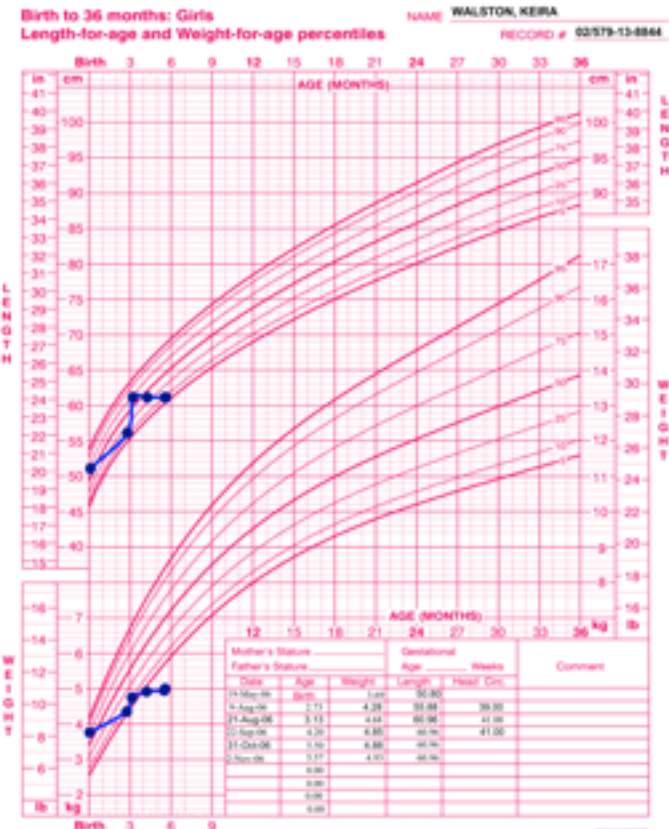
# Case Presentation

- 4 mo F, well child visit
  - Mom complained about poor wt gain
  - Same problem with first child
  - Husband deployed
  - Parents small stature
  - Other development was normal
  - Mom alleged that feeding was going well (breastfeeding)
  - Wt = 10 lb 8 oz



# Case Presentation

- Went to ER at age 5 months
  - Wt was “down 1 lb”
  - Infant transferred to a children’s hospital for inpatient stay
  - Infant refusing to breast or bottle feed
  - NG tube placed
  - 4oz q4 hours
  - OT working with baby to help with feeding



Published May 30, 2000 (modified 4/2007)  
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2002).  
<http://www.cdc.gov/growthcharts>



# Contributing Factors for FTT

- **Organic**

- Inability to take in food
- Unable to retain/utilize calories
- Increased needs
- Altered growth potential

- **Non-organic**

- Inadequate provision of food
- Psychosocial issues
- Lack of knowledge/misguided feeding practices

# Common Diagnoses Related to Pediatric Malnutrition

- Prematurity
- GI Disease
- Cancer
- Trauma
- Infection
- HIV
- Chronic Diseases
  - Genetic Disorders

# Evaluating Growth

- ✓ Weight for Age; Ht/Length for Age
- ✓ Head circumference until 3 yrs old
- ✓ Weight for Length (<2 yrs old)
- ✓ BMI for Age (>2 yrs old)
- ✓ Corrected age to 3 yrs old
- ✓ Rate of weight gain
- ✓ Rate of linear growth
- ✓ Parental height

# Nutrition Screening

Identifies those at “nutritional risk”

- **Indicators of malnutrition**

- poor appetite
- ↓oral intake
- dietary restrictions
- dx with ↑increased nutritional needs
- dx which prevent nutrient intake/  
absorption
- weight loss/ no gain or growth
- albumin < 3.5g/dl

# Nutrition Assessment

- Birth Data
- Presence of chronic illness
- Presence of congenital abnormalities or chromosomal/genetic errors
- Wt, length & head circumference
- Gestational age
- Chronological age
- Gender



# Nutrition Assessment

- History of wt change
- Physical assessment
- Dietary/nutrient assessment
- Anthropometric assessment
- Social & economic barriers to obtaining adequate intake
- Family/personal medical history
- Past & Present
  - feeding intolerances
  - feeding modalities
  - treatment modalities

# Average Rate of Weight Gain for Healthy Children

National Center for Health Statistics

<b>Age (mo.)</b>	<b>g/day</b>	<b>Age (yrs.)</b>	<b>g/mo</b>
0-3	25-29	2-7	38
3-6	20	7-9	56-62
6-9	15	9-11	67-77
12-18	8	11-13	85-110
18-24	6		

# Growth Velocity: Expected gains for normal children

<b>Age</b>	<b>Length (cm/mo)</b>	<b>Head Circumference (cm/wk)</b>
0-3mos	2.6-3.5	0.5
3-6mos	1.6-2.5	0.5
6-12mos	1.2-1.7	0.5
1-3yrs	0.7-1.1	
4-6yrs	0.5-0.8	
7-10yrs	0.4-0.6	

- Adapted from: Fomon SJ, Haschke, F et al. Body composition of reference children from birth to age 10 years. Am Journal of Clinical Nutrition 1982;35:1169.

# Pediatric Recommended Dietary Intakes (DRI, 2006)

Age	kg	kcal/kg	Protein/
<b>Infant</b>			
0 – 3 mo		102	2.2
4-6 mo		82	1.6
7-12 mo		80	1.2
13-36 mo		82	1.1
<b>Children</b>			
3 yr		85	1.0
4 yr		70	1.0
5-6 yr		65	0.9
7 – 8 yr		60	0.8
<b>Males</b>			
9-13 yr		47	1.0
14-18	yr	38	0.8
<b>Females</b>			
9-13 yr		40	1.0
14 -18		32	0.8

# Fluid Requirements

<b>Body Wt</b>	<b>ml/day</b>
1 - 10 kg	100 ml/kg/day
11 – 20 kg	1000 + 50 ml/kg for each kg >10 kg
>20kg	1500 + 20 ml/kg for each kg >20 kg (+ extraneous losses)

ex. 19 kg = (1000 ml) + (9 kg x 50) = 1450ml

# Special Needs Children

- **Specific growth charts are available for special needs children**
  - Developmentally delayed children
  - Pre-mature up through 3 y.o.
- **Calorie & protein calculation also differ due to individualized needs**

# Examples

- Down Syndrome Growth Charts:
  - <http://www.ndss.org>
  - click on 'healthcare'
- Cerebral Palsy Growth Charts:
  - [http://www.kennedykrieger.org/kki\\_misc.jsp?pid=2694](http://www.kennedykrieger.org/kki_misc.jsp?pid=2694)
- Discussion on using specialty growth charts
  - <http://depts.washington.edu/nutrpeds/fug/growth/specialty.htm#down>

# Recommendations for Increased Needs



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- **Calculating catch-up growth:**
  - $\text{kcal/kg per day} = \text{kcal required for age (kcal kg/d)} \times \text{ideal wt for age (kg)} \div \text{actual wt (kg)}$
  - $\text{g Pro/kg} = \text{Pro required for age (g/kg)} \times \text{ideal wt for age (kg)} \div \text{actual wt (kg)}$



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- Infants with FTT may need as much as 150 kcal/ kg and 3.0-3.5 gm protein/ kg promote catch up growth



# Nutritional Intervention

- **Oral supplementation**
- **Transitional/combined therapies**
  - Oral / enteral
  - Oral / parenteral
- **Enteral**
  - Bolus feedings
  - Continuous feedings
  - Nocturnal feedings
- **Parenteral feedings**

# Enteral Access Route

- **Short Term (nonpermanent):**
  - Nasogastric
  - Orogastric
  - Nasojejunal
  - Orojejunal
- **Long Term (indefinite):**
  - Gastrostomy
  - Jejunostomy
  - G-J tube

# Enteral Feedings for Infants

- Breast milk
- Standard (polymeric)
- Partially hydrolyzed formula
- Modular
  - glucose polymers /emulsified fat /modular protein
- Specialized
  - Intact protein sensitivity
  - Fat malabsorption
  - Generalized malabsorption

# Parenteral Access

- **Short term/Peripheral** (rarely used)
- **Long term/Central** (> 2 weeks)
- **Indications for PN:**
  - inability to absorb nutrients
  - excessive GI losses (vomiting, diarrhea, fistula)
  - inability to obtain enteral access
  - inadequate nutrient intake with oral or enteral feeding including failure to thrive (FTT)

# Parenteral Guidelines

## Dextrose

- Maximum peripheral infusion: 10%
- Maximum central infusion: 20 - 25%

<b>Age</b>	<b>Initial dose</b>	<b>Advance/Day</b>
Preterm	5%	2.5% to goal
Term infant/child	5 - 10%	5% to goal
Adolescent	10%	5 - 10% to goal

# Glucose Management

- Glucose Infusion Rates

	Preterm	Infants/Children	Adolescents
Initial dose (mg/kg/min)	5-7	6-9	3-5
Advance daily (mg/kg/min)	0.5-2	1-2	1-2
Recommended maximum (mg/kg/min)	12	8-10	5-6

# Parenteral Guidelines

## Protein

<b>Age</b>	<b>Initial Dose</b>	<b>Daily ↑</b>	<b>Goal</b>
	(g/kg/d)	(g/kg/d)	(g/kg/d)
Preterm	1.0	1.0	3.5 - 4.0
Term Infants	1.0	to goal	2.0 - 2.5
Children	1.0 - 1.5	to goal	1.5 - 2.0
Adolescents	1.0 - 1.5	to goal	1.0 - 1.5

# Amino Acid Solutions

- **Standard- crystalline amino acids**
  - Physiologic mixture of essential and nonessential amino acids formulated for adults and children  $\geq 1$  year of age.
  - 3.5 – 15% concentrations
- **Modified – renal and hepatic formulations**
  - Do not use in infants ( not studied )

# Pediatric Amino acids

- **Goals of formulations:**
  - Normalize plasma amino acids in the infant
  - Improve nitrogen retention and growth
  - Attenuate TPN-associated cholestasis
  - Provide the infant with essential amino acids taurine and tyrosine.

# Pediatric Amino Acid Formulations

- **Trophamine™ and Aminosyn PF™**
  - Trophamine™: formulated to result in serum amino acid levels in the parenterally fed infant similar to those of normally growing 30-day-old, human milk-fed term infants.
  - Both solutions contain the non-essential amino acids glutamic acid and aspartic acid not found in other solutions in order to normalize plasma glycine levels in the baby and thereby decrease risk of hyperglycemia and hyperammonemia.

# Cysteine

- Can be added to the formula to increase acidity and thereby increase solubility of calcium and phosphorus so that the greater needs of the neonate can be met.
- Unstable in solution with TPN components over extended periods.
- Must, therefore, be added separately in the home just before infusion.
- Usual dose: 40mg of cysteine per gram of amino acids.

# Parenteral Guidelines

## Lipids

<b>Age</b>	<b>Initial dose</b>	<b>Daily ↑</b>	<b>Max Dose</b>
	<i>(g/kg/d)</i>	<i>(g/kg/d)</i>	<i>(g/kg/d)</i>
Preterm/SGA	0.5	0.5	3.0
Children 1-10 yr	1.0	to goal	2.0 – 3.0
Adolescents	1.0	0.5 - 1.0	2.5

# Pediatric TPN Triple Check

- **Assures safety and accuracy**
  - Compounded in a Certified Class 100 hood
  - Aseptic Technique Validation
  - Verification of exact volumes & solutions
  - Refractive Index Measurement
  - Visual Inspection

# Recommended Pediatric Vitamin Dose

- Neonates (<1kg): 2 mL/kg  
(>1 kg): 5 mL/day
- Children (1-11 yrs): 5.0 mL/day
- Adolescents (11-18 yrs): 10.0 mL/day  
of Adult Infuvite

MVI-Peds dosing per NAG-AMA Guidelines

# Trace Element Guidelines

- Pre-term ( $\leq 3\text{kg}$ ): 0.2mL/kg up to 3mL/day  
+200 mcg zinc
- Term ( $\leq 3\text{mo.}$ ): 0.2mL/kg up to 3mL/day
- Children ( $>3\text{mo.}$ ): 0.2mL/kg/d up to 3mL/d
- Adolescents: 3-5mL/day

PTE-4 contains: Zn, Cu, Mn, and Cr.

PTE-5 contains: above plus Se (should be used in pts on TPN  $>2\text{weeks}$ )

# Iron Supplementation

- Should be considered for patients on long-term TPN as iron is incompatible with IV lipid.
- IV iron is indicated with documented deficiency (low ferritin levels)
- Dose calculation:

Children <14kg:

$$\text{Fe Dosage (mg)} = \text{wt(kg)} \times (12\text{g/dL} - \text{Hgb g/dl observed}) \times \frac{4}{4}$$

Children >14kg:

$$\text{Fe Dosage (mg)} = \text{Wt(kg)} \times (14.8\text{g/dL} - \text{Hgb g/dL observed}) \times 4.5$$

# Electrolytes

<b>Element</b>	<b>Infant/Child</b>	<b>Adolescent</b>
Sodium	2.0-4.5	1.0-2.0
Potassium	2.0-4.0	1.0-2.0
Chloride	To balance	To balance
Mg (max=12mEq/d)	0.3- 0.5	10-30 mEq/day
Ca	1.0-4.0	10-20 mEq/day
Phos	0.5- 2.0 (mMol/kg)	10-40 <u>mMol/day</u>
Acetate	To balance	To balance

# Clinical Monitoring

- Pediatric patients should be started in hospital and stabilized before going home on TPN
- Once Stable: Draw labs once/week
  - To include: CBC with diff, CMP, Mg, Phos, TG
  - Fingertstick BG 2hrs into and 1hr after end of infusion

# Pediatric Labs

- Pediatric lab reference ranges vary by age, gender, and lab (Hospital lab v.s. Independent lab)
- Consistency in utilizing the same lab and the appropriate reference range for age and gender is key to detecting important changes

# Complications

- **Mechanical:**
  - catheter occlusions, thrombus
- **Metabolic:**
  - fluid, electrolytes, hyper/hypoglycemia
  - acid-base imbalance
  - cholestasis, liver dysfunction/failure
  - metabolic bone disease/osteopenia
- **Infectious:**
  - catheter sepsis



# Home Nutrition Support Team

- **Why a Home Nutrition Support Team?**
  - Patients are going home earlier and sicker
  - Hospital NST's are being dissolved
  - Literature supports the effectiveness of the NST in managing cost and clinical appropriateness on NS
- **Members of the HNST**
  - RD, RN, RPh, MD, OT, PT, SW, Clergy
- **Responsibilities of the HNST**
  - Patient clinical management and case management

# Home Nutrition Support Team Benefits

- Collaborative effort to transition feedings
- Avoid multiple lab draws
- More comprehensive psycho-social support
- Achievement of positive outcomes

# Pediatric Outcomes of Home Nutrition Support Team (HNST) management

- 17 patients referred for HPN and managed by a HNST over a 6 month period
- **Diagnosis**
  - 12% Protein/calorie malnutrition
  - 12% Acute pancreatitis
  - 17% Cancer
  - 59% SBS (due to a variety of reasons)
- **Average age 7.3 years old (8 mos-16 yrs)**
- **Catheters**
  - 65% Single lumen central tunneled access
  - 23% PICC
  - 12% Double lumen central tunneled access

Nutrition in Clinical Practice 2005; 20(1):126 .

# Pediatric Outcomes of Home Nutrition Support Team (HNST) management

## Results/Outcomes:

- Clinical
  - 15 or 88% achieved their HNST (health goal) w/in 6 months study period
- Cost Savings
  - Hospital prevention 25d x \$1,000/day= \$ 25,000
  - HPN component reduction= \$ 822
  - Appropriate weaning by HNST= \$ 46,752
  - Total= **\$ 72,574**
- HNST management of complex pediatric patients on HPEN improves clinical and financial outcomes

# Summary

- Identify the risks of malnutrition.
- List the benefits of early nutrition intervention in the pediatric patient
- Discuss the components of a nutritional assessment
- Describe the applications of nutrition support in the pediatric patient

# Guidelines in the Nutritional Management of Pediatrics

Are just that...

***GUIDELINES***

***INDIVIDUALIZATION IS THE KEY***



# Questions??

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