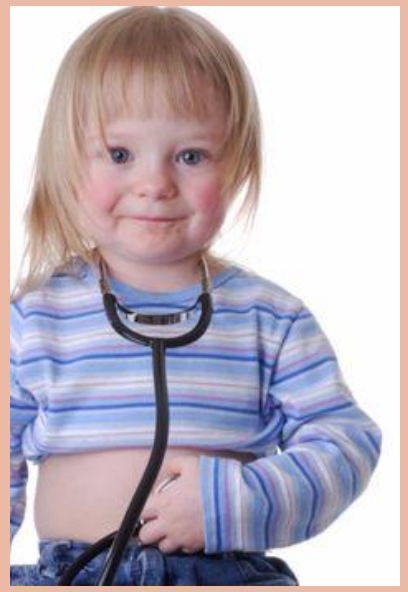

Pediatric Nutrition Assessment

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Learning Objectives

1. Identify the five components of a pediatric nutrition assessment.
2. Utilize appropriate growth charts for infants and children.
3. Utilize appropriate equations to determine a child's energy and protein needs.
4. Define pediatric malnutrition (undernutrition) in the hospital setting.
5. Apply concepts of pediatric nutrition assessment in case studies.

NUTRITION ASSESSMENT

Nutrition Assessment

Method for obtaining, verifying, interpreting, and documenting data needed to identify a nutrition-related problem.

In performing a nutrition assessment, the registered dietitian uses critical thinking to:

- Determine the need for additional information
- Select assessment tools and procedures that match the situation
- Apply assessment tools in valid and reliable ways
- Distinguish relevant from irrelevant data
- Validate the data

Nutrition Assessment Components

1	2	3	4	5
Client History	**Food/Nutrition History**	**Biochemical Data, Medical Tests and Procedures**	**Anthropometric Measurements**	**Nutrition Focused Physical Examination**
• Current and past information related to personal, medical, family, social history.	• Intake • Food/nutrient administration • Medication and alternative medicine use • Knowledge/belief /attitudes • Behavior • Food availability • Physical activity	• Laboratory data eg. electrolytes, lipid panel, glucose • Tests eg. resting metabolic rate; gastric emptying time.	• Height • Weight • Growth patterns/ percentiles • Weight history	• Evaluation of body systems • Muscle and fat wasting • Oral health • Suck/swallow /breathe ability

1. Client History

A. Medical History

- Chief complaint
- Current health status
- Chronic disease status
- Psychiatric history
- Surgical history
- Diagnostic procedures
- Medical therapies (eg. chemotherapy)
- Oral health history
- Medications and supplements (taken over past several weeks/months)
- Growth History
- Stool patterns
- For infants: prenatal and birth history; birth related factors (prematurity); breastfeeding; formula choice

Common Pediatric Diagnosis and Possible Nutrient Deficiencies

Diagnosis	Possible Nutrient Deficiencies
Inflammatory bowel disease	Iron, folate, selenium, magnesium, zinc, calcium, vitamin D
Chronic diarrhea	Zinc
Cystic fibrosis	Fat-soluble vitamins (A, D, E, K), protein-calorie malnutrition
Congenital heart defects	Protein-calorie malnutrition
Prematurity	Vitamin D, calcium
Intestinal failure	With fat malabsorption: fat soluble vitamins (A, D, E, K), zinc, calcium, magnesium
	Ileal resection: vitamin B_{12}
	Duodenal involvement: iron, folate
Liver disease	Vitamin K, essential fatty acid deficiency
Chylothorax	Essential fatty acid deficiency, protein deficiency
Burns	Vitamin C, vitamin A, zinc, protein-calorie malnutrition
Cancer	Protein-calorie malnutrition
Poor wound healing	Vitamin C, vitamin A, zinc, protein-calorie malnutrition
Renal	Zinc, copper, iron, magnesium
	With dialysis: water-soluble vitamins

Corkins, 2015

Common Nutrient-Drug Interactions

Drug	Nutrients Affected	Overall Effect	Prevention
Antibiotics	Minerals, fats, protein	Temporary decrease in absorption; destroys “good” bacteria	Probiotics may help
Anticonvulsants	Vitamins: D, K, B6, B12, folate, Ca	Decreased nutrient absorption or stores.	Vitamin/mineral supplement (but may influence drug effectiveness)
Cardiac Medications (Diuretics)	K, Mg, Ca, folate	Possible loss of nutrient stores; may also cause nausea, vomiting, diarrhea.	Foods high in K, Mg. Strategies to help with reduced appetite.
Corticosteroids	Ca, P, Na, K, vit C, glucose, vit D, Zn, water	Long-term use can cause stunting; can deplete Ca, P; can affect glucose. Can cause fluid retention. Can increase appetite, lead to weight gain. Vomiting, diarrhea.	Monitor weight, labs. Supplement with Ca, vit D
Stimulants		Can reduce appetite, cause weight loss, affect overall growth.	Let child eat before each medication. Monitor growth.

1. Client History - cont'd

B. Development

- Motor development (WHO milestones in first 2 years of life-6 components)
- Cognitive development (ask caregiver, check medical records)
- Sexual maturation (Tanner stages of pubertal development)

1. Client History - cont'd

C. Family and Community Environment

- Child caregivers; Members of household
- Caregivers ability to purchase and prepare food
- Setting for meals and snacks; mealtime environment and atmosphere
- Caregivers approach to child's food preferences, ability to make choices, regulate intake
- Financial resources
- Cultural or religious food preference, dietary habits, feeding practices
- Family dysfunction
- Emotional distress or depression
- Caregivers attitudes toward and expectations for child's health and nutrition status

2. Food and Nutrition History

- Primary determinants of nutrition status.
- **Main concern: is the child's current intake meeting nutrient needs in context of current clinical situation, growth pattern, and developmental level.**
- Accurate estimates of the adequacy of protein and energy intake should be routinely determined for all children, especially if at increased risk of malnutrition.
- Food/nutrient intake can be obtained by history and/or direct observation.

Diet History

- Type/amount of food, beverages, breastmilk, formula consumed at meals/snack
- Preparation methods for foods/formula
- If breastfeeding: number; length; number of wet diapers; supplemental feedings
- Food allergies and intolerances
- Food preferences, likes/dislikes
- Frequency, timing, length, location of meals/snacks
- Current/past use of special diets
- Cultural/ethnic family eating practices
- Physical activity habits and media viewing behaviors

Estimation of Energy Needs

- Indirect calorimetry is the most accurate method.
- Predictive equations do not accurately determine energy expenditure or account for variability in metabolic rate during illness.
- Most widely used equations (0-18 years):

1. **FAO/WHO**
2. **Schofield**

Most commonly used in critically ill patients in the hospital setting.

3. **EER Equations**

- Important to avoid overfeeding critically ill child as hepatic and pulmonary complications can occur.

Stress Factors:

Starvation 0.70–0.85
Surgery 1.05–1.5
Sepsis 1.2–1.6
Closed head injury 1.3
Trauma 1.1–1.8
Growth failure 1.5–2
Burn 1.5–2.5

Becker et al, 2015

Equations

Age, months	EER (kcal/day)
0-3	{89 x weight (kg)} + 75
4-6	{89 x weight (kg)} – 44
7-12	{89 x weight (kg)} – 78
13-36	{89 x weight (kg)} - 80

Age	WHO Equation (kcal/day)
0-3	Male: (60.9 x weight (kg)) – 54 Female: (61 x weight (kg)) – 51
3-10	Male: (22.7 x weight (kg)) + 495 Female: (22.5 x weight (kg)) + 499

Energy Needs: Developmental Disabilities

Cerebral Palsy (age 5–11 y*):
Mild-moderate activity: 13.9 kcal/cm height
Severe physical restrictions: 11.1 kcal/cm height
Severe restricted activity: 10 kcal/cm height
Athetoid cerebral palsy: Up to 6000 kcal/d (adolescence)

Down Syndrome (5–12 y*):
Boys 16.1 kcal/cm height
Girls 14.3 kcal/cm height

Prader-Willi Syndrome (for all children and adolescents):
10–11 kcal/cm height for maintenance
8.5 kcal/cm height for weight loss

Myelomeningocele (Spina bifida) (over 8 years of age and minimally active):
9–11 kcal/cm height for maintenance
7 kcal/cm height for weight loss
Approximately 50% RDA for age after infancy
[RDA for weight age (kcal/kg) × Ideal body weight for height] ÷ Actual weight

Becker et al, 2015

Estimation of Protein Needs-Healthy

- DRI typically used to estimate protein needs for children with normal growth, body composition, and activity who are also metabolically normal.

Age	DRI for Protein
0-6 months	1.52 g/kg/d*
6-12 months	1.2 g/kg/d
12-36 months	1.05 g/kg/d
4-13 years	0.95 g/kg/d
14-18 years	0.85 g/kg/d
>18 years	0.8 g/kg/d

Note: This is an Adequate Intake recommendation.*

Becker et al, 2015

Estimation of Protein Needs-Critically Ill

- Must take into account child's clinical status.
- Some situations require additional protein to achieve positive Nitrogen Balance eg. major surgery, wound healing, infection, catch-up growth.
- Some situations require less protein eg. acute renal failure.
- A.S.P.E.N. Clinical Guidelines - Nutrition Support of the Critically ill Child:

Activity 1:

Calculate protein needs for a 5 year old boy who is post-operative. His weight is 18 kg.

AGE	PROTEIN NEEDS
0-2 years	2-3 g/kg/d
2-13 years	1.5-2 g/kg/d
13-18 years	1.5 g/kg/d

To meet increased demands of metabolic stress and spare use of endogenous protein stores.

Becker et al, 2015

Estimation for Catch-Up-Growth

Peterson's Failure to Thrive

- **Energy Needs:**
  {EER for weight age (kcal/kg) x ideal body weight for height (kg)} / actual weight (kg)
- **Protein Needs:**
  {protein required for weight age (g/kg/d) x ideal weight for age (kg)} / actual weight (kg)

Step 1: determine height-age, defined as age at which current height/length would fall at 50th percentile on length/height-for-age growth charts.

Step 2: identify weight, for which is the corresponding weight at the 50th percentile for height-age. This is needed to calculate EER.

Activity 2:

Calculate the energy needs for catch up growth for a 7 month old boy. Weight: 6.4 kg and height: 66 cm.

Estimation of Fluid Needs

Holliday – Segar Method

Weight (kg)	Fluid Needs
1 – 10 kg	100 ml/kg
11 – 20 kg	1000 ml + 50 ml/kg for each kg above 10kg
Above 20 kg	1500 ml + 20 ml/kg for each kg above 20kg

Activity 3:
Determine fluid needs for a girl weighing 17kg.

Nutrition Requirements – Preterm Infants

	Growing		RDA/AI[a]	
Nutrient	**ELBW (< 1,000 g)**	**VLBW (< 1,500 g)**	**Age 0-6 mo**	**Age 7-12 mo**
Fluid	160-220 mL/kg	135-190 mL/kg	0.7 L/day	0.8 L/day
Energy	130-150 kcal/kg	110-130 kcal/kg	555 kcal/day	694 kcal/day
Carbohydrate	9-20 g/kg	7-17 g/kg	60 g/day	95 g/day
Protein	3.8-4.4 g/kg	3.4-4.2 g/kg	9.1 g/day	11 g/day
Fat	6.2-8.4 g/kg	5.3-7.2 g/kg	31 g/day	30 g/day
Linoleic acid	700-1680 mg/kg	600-1440 mg/kg	4.4 g/day (14%)	4.6g/day
Alphalinolenic acid	0.7-2.1% kcal	0.7-2.1% kcal	0.5 g/day (1.6%)	0.5 g/day
DHA	≥ 21 mg/kg	≥ 18 mg/kg	–	–
ARA	≥ 28 mg/kg	≥ 24 mg/kg	–	–

Corrected/Adjusted Age **(used for at least 1st year of life)**

- Adjust for prematurity: May 1, 2009, born GA 27 weeks: 13 weeks before estimated term date (40 weeks – 27 weeks = 13 weeks, or 3 months preterm)
- November 1, 2009, chronological age of 6 months: 26 weeks past actual date of birth
- November 1, 2009, corrected age of 3 months: 26 weeks – 13 weeks = 13 weeks, or 3 months

Nutrition Requirements – Preterm Infants

		RDA/AI[a]	
Trace Element	**Growing ELBW (< 1,000 g) or VLBW (< 1,500 g)**	**Age 0-6 mo**	**Age 7-12 mo**
Zinc	1,000-3,000 mcg/kg	2 mg/day	3 mg/day
Copper	120-150 mcg/kg	200 mcg/day	220 mcg/day
Iron	2-4 mg/kg	0.27 mg/day	11 mg/day
Chromium	0.1-2.25 mcg/kg	0.2 mcg/day	5.5 mcg/day
Molybdenum	0.3 mcg/kg	2 mcg/day	3 mcg/day
Manganese	0.7-7.5 mcg/kg	0.003 mg/day	0.6 mg/day

		AI[a]	
Vitamin	**Growing ELBW (< 1,000 g) or VLBW (< 1,500 g)**	**Age 0-6 mo**	**Age 7-12 mo**
Vitamin A	700-1500 IU/kg	400 mcg/day[b]	500 mcg/day[b]
Vitamin D	150-400 IU/day	5 mcg/day[c]	5 mcg/day[c]
Vitamin E	6-12 IU/kg	4 mg/day[d]	5 mg/day[d]
Vitamin K	8-10 mcg/kg	2 mcg/day	2.5 mcg/day
Vitamin C	18-24 mg/kg	40 mg/day	50 mg/day
Thiamin	180-240 mcg/kg	0.2 mg/day	0.3 mg/day
Riboflavin	250-360 mcg/kg	0.3 mg/day	0.4 mg/day

		AI[a]	
Mineral	**Growing ELBW (< 1,000 g) or VLBW (< 1,500 g)**	**Age 0-6 mo**	**Age 7-12 mo**
Calcium	100-220 mg/kg	210 mg/day	270 mg/day
Phosphorus	60-140 mg/kg	100 mg/day	275 mg/day
Magnesium	7.9-15 mg/kg	30 mg/day	75 mg/day
Sodium	3-5 mEq/kg (69-115 mg/kg)	120 mg/day	370 mg/day
Potassium	2-3 mEq/kg (78-117 mg/kg)	400 mg/day	700 mg/day
Chloride	3-7 mEq/kg (107-249 mg/kg)	180 mg/day	570 mg/day

3. Biochemical Data; Medical Tests

When available, can be used for:

- Screening for malnutrition
- Evaluation of nutritional status
- Diagnosis of insufficient intakes of specific nutrients
- Monitoring of nutritional rehabilitation

Common Laboratory Tests for Preterm/Term

- BUN (5-20mg/dL)
- Creatinine (0.2-1.0mg/dL)
- Sodium (130-145mg/dL)
- Chloride (100-110mEq/L)
- Potassium (3.5-6mEq/L)
- Magnesium (1.5-2.5mg/dL)
- Calcium, serum (6-12mg/dL)
- Phosphorus (term: 4-8mg/dL; preterm: 5.6-11mg/dL)
- Alkaline phosphatase (100-500U/L)
- Triglycerides, serum (less than 200mg/dL)
- Hemoglobin (10-15mg/dL)
- Hematocrit (30-45%)
- Albumin (3-5mg/dL)
- Prealbumin (10-25mg/dL)
- Glucose (60-100mg/dL)

Lab Tests - Malnutrition

Large body pool. Multiple diseases that alter level of albumin, it is an unreliable serum marker for malnutrition. Also, not reliable as a marker for protein-calorie malnutrition (levels drop post-signs).

- **Albumin** → Half life = 20 days. Low in malnutrition, also in infection, burns, fluid overload, hepatic failure, cancer, nephrotic syndrome.

Elevated in Fe deficiency due to increased Fe absorption. Not reliable as serum marker for assessing malnutrition. Levels also increase with renal failure.

- **Transferrin** → Half-life = 10 days. Low in protein energy malnutrition, but also affected by iron status

A study reported that PAB and RBP not useful for nut assessment in postsurgical patients: influenced by metabolic stress response post surgery.
Another study however, showed PAB was better indicator than albumin for assessing adequacy of postoperative nutr support. PAB levels rose quickly to normal range after administration of PN. May be effective for determining nutr status + response to therapy.

More reliable indicator of acute changes in a patient's nutritional status (shorter half life than albumin).
Degraded by kidneys, any renal dysfunction leads to increase in serum levels.

- **Prealbumin** → Half-life = 2-3 days. Low in malnutrition, also in infections, liver failure and increased in renal failure

- **CRP** → Positive acute phase reactant. Helps determine whether above proteins are reduced because of inflammatory process or due to inadequate substrate, as in malnutrition.

Affected by non-nutritional factors (CVD) and other inflammatory states (infections).

Bharadwaj et al, 2016

Lab Tests - Malnutrition

Nitrogen Balance

- Historical gold standard for assessing protein intake.
- A negative nitrogen balance means there is more loss than intake; can be used as a marker for assessing malnutrition.
- Nitrogen balance can be studied by measuring the concentration of urea in the urine.
- Another technique is to calculate the urinary creatinine/height index. Values of 60–80% and 40% indicate mild and severe protein malnutrition, respectively.
- **Nitrogen balance: g/d = (protein intake g/d ÷ 6.25 g/d) – (UUN g/d + 4)**

4. Anthropometric Assessment

- Growth is the primary outcome measure of nutritional status in children. It is defined as an increase in size and the development to maturity.
- Growth velocity is defined as rate of change in weight or length/height over time.
- Must be monitored at regular intervals during childhood and adolescence.

Preterm Infants:
- ❖ length for age
- ❖ weight-for-age
- ❖ head circumference-for-age
- ❖ weight-for-length

Children <36 months, measures of growth:
- ❖ length for age
- ❖ weight-for-age
- ❖ head circumference-for-age
- ❖ weight-for-length

Children aged 2-20, measures of growth:
- ❖ height-for-age
- ❖ weight-for-age
- ❖ BMI-for-age

Anthropometric Measurements

Weight	• Different scales can yield different results (small difference can be significant).
Length (< 2 years) Height	• Can be difficult to obtain due to medical condition, contractures, physical impairment. • Alternative method: arm span, knee height, tibia length.
Head Circumference	• Can indicate growth when accurate length is not available. • Measured until age 36 months, to the nearest 1mm (0.1cm) • Correction for prematurity done until 18 months of age. • Last to be affected by poor nutrition (after weight and height)
Midupper Arm Muscle Circumference	• Used in determining malnutrition in children 6-59 months when compared to WHO standards. • Useful when weight is unreliable due to edema, ascites.

Janet Sugarman Isaacs

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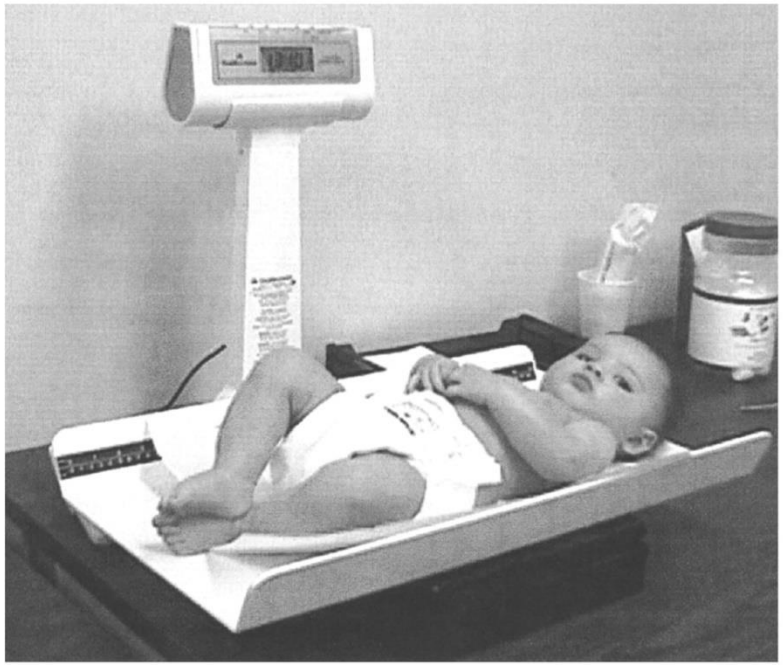
Nancy H. Wooldridge



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WHO Growth Curves

- *z* scores are the number of standard deviations from the mean.
- More precise than percentiles, which do not reveal actual degree of deviation from population norms.
- *z* score tells how a single data point compares with normal data, and if above or below “average”, how atypical the measurement is.
- Children growing and developing normally will be on or between -1 and 1 z score of a given indicator.
- Must plot serial measurements to track growth compared with normal standards, and track changes in growth curves.

WHO Growth Curves

- A Z-score cut-off point of <-2 SD is used to classify low weight-for-age, low height-for-age and low weight-for-height as moderate and severe undernutrition
- A Z-score cut-off point of <-3 SD defines severe undernutrition.
- The cut-off point of >+2 SD classifies high weight-for-height as overweight.

Z-score	Growth indicators			
	Length/height-for-age	Weight-for-age	Weight-for-length/height	BMI-for-age
Above 3	*See note 1*	*See note 2*	*Obese*	*Obese*
Above 2			*Overweight*	*Overweight*
Above 1			*Possible risk of overweight (See note 3)*	*Possible risk of overweight (See note 3)*
0 (median)				
Below −1				
Below −2	*Stunted (See note 4)*	*Underweight*	*Wasted*	*Wasted*
Below −3	*Severely stunted (See note 4)*	*Severely underweight (See note 5)*	*Severely wasted*	*Severely wasted*

Notes:

1. *A child in this range is very tall. Tallness is rarely a problem, unless it is so excessive that it may indicate an endocrine disorder such as a growth-hormone-producing tumor. Refer a child in this range for assessment if you suspect an endocrine disorder (e.g. if parents of normal height have a child who is excessively tall for his or her age).*
2. *A child whose weight-for-age falls in this range may have a growth problem, but this is better assessed from weight-for-length/height or BMI-for-age.*
3. *A plotted point above 1 shows possible risk. A trend towards the 2 z-score line shows definite risk.*
4. *It is possible for a stunted or severely stunted child to become overweight.*
5. *This is referred to as very low weight in IMCI training modules. (Integrated Management of Childhood Illness, In-service training. WHO, Geneva, 1997).*

Degree of Stunting

Degree of Stunting = (actual height (cm) / 50th percentile for height-for-age (cm) x 100

% degree of stunting	Classification
≥ 95%	Normal
90 – 94%	Mild stunting
85 – 89%	Moderate stunting
< 85%	Severe stunting

Percentage of Ideal Body Weight

% IBW = (actual weight (kg) / IBW (kg) x 100**

% IBW	Classification
≥ 90%	Normal
80 – 90%	Mild wasting
70 – 80%	Moderate wasting
< 70%	Severe wasting

Note: IBW – find child's height on *x-axis,* go up to 50% percentile, determine corresponding weight on *y-axis*.**

Unintentional Weight Loss

% Weight change = (usual weight – current weight)/usual weight x 100

% weight loss	Time frame
2%	1 week
5%	1 month
7.5%	3 months
10%	6 months

5. Nutrition Focused Physical Examination

- NFPE is a crucial component of a complete nutrition assessment.
- **It identifies or confirms muscle wasting, subcutaneous fat loss, edema and micronutrient deficiencies.**
- Many nutrition-related signs and symptoms found during the clinical examination can later be more objectively confirmed with laboratory assessment.
- Dietitians should take responsibility, with help of multidisciplinary team eg. patient's bedside nurse.

Techniques of: NFPE

- Decide how focused your exam will be depending on: history, primary diagnosis, medical status.
- Tools to consider: disposable gloves, small penlight, tape measure, stethoscope, tongue depressors, skin calipers.
- Includes following four components:

1. **Inspection**
2. **Palpation**
3. **Percussion**
4. **Auscultation**

Inspection

- Visual Exam
- Observe color, shape, texture, symmetry
- NFPE begins with general inspection and proceeds from head to toe order.

Palpation

- Touching/feeling patient to determine texture, temperature, distension, muscle rigidity, hydration of skin, tenderness.

Percussion

- Helps determine solids, fluid, gas in body.
- Performed using examiners fingers to tap on child's body producing sounds.

Auscultation

- Listening to body sounds through a stethoscope.
- Used most often to determine bowel sounds during abdominal examination.

General Examination	Inspection	Palpation	Auscultation	
Abdominal Examination	Inspection	Auscultation	Percussion	Palpation

Steps to Performing a Basic NFPA

Step[a,b]	Description[c]
General survey	Overall appearance—alertness, demeanor, facial expression, body habitus, and size (eg, wasting, cachectic, obese).
Skin	Inspect the entire skin surface in good light and throughout the exam. Observe for color: hyper/hypopigmentation; redness, pallor, cyanosis, yellowing. Assess for moisture (dryness/sweating), texture (roughness and smoothness), temperature, lesions, and turgor.
Head/hair	Inspect the scalp and hair for quantity, distribution, texture, color, easily plucked. While palpating the head assess and rate temporalis muscle.
Eyes	Ask if changes in dryness or night vision are noted. Observe the color of sclera and conjunctiva, and inspect the cornea for white foamy spots. Assess fullness and color around the orbital region.
Mouth	Observe for moisture, swelling, color, dentition, lesions around the extra/intraoral cavity—lips, corners of the mouth, tongue, mucous membrances, gums, and teeth. Ask if taste changes are present.
Neck/upper body	Inspect the neck for venous distention or masses. Assess for muscle and subcutaneous fat loss in these regions: clavicles, shoulders, scapula, fat overlying the ribs, and triceps.
Hand/nails	Inspect the hand and nails for color, texture, shape, and lesions. Palpate the interosseous muscle for fullness and distribution.
Musculoskeletal/ lower extremity	Observe overall muscle appearance—ask if strength/movement, swollen or painful joints are present. Observe for bowlegs and/or knocked knees; inspect and palpate the shape and size of quadricep and calf muscles; rate fluid accumulation around ankles with edema rating scale.

Esper, 2015

Nutrition Concerns Based on NFPE

Site	Physical Examination	Potential Nutrition/Metabolic Status
Skin integrity	Pallor	Iron, folate, or vitamin B_{12} deficiency
	Dry, scaly skin	Vitamin A or essential fatty acid deficiency
	Dermatitis	Essential fatty acid deficiency; zinc, niacin, riboflavin, or tryptophan deficiency
Nail	Spoon shape	Iron deficiency
	Lackluster, dull	Protein deficiency
	Mottled, pale, poor blanching	Vitamin A or C deficiency
Face	Moon face	Protein-calorie deficiency
	Bilateral temporal wasting	Protein-calorie deficiency
Neck	Enlarged thyroid	Iodine deficiency
Mouth	Dry, cracked, red lips	Riboflavin, niacin, vitamin B_6 deficiency
	Bleeding gums	Vitamin C deficiency
	Inflamed mucosa	Vitamin B complex, iron, or vitamin C deficiency
Tongue	Magenta color	Riboflavin deficiency
	Beefy red color and diminished taste	Niacin, folate, riboflavin, iron, or vitamin B_{12} deficiency
Eyes	Night blindness; dull dry appearance to sclerae or inner lids; dull milky appearance of the cornea	Vitamin A deficiency
	Cracked, red corners	Riboflavin or niacin deficiency
Hair	Dull, lackluster, thin, sparse	Protein, iron, zinc, or essential fatty acid deficiency
	Easily pluckable	Protein deficiency
Dentition	Excessive dental caries	Excessive simple carbohydrate intake

Corkins, 2015

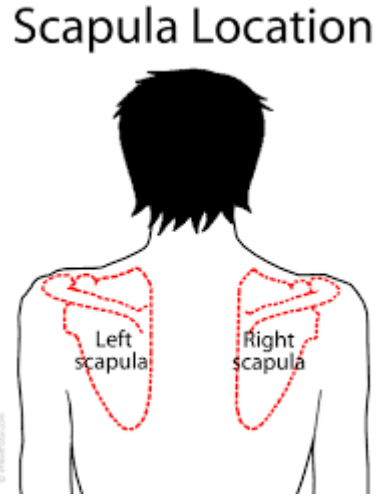
NFPE: Subcutaneous Fat Loss

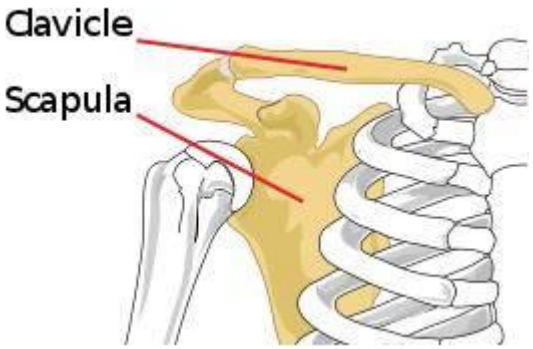
- **Inspect: child's face, arms, chest, and buttocks (infants and toddlers).**
- **Areas appear bony, hollow cheeks, flat/baggy buttocks.**

Source: Goldsmith LA, Katz SI, Gilchrest BA, Paller AS, Leffell DJ, Wolff K: *Fitzpatrick's Dermatology in General Medicine, 8th Edition*: www.accessmedicine.com

NFPE: Muscle Mass Loss

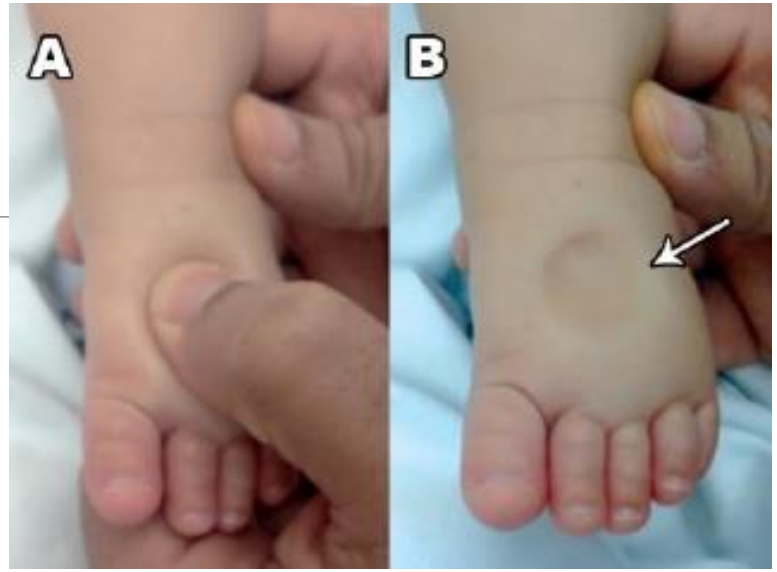
- **Inspect: temple, clavicle, shoulder, scapula, thigh, knee, calf.**
- **Signs of muscle wasting: protruding bone structures and hollowing of muscle.**

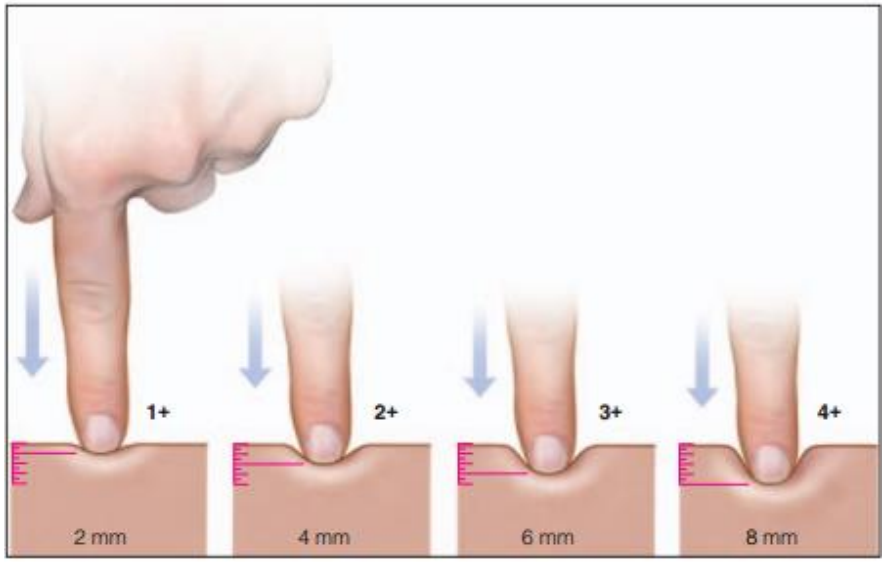




NFPE: Edema

- Apply firm pressure with thumb into skin over bony surface of the distal anterior surface of the foot, or over the sacrum (for infants and bedridden children). Hold for 5 seconds.
- Observe the depth of the depression and whether it persists after lifting the thumb.
- Edema related to the child's illness (nephrotic syndrome, CHF) should not be rated as potential malnutrition.
- Assess whether tissue wasting is hidden by fluid retention.



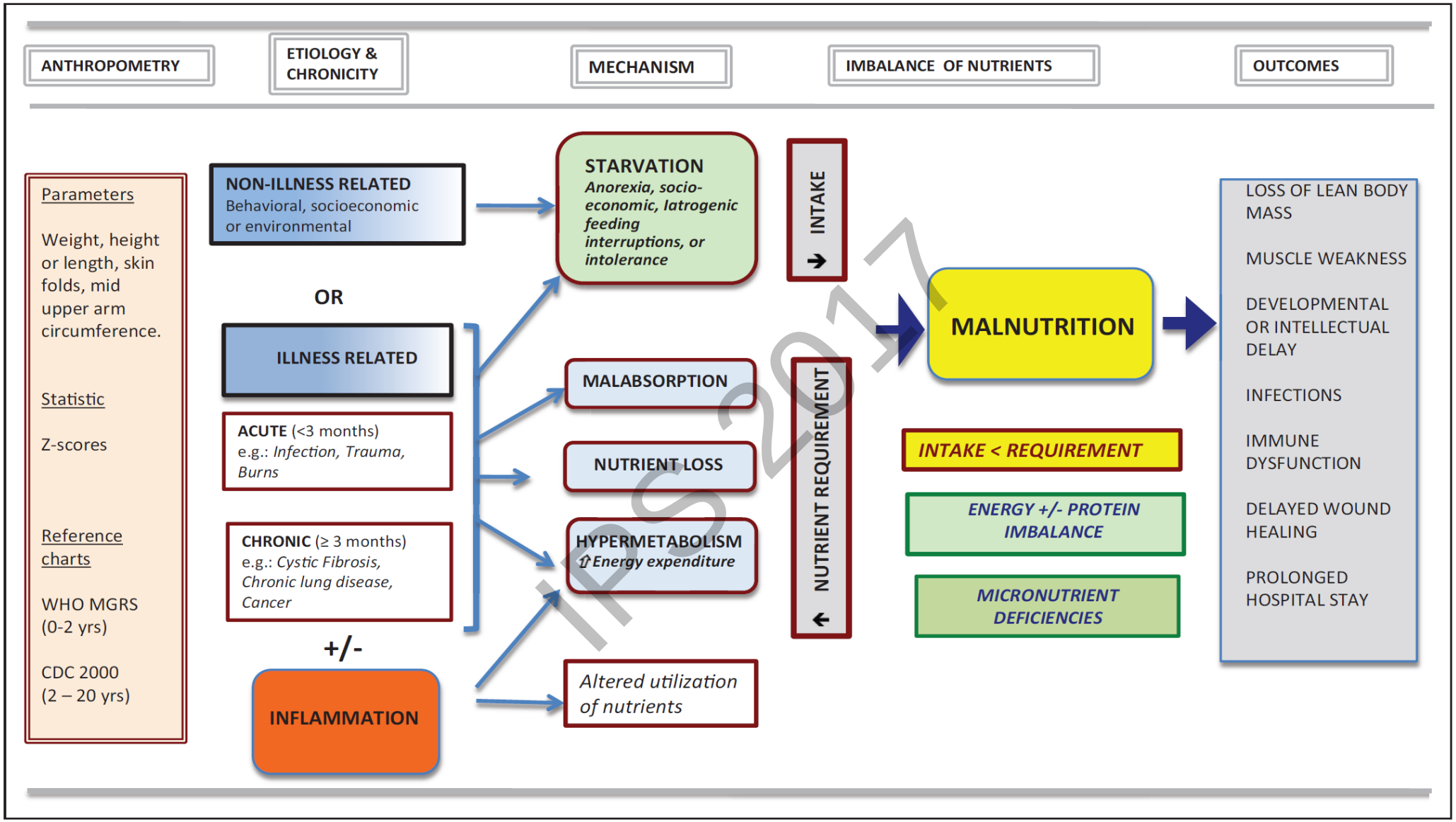


PEDIATRIC MALNUTRITION (Undernutrition)

Pediatric Malnutrition/Undernutrition

- A.S.P.E.N. have defined pediatric malnutrition as: *"an imbalance between nutrient requirement and intake, resulting in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development and other relevant outcomes."*
- Malnutrition etiology in developed countries is often a result of *chronic illness, trauma, burns, surgery, or congenital anomalies.*
- Attributed to:
  - **Nutrient Loss**
  - **Increased energy expenditure**
  - **Reduced nutrient intake**
  - **Altered nutrient utilization**

Defining Malnutrition in Hospitalized Children.



Mehta et al, 2013

Acute Vs. Chronic Pediatric Undernutrition

- WHO and UNICEF provided diagnostic parameters to characterize level of undernutrition.
- Undernutrition/malnutrition identified using: *z* score, decline in *z* score, negative *z* score.
- **Weight is primarily affected during periods of acute undernutrition, while chronic undernutrition manifests as stunting.**
- Mild acute undernutrition presents with unintentional weight loss or weight gain velocity below expected.
- Severe acute undernutrition (ages 6-60 months of age) is defined as ➡ very low weight-for-age *z* score less than -3.
- Wasting is defined as ➡ weight-for-height less than -2 SD.
- Chronic undernutrition or stunting is defined as ➡ height-for-age (or length-for-age) less than -2 SD of the median international reference.

Pediatric Undernutrition

Malnutrition Classification: when single data points are available.

	Mild Malnutrition	Moderate Malnutrition	Severe Malnutrition
Weight-for-height *z* score	−1 to −1.9 *z* score	−2 to −2.9 *z* score	−3 or greater *z* score
BMI-for-age *z* score	−1 to −1.9 *z* score	−2 to −2.9 *z* score	−3 or greater *z* score
Length/height-for-age *z* score	No data	No data	−3 *z* score
Mid–upper arm circumference	Greater than or equal to −1 to −1.9 *z* score	Greater than or equal to −2 to −2.9 *z* score	Greater than or equal to −3 *z* score

Malnutrition Classification: when 2 or more data points are available.

	Mild Malnutrition	Moderate Malnutrition	Severe Malnutrition
Weight gain velocity (<2 years of age)	Less than 75%[a] of the norm[b] for expected weight gain	Less than 50%[a] of the norm[b] for expected weight gain	Less than 25%[a] of the norm[b] for expected weight gain
Weight loss (2–20 years of age)	5% usual body weight	7.5% usual body weight	10% usual body weight
Deceleration in weight for length/height *z* score	Decline of 1 *z* score	Decline of 2 *z* score	Decline of 3 *z* score
Inadequate nutrient intake	51%–75% estimated energy/protein need	26%–50% estimated energy/protein need	≤25% estimated energy/protein need

Becker et al, 2015

Pediatric Undernutrition - MUAC

- Using MUAC to classify malnutrition (children 6-60 months of age):
  - **Severely malnourished: MUAC < 11.5 cm**
  - **Moderately malnourished: 11.5 - 12.4 cm**
  - **At risk of malnutrition: 12.5 - 13.4 cm**

Subjective Global Nutritional Assessment

- Used as an assessment tool for children at risk of malnutrition.
- Considering presence or absence of historical features and physical signs associated with malnutrition, a child's nutrition status is assigned a global rating of (not a numerical scoring system):
  - normal/well nourished
  - moderately malnourished
  - severely malnourished

Nutrition Focused Medical History:

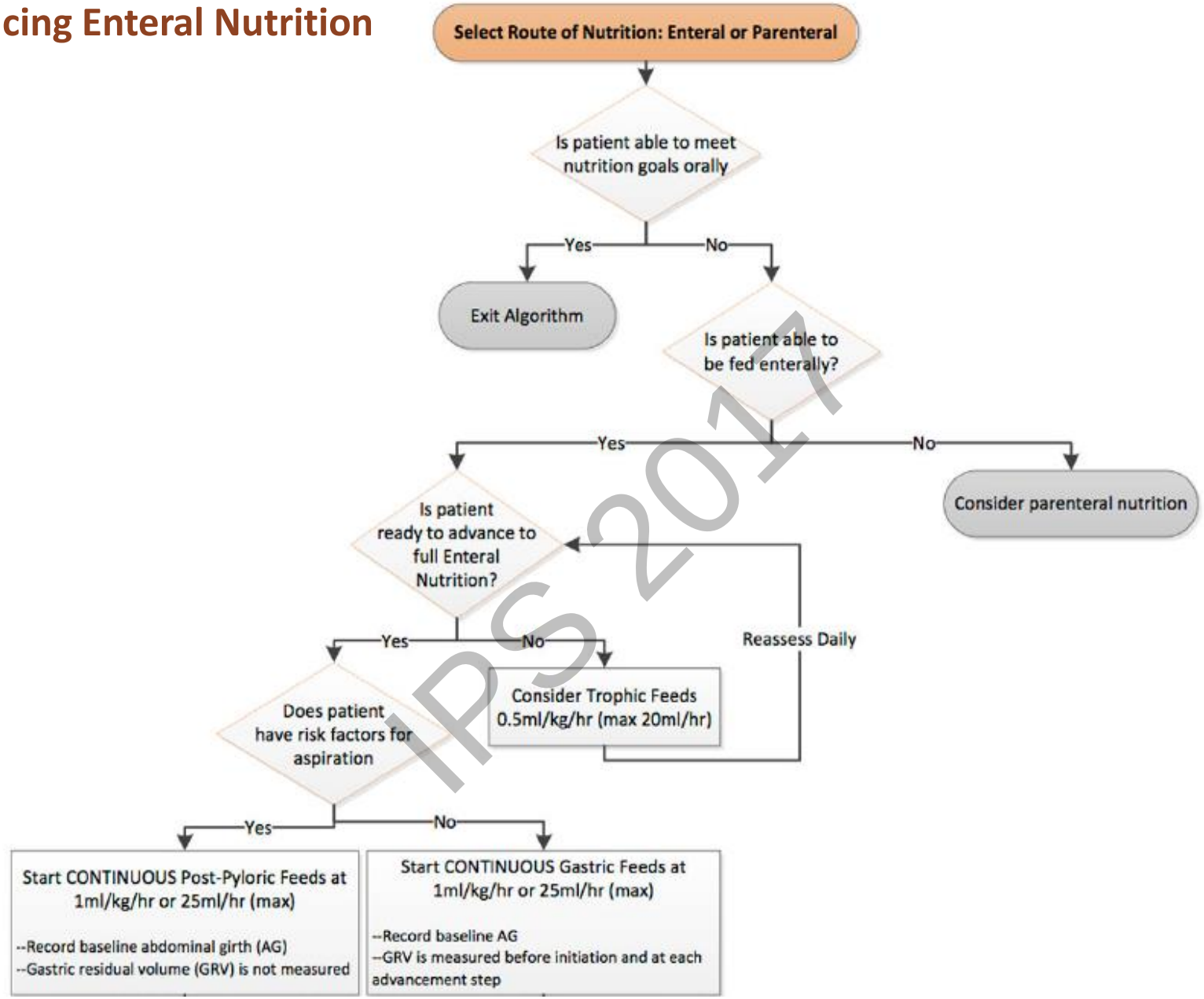
1. Linear growth
2. Weight relative to length/height
3. Changes in body weight
4. Adequacy of dietary intake
5. Persistent Gastrointestinal Symptoms
6. Functional impairment
7. Metabolic stress

Nutrition Focused Physical Examination:

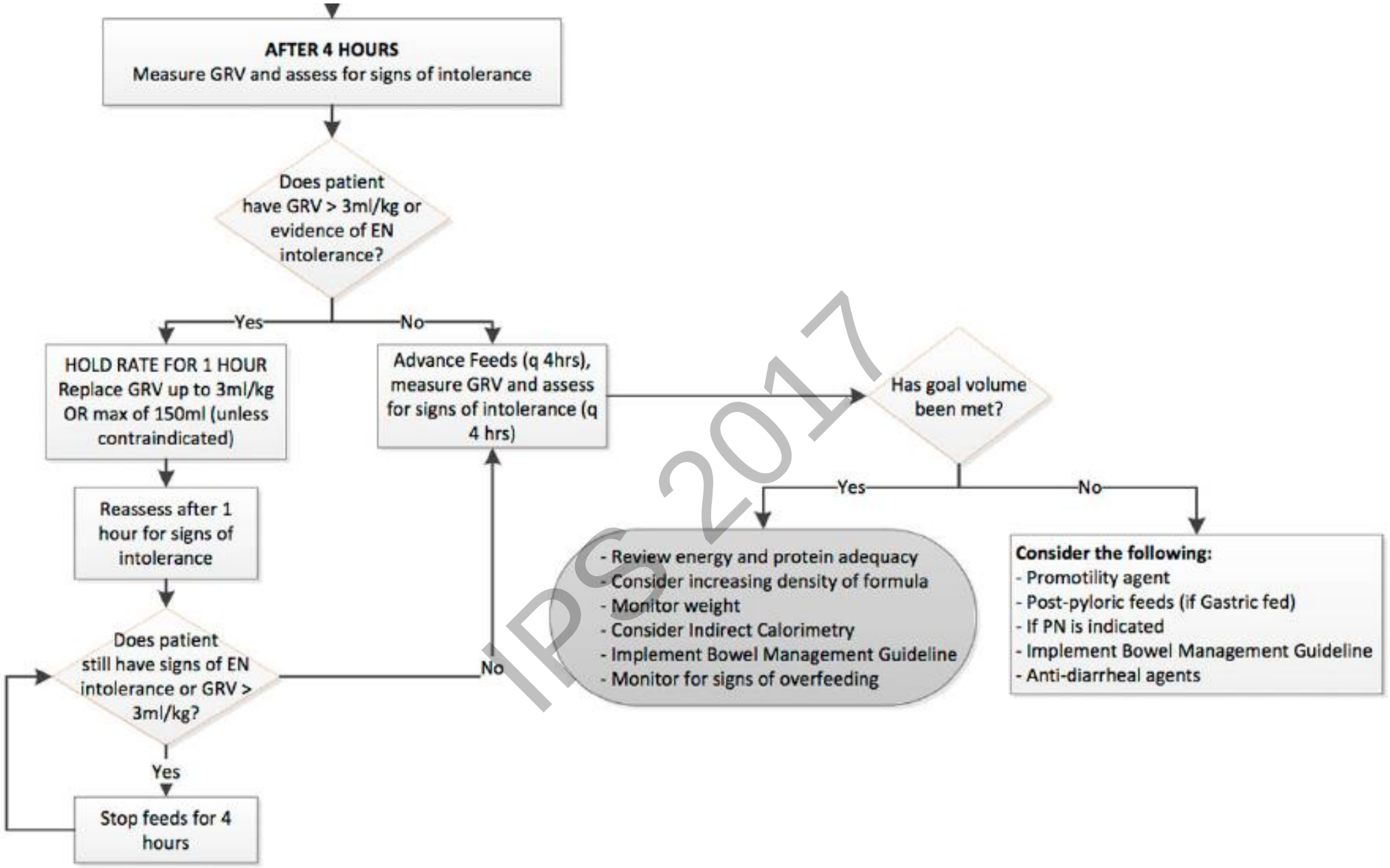
1. Loss of subcutaneous fat
2. Muscle wasting
3. Edema

ENTERAL NUTRITION

Initiating and Advancing Enteral Nutrition in Pediatric ICU.



Hamilton et al, 2014



Hamilton et al, 2014

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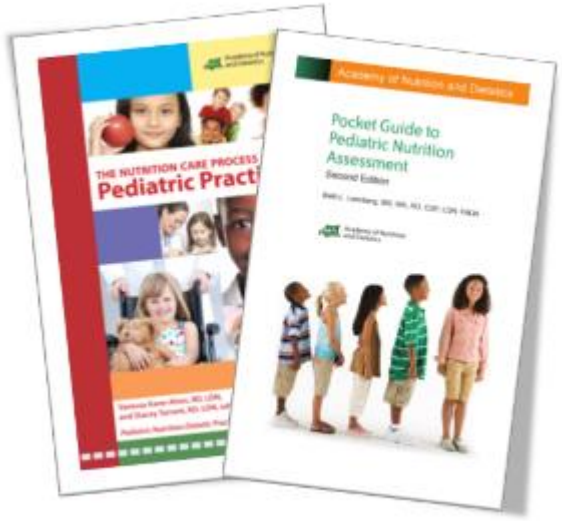
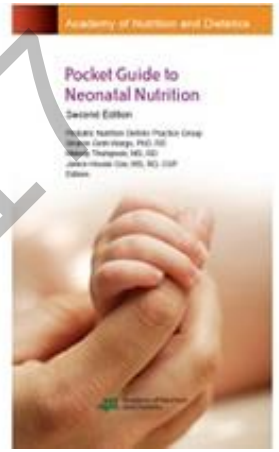
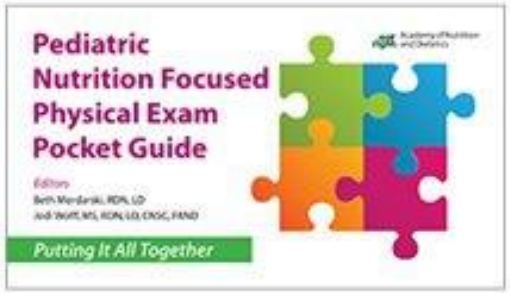
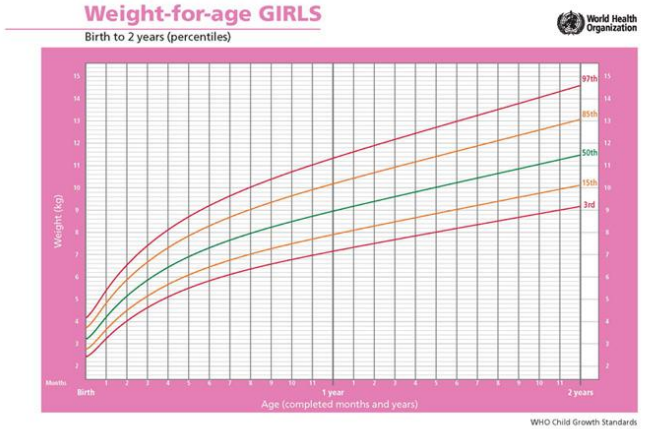
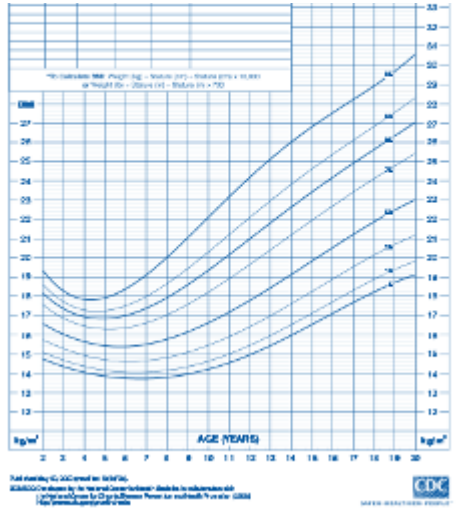
Useful tools











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CASE STUDIES
and
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