Nestlé Health Science has endeavored to include in this guide only such clinical information that it believes to be accurate and reliable as of the date of publication.

The information contained in these guidelines is not intended as a replacement for medical advice, standards of care, approved practices or policies of a particular physician and/or healthcare facility, all of which should be considered when utilizing this guide.

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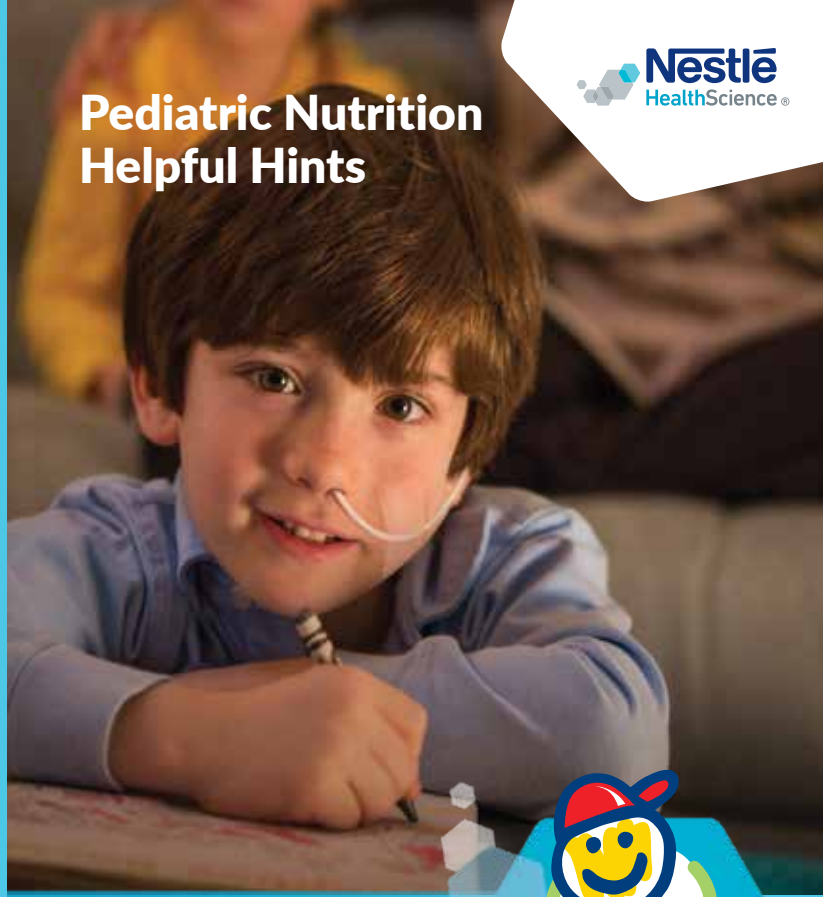
Pediatric Nutrition Helpful Hints



Specialized nutrition for your most vulnerable patients.

PEDIATRIC NUTRITION

CRITICAL CARE NUTRITION

NEUROLOGIC IMPAIRMENT NUTRITION

PEDIATRIC NUTRITION

Baseline fluid requirements: Holliday-Segar method

1-10 kg	100 mL/kg
10-20 kg	1000 mL + 50 mL/kg for each kg above 10 kg
> 20 kg	1500 mL + 20 mL/kg for each kg above 20 kg

Daily fluid

Fluid needs based on above formula:

WEIGHT (kg)	DAILY FLUID REQUIREMENTS* (mL)	WEIGHT (kg)	DAILY FLUID REQUIREMENTS* (mL)
1	100	52	2140
2	200	54	2180
3	300	56	2220
4	400	58	2260
5	500	60	2300
6	600	62	2340
7	700	64	2380
8	800	66	2420
9	900	68	2460
10	1000	70	2500
12	1100	72	2540
14	1200	74	2580
16	1300	76	2620
18	1400	78	2660
20	1500	80	2700
22	1540	82	2740
24	1580	84	2780
26	1620	86	2820
28	1660	88	2860
30	1700	90	2900
32	1740	92	2940
34	1780	94	2980
36	1820	96	3020
38	1860	98	3060
40	1900	100	3100
42	1940	102	3140
44	1980	104	3180
46	2020	106	3220
48	2060	108	3260
50	2100	110	3300

*This number is only an estimate based on the above equation. Physician may determine actual individual fluid needs to be either lower or higher than this amount. Adapted from: Thomas EY. Fluid and Electrolytes. *The Harriet Lane Handbook*, 22nd Edition. Elsevier Saunders 2020, Chapter 11.

Catch-up growth requirements

$$\text{Catch-up growth Requirement (kcal/kg/d)} = \frac{\text{Kcals for age (kcal/kg/d)} \times \text{Ideal weight for height (kg)}}{\text{Actual weight (kg)}}$$

$$\text{Protein requirement (g/kg/d)} = \frac{\text{Protein for age (g/kg/d)} \times \text{Ideal weight for height (kg)}}{\text{Actual weight (kg)}}$$

1. Plot the child's height and weight on the growth charts (WHO charts if child is 0-2 years, NCHS charts if child is over the age of 2)

2. Determine the child's recommended calories per kg for this child's age

3. Determine the ideal weight (50th percentile) for this child's height

4. Multiply the value obtained in (2) by the value obtained in (3)

5. Divide the value obtained in (4) by actual weight

For the protein equation, follow same steps, but in (2), substitute protein for calories.

Guidelines are used to estimate catch-up growth requirements; precise individual needs vary and are mediated by the medical status and diagnosis.

Adapted from KM Corrales and SL Utter, Failure to Thrive. In Samour PQ, Helm KK and Lang CE. *Handbook of Pediatric Nutrition*, 2nd ed. Aspen Publishers. 1999;406.

Estimated Energy Requirements (EER)

WHO[a] and Schofield[b]

EER (kcal/day) = Resting Energy Expenditure X Activity Factor X Stress Factor

Resting energy expenditure

AGE	GENDER	WHO[A]	SCHOFIELD[B]
0-3 yrs	Male	60.7W - 54	0.17W + 15.17H - 617.6
	Female	61W - 51	16.25W + 10.232H - 413.5
3-10 yrs	Male	22.7W + 495	19.6W + 1.303H + 414.9
	Female	22.5W + 499	16.97W + 1.618H + 371.2
10-18 yrs	Male	17.5W + 651	16.25W + 1.372H + 515.5
	Female	12.2W + 746	8.365W + 4.65H + 200.0

Note: W=Weight (kg); H=Height (cm)

A. WHO. Energy and Protein Requirements. WHO Tech Rep Ser no 724. Geneva; 1985.

B. Schofield WN. Predicting basal metabolic rate, new standards and review of previous work. *Hum Nutr Clin Nutr* 1985;39c(1s):5-42.

Dietary Reference Intakes (DRI)

EER (kcal/day) = Total Energy Expenditure + Energy Deposition

Infants and young children (ages 0-35 months)		Children and adolescents (ages 3-18 years)	
AGE	**EER**	**AGE**	**EER**
0-3 mos	(89W - 100) + 175	Boys 3-8 yrs	88.5 - (61.9A + PA[26.7W + 903H])+20
4-6 mos	(89W - 100) + 56	9-18 yrs	88.5 - (61.9A + PA[26.7W + 903H])+25
7-12 mos	(89W - 100) + 22	Girls 3-8 yrs	135.3 - (30.8A + PA[10W + 934H])+20
13-35 mos	(89W - 100) + 20	9-18 yrs	135.3 - (30.8A + PA[10W + 934H])+25

Note: W= Weight (kg); H= Height (m); A= Age

Physical activity coefficients (PA), DRI (ages 3-18 years)

GENDER	SEDENTARY	LOW ACTIVE†	ACTIVE††	VERY ACTIVE†††
Boys	1.00	1.13	1.26	1.42
Girls	1.00	1.16	1.31	1.56

† (30-60 Mins. Daily moderate activity)
†† (60 Mins. Daily moderate activity)
††† (120 Mins. Daily moderate activity, or 60 mins. Moderate + 60 mins. Vigorous activity)

Estimates for overweight children

Total energy expenditure (TEE) for weight maintenance in overweight* children ages 3-18 years

GENDER	TEE (kcal/DAY)
Boys	114-50.9 x age (y) + PA x (19.5 x weight [kg] + 1161.4 x height [m])
Girls	389-41.2 x age (y) + PA x (15.0 x weight [kg] + 701.6 x height [m])

*Defined as BMI >95th %ile for age and sex
PA = physical activity coefficient

Physical activity coefficients (PAs) for overweight children ages 3-18 years

	PHYSICAL ACTIVITY LEVEL†			
GENDER	**SEDENTARY**	**LOW ACTIVE**	**ACTIVE**	**VERY ACTIVE**
Boys	1.00	1.12	1.24	1.45
Girls	1.00	1.18	1.35	1.60

†Physical activity level (PAL) is defined as the ratio of total energy expenditure to basal energy expenditure. PAL is determined from assessment of the amount of time the child or adolescent spends in moderate and vigorous play and work.

Food And Nutrition Board. Dietary Reference Intakes For Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids. Prepublication edition. Washington, DC: National Academies Press; 2005.

Growth:

Z-scores and percentiles

Z-SCORE	PERCENTILE
3	99.8%
2	97.7%
1	84.1%
0	50%
–1	15.9%
–2	2.3%
–3	0.1%

Degree of malnutrition and z-scores

DEGREE	Z-SCORE
Mild or at risk for malnutrition	<–1
Moderate	–2 to –3
Severe	<–3

Mehta N et al. *JPEN*. 2013:37(4):460-481

Chronicity of Malnutrition

Acute (Wasting)	< 3 months duration
Chronic (Stunting)	≥ 3 months duration

Mehta N et al. *JPEN*. 2013:37(4):460-481

Dietary Reference Intakes for Total Protein by Life Stage Group:

AGES 1-18 YEARS				
DRI Values (g/kg/day)				
	EAR[a]		RDA[b]	
	MALES	FEMALES	MALES	FEMALES
1 through 3 years	0.87	0.87	1.05 (13)[c]	1.05 (13)
4 through 8 years	0.76	0.76	0.95 (19)	0.95 (19)
9 through 13 years	0.76	0.76	0.95 (34)	0.95 (34)
14 through 18 years	0.73	0.71	0.85 (52)	0.85 (46)

[a]EAR = Estimated Average Requirement. An EAR is the average daily nutrient intake level estimated to meet the requirements of half of the healthy individuals in a group.

[b]RDA = Recommended Dietary Allowance. An RDA is the average daily dietary intake level sufficient to meet the nutrient requirements of nearly all (97-98%) healthy individuals in a group.

[c]Values in parentheses ( ) are examples of the total g/day of protein calculated from g/kg/day times the reference weights in Part I, "Introduction to the Dietary Reference Intakes", Table 1 in: Dietary Reference Intakes, The Essential Guide to Nutrient Requirements. National Academy of Sciences, 2006.

Source: This table is derived from the DRI report: see **http://nap.edu**

Initiation and Advancement of Enteral Feeds
(from ASPEN Enteral Nutrition Practice Recommendations, 2009):

1. Beginning and advancing enteral feedings in pediatric patients is guided by clinical judgment and institutional practices in the absence of prospective controlled clinical trials.
2. Generally children are started on an isotonic formula at a rate of 1-2 mL/kg/h for smaller children and 1mL/kg/h for larger children over 35-40 kg.
3. The rate is advanced based on tolerance by the child with the goal of providing 25% of the total calorie needs on day 1.
4. Feedings are advanced to goal calories within 24-48 hours and then bolus feedings are started, if indicated.
5. Bolus feedings are given via gravity or over a longer period of time via an enteral feeding pump.
6. When the plan involves beginning with bolus feedings, a volume of 2.5-5 mL/kg can be given 5-8 times per day with gradual increases in this volume to decrease the number of feedings to closer to 5 times daily.
7. Bolus feedings can be given over shorter periods of time by gradually increasing the volume infused per hour.
8. At no time should a bolus feeding be given in a shorter period of time than a child would be expected to consume if given a bottle feeding.
9. Maximum volumes for continuous and bolus feedings are determined by the child's response to the regimen, weight gains, and overall GI status.
10. Bolus feedings may be started with 25% of the goal volume divided into the desired number of daily feedings.
11. Formula volume may be increased by 25% per day as tolerated, divided equally between feedings.
12. Pump-assisted feedings: A full-strength, isotonic formula can be started at 1-2 mL/kg/h and advanced by 0.5-1 mL/kg/h every 6-24 hours until the goal volume is achieved.
13. Preterm, critically ill, or malnourished children who have not been fed enterally for an extended period may require a lower initial volume of 0.5-1 mL/kg/hour.

Adapted from Bankhead R, et al. ASPEN Enteral Nutrition Practice Recommendations. *JPEN J Parenter Enteral Nutr* 2009; 33; 122-167.
Yi DY. Enteral Nutrition in Pediatric Patients. *Pediatr Gastroenterol Hepatol Nutr.* 2018 Jan;21(1):12-19. doi: 10.5223/pghn.2018.21.1.12. Epub 2018 Jan 12.

Selected Clinical Conditions Relevant to a Patient's Ability to Tolerate EN.

- Prematurity in the neonate results in immature GI motility and risk of developing necrotizing enterocolitis.
- Trauma and critically ill patients may have altered metabolism and varying needs during the different phases of illness.
- Critically ill patients with traumatic brain injury have a higher frequency of GI disorders, such as gastroparesis and subsequent feeding intolerance.
- Diabetes and certain neurological conditions place patients at risk for gastroparesis and poor EN tolerance.
- Chronic obstructive pulmonary disease predisposes patients to muscle atrophy and weight loss related to chronic inflammation, increased metabolism, and other physiologic derangements.
- Ventilator-dependent respiratory failure may affect decision of formula selection and concentration.
- Altered GI anatomy resulting from small bowel resection, bariatric surgery, other GI surgery, or fistula affects decision making about feeding route and formula selection.
- Altered GI anatomy also poses a risk of anastomotic leak, malabsorption leading to diarrhea, and subsequent loss of nutrients, which may result in metabolic derangements.
- Renal failure affects the patient's ability to tolerate fluid volume and electrolytes.
- Hemodynamic instability may preclude the safe initiation of EN in the critical care patient.
- Cancer and ongoing treatments such as high-dose radiation to the head/neck may result in inflammation of the esophagus with dysphagia.
- Dysmotility conditions associated with gastroschisis or scleroderma may impact ability to tolerate EN.
- Neuromuscular diseases such amyotrophic lateral sclerosis can result in dysphagia.

EN = Enteral Nutrition **GI = Gastrointestinal**

Boullata JI, et al. ASPEN Safe Practices for Enteral Nutrition Therapy. ***Journal of Parenteral and Enteral Nutrition***, 2016.

Normal Growth Velocity in Children

AGE	WEIGHT (g/DAY)	LENGTH (cm/MO)
< 3 mo	20-30	2.6-3.5
3-9 mo	15-22	1.6-2.5
9-12 mo	6-11	1.2-1.7
1-3 yr	4-10	0.7-1.1
4-6 yr	5-8	0.5-0.8
7-10 yr	5-12	0.4-0.6

Adapted from Fomon SJ, Haschke F, et al. Body composition of reference children from birth to age 10 years. *Am J Clin Nutr* 1982;35:1169. Adapted from La Charite J. Nutrition and Growth. The Harriet Lane Handbook 22nd Edition. Elsevier Saunders, Chapter 21.

Enteral Feeding Troubleshooting

Gastrointestinal

COMPLICATION	POSSIBLE CAUSE	MANAGEMENT/PREVENTION
Aspiration pneumonia	Aspiration of feedings Emesis	Confirm tube placement prior to administration of feeds
	Displacement or migration	Elevate head 30 to 45 degrees
	Supine position during feeds	
	Gastroesophageal reflux	
	Presence of nasogastric tube preventing complete closure of esophagus	Tube placement into the duodenum
	Delayed gastric emptying	Use of prokinetics or formula change
Bloating/ cramps/gas	Air in tubing	Remove as much air as possible when setting up feeding
Diarrhea	Microbial contamination of formula	Always check formula expiration dates. For open feeding systems use clean technique formula preparation.
		Adhere to formula hang times at room temperature and refrigerated limits. Dilute powdered formulas with sterile water.
	Food allergies	Consider changing formula
	Hyperosmolar formulas	Consider an isotonic formula
	Too rapid infusion	Administer via continuous infusion.
		Decrease rate of formula administration to last tolerated TF rate.
	Low fiber intake or rapid gastric emptying	Consider a fiber-containing formula
	Fat malabsorption	Consider changing formula to product with partial MCT content
	Current drug therapy	Consult pharmacist to review medication prescribed
Vomiting	Rapid feeding	Administer via continuous infusion.
		Decrease rate of formula administration to last tolerated TF rate.
	Hyperosmolar formulas	Consider changing to isotonic formula
	Delayed gastric emptying	Consider small bowel tube feeding
		Maintain head of bed at least 30°
		Elevate head of bed 45 degrees during feeding
		Consider prokinetic agent
		Decrease fiber load
	Obstruction	Hold feeding until patient is evaluated
	Too rapid advancement of volume or concentration	Return to previously tolerated strength and volume, and advance more slowly

Enteral Feeding Troubleshooting

Mechanical

COMPLICATION	POSSIBLE CAUSE	MANAGEMENT/PREVENTION
Clogged tube	Inadequate flushing	Flush tube before and after aspirating residuals, after bolus feedings, and every 4-8 hours during continuous feeds
	Inadequate crushing of medications	Dissolve crushed tablets in warm water
	Formula and medication residue	Flush tube before and after medication administration; avoid mixing formula with medication
	Kinking of the feeding tube	Replace feeding tube
	Highly viscous fiber-rich formulas	Llarger tube size
Tube displacement	Coughing Vomiting Inadvertent dislodgement Removal of tube by patient	Replace the tube

Metabolic

COMPLICATION	POSSIBLE CAUSE	MANAGEMENT/PREVENTION
Dehydration	Inadequate free water	Monitor I's and O's
		Monitor hydration status of patient routinely
	Hyperosmolar feedings	Assess renal solute load of formula
Overhydration	Excessive fluid administration	Advance feeds slowly
	Too rapid refeeding or patients with moderate to severe PEM	Allow a 5-7 day period to meet nutritional goals
Electrolyte imbalance	Formula components	Evaluate electrolyte adequacy of specific formula and appropriateness of formula dilution
	Medical condition/ diagnosis	Monitor electrolytes, phosphorus, BUN, creatinine, glucose
Failure to achieve weight gain	Inadequate nutrient intake	Evaluate adequacy of nutrient intake
		Perform routine nutritional assessments

Adapted From Cox JH, ed. *Nutrition Manual for At-Risk Infants and Toddlers*. Chicago: Precept Press;1997.

Nursing Guidelines — Managing Tube Feeding. 2023 Nestle. NEST-10377-0523.

EQUATIONS TO ESTIMATE ENERGY REQUIREMENT: AGES 0-18 YEARS		
Infants and Young Children Estimated Energy Requirement (kcal/day) = Total Energy Expenditure + Energy Deposition		
0-3 months		EER[a] = (89 x weight [kg] – 100) + 175
4-6 months		EER = (89 x weight [kg] – 100) + 56
7-12 months		EER = (89 x weight [kg] – 100) + 22
13-35 months		EER = (89 x weight [kg] – 100) + 20
Children and Adolescents 3-18 years Estimated Energy Requirement (kcal/day) = Total Energy Expenditure + Energy Deposition		
BOYS	3-8 yrs	EER = 88.5 – (61.9 x age [y]) + PA[b] x [(26.7 x weight [kg])] + (903 x height [m]) + 20
	9-18 yrs	EER = 88.5 – (61.9 x age [y]) + PA x [(26.7 x weight [kg])] + (903 x height [m]) + 25
GIRLS	3-8 yrs	EER = 135.3 – (30.8 x age [y]) + PA x [(10.0 x weight [kg])] + (934 x height [m]) + 20
	9-18 yrs	EER = 135.3 – (30.8 x age [y]) + PA x [(10.0 x weight [kg])] + (934 x height [m]) + 25

NOTE: These equations provide an estimate of energy requirement. Relative body weight (i.e., loss, stable, gain) is the preferred indicator of energy adequacy.
[a]**EER** = Estimated Energy Requirement
[b]**PA** = Physical Activity Coefficient
Source: This table is derived from the DRI report: see **http://nap.edu**

Body Mass Index (BMI)

BMI is recommended as a routine screening tool for overweight children and adolescents[1]

Procedure:

1. Obtain standing height for children ages 2 to 20 with a stadiometer
2. Record weight to the nearest 1⁄2 ounce or 0.01 kg[2]
3. Calculate **BMI**[3]

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m)}^2} \quad \textbf{or} \quad \text{BMI} = \left[\frac{\text{weight (lb)}}{\text{height (in)}^2}\right] \times 703$$

4. For children ages 2 to 20, plot BMI using the BMI growth chart appropriate for gender[4]

Recommended BMI-for-age cutoffs[5,6]:

1. ≥ 95th percentile is considered "obese"
2. 85th to 95th percentile is considered "overweight"
3. < 5th percentile is considered "underweight"

1. Barlow, SE and Dietz, wh. Obesity evaluation and treatment: expert committee recommendations. *Journal of Pediatrics* 1998; 102(3):e29.
2. U.S. Department of Health and Human Services. Accurately Weighing & Measuring: Technique: http://depts.Washington.Edu/growth/module5/text/intro.htm. Accessed August 29, 2005.
3. Keys A, Fidanza F, Karvonen MJ, Kimura N, Taylor HL. Indices of relative weight and obesity. *Journal of Chronic Disease* 1972; 25:329-343.
4. Kuczmarski RJ, Ogden CL, Guo SS, et al. 2000 CDC Growth Charts for the United States: Methods and Development. National Center for Health Statistics. Vital Health Statitistics 2002;11(246).
5. Himes, JH and Deitz, WH. Guidelines for overweight in adolescent preventive services: recom–mendations from an expert committee. *AmericanJournal of Clinical Nutrition* 1994;59:307-316.
6. American Medical Association. Expert Committee Recommendations on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity. June 6, 2007. http://www.Ama-assn.Org/ama1/pub/upload/mm/433/ped_obesity_recs.pdf. Accessed:July 20, 2007.

Home Delivery Carton Calculator for Nestlé Enteral Nutrition Formulas in cartons

Use this calculator to determine each patient's weekly or monthly enteral product needs for home delivery based on volume of formula ordered per day

TOTAL DAILY VOL. (mL/d)	CARTONS/DAY	CASES/WEEK	CASES/MONTH
500	2.0	0.6	2.6
550	2.2	0.6	2.8
600	2.4	0.7	3.0
650	2.6	0.8	3.3
700	2.8	0.8	3.5
750	3.0	0.9	3.8
800	3.2	0.9	4.0
850	3.4	1.0	4.3
900	3.6	1.1	4.5
950	3.8	1.1	4.8
1000	4.0	1.2	5.0
1050	4.2	1.2	5.3
1100	4.4	1.3	5.5
1150	4.6	1.3	5.8
1200	4.8	1.4	6.0
1250	5.0	1.5	6.3
1300	5.2	1.5	6.5
1350	5.4	1.6	6.8
1400	5.6	1.6	7.0
1450	5.8	1.7	7.3
1500	6.0	1.8	7.5
1550	6.2	1.8	7.8
1600	6.4	1.9	8.0
1650	6.6	1.9	8.3
1700	6.8	2.0	8.5
1750	7.0	2.0	8.8
1800	7.2	2.1	9.0
1850	7.4	2.2	9.3
1900	7.6	2.2	9.5
1950	7.8	2.3	9.8
2000	8.0	2.3	10.0
2050	8.2	2.4	10.3
2100	8.4	2.5	10.5

CRITICAL CARE NUTRITION

Nutritional Assessment of the Critically Ill Child

ELEMENTS OF CRITICAL CARE ENTERAL NUTRITION (EN) PRACTICE BUNDLE

1. Nutritional assessment on admission
2. Caloric goal (measured by energy expenditure or estimate)
3. Early enteral nutrition (within 24 hours of admission)
4. Head of bed elevation (≥30 degrees)
5. Daily checklist for enteral nutrition status/protocolized EN advancement

Mehta NM. Approach to enteral feeding in the PICU. *Nutrition in Clinical Practice* 2009;24(3):384.

Pediatric Critical Care Guidelines for Protein[1]

3A Recommend minimum protein intake of 1.5 g/kg/d. Protein intake higher than this threshold has been shown to prevent cumulative negative protein balance. In critically ill infants and young children, the optimal protein intake may be much higher than this minimum threshold.

3B Suggest provision of protein early in the course of critical illness; delivery of a higher proportion of the protein goal has been associated with positive clinical outcomes.

Recommendations for Pediatric Patients[2] by age	A.S.P.E.N RECOMMENDATIONS FOR PROTEIN
0-2 years	2-3 g/kg/day
2-13 years	1.5-2 g/kg/day
13-18 years	1.5 g/kg/day

1. Mehta NM, et al. *JPEN* 2017;(41)5:706-742.
2. Mehta NM, et al. *JPEN* 2009;33:260-276.

Equation For Assessing Energy Requirements of Ventilated, Critically Ill Children

MEASUREMENT OF ENERGY EXPENDITURE:

Indirect calorimetry:

Energy expenditure by indirect calorimetry (IC) be used to determine energy requirements and guide prescription of the daily energy goal. IC uses a metabolic cart to measure the amount of oxygen consumed and carbon dioxide exhaled to determine resting energy expenditure. This often provides the respiratory quotient (RQ) which may help determine substrate utilization (fat, protein, mixed, carbohydrate or fat synthesis). Patients that are spontaneously breathing are often measured under a hood which creates a seal to trap all oxygen inhaled and carbon dioxide exhaled. Ventilated patients or patients with tracheostomies may also be tested, as long as there are no inspiratory or expiratory air leaks and the patient is not on high frequency ventilation of FIO_2 of >60%.

Ireton-Jones CS. Estimating Energy Requirements. *Nutritional Considerations in the Intensive Care Unit*. ASPEN; Kendall Hunt Publishing, Dubuque:2002.

Indirect calorimetry provides REE and a measure of substrate utilization as reflected in the RQ:

RQ <0.85 **indicates underfeeding**
RQ 0.85-1.0 **indicates adequate feeding**
RQ >1.0 **indicates overfeeding**

- Suggest achieving delivery of at least two-thirds of the prescribed daily energy requirement by the end of the first week in the PICU.
- Recommend a minimum protein intake of 1.5 g/kg/d

Ista E, Joosten K. Nutritional Assessment and Enteral Support of Critically Ill Children. *Crit Care Nurs Clin N Am* 2005;17(4):385–93.

Mehta NM, Skillman HE, et al. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Pediatric Critically Ill Patient: Society of Critical Care Medicine and American Society of Perenteral and Enteral Nutrition. *Journal of Parenteral and Enteral Nutrition* 2017; Vol 4(5): 706-742.

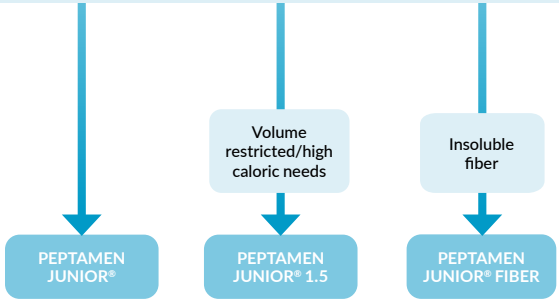
Enteral Nutrition Support Algorithm

The PEPTAMEN JUNIOR® family offers a variety of solutions for patients with GI dysfunction.

Complete peptide-based nutrition with MCT for:

Impaired GI function, which may result from:
- Short bowel syndrome
- Cerebral palsy
- Cystic fibrosis
- Crohn's disease

Malabsorption
Chronic diarrhea
Delayed gastric emptying
Growth failure
Early enteral feeding
Transition from or dual feeding with TPN



ENTERAL FEEDING INTOLERANCE

Gastric residual volumes (GRV) recorded prior to each bolus feed or q4hrs in patients on continuous gastric feedings with abdominal discomfort, distention or emesis.

If GRV >150 mL; or 5 mL/kg, or >½ volume of previous feeding; or >total 2 hourly infusion rate in patients on continuous feeding – hold feedings and repeat GRV after 2 hrs. If repeat GRV is elevated, hold feedings and monitor GRV at 4 hrs.

If abdominal distension, (abdominal girth increased for 2 consecutive measurements) or abdominal discomfort or emesis x2 – hold feedings for 4 hrs and reassess.

CONSTIPATION

(for age >1 month/non-neutropenic)
NO STOOL AFTER 48 HOURS OF EN
Day 1: Prune juice
Day 2: Glycerin supp.

Docusate
(<3 yrs: PO 10 mg BID)
(3–6 yrs: PO 20 mg BID)
(6–12 yrs: PO 50 mg BID)
(≥12 yrs: PO 100 mg BID)

Senna (discontinue after 2 normal stools)
(1 mo–2 yrs: PO 2.5 mL BID)
(2–5 yrs: PO 3.75 mL BID)
(5–12 yrs: PO 7.5 mL BID)
(≥12 yrs: PO 1 Tab BID)

Fleet Enema (for age >2 yrs)
Pediatric Fleet enema: 2–12 yrs (66 mL/bottle) 1 enema
Adult Fleet enema: ≥12 yrs

DIARRHEA (>4 loose stools/24 hrs)

Discontinue laxatives (senna) and stool softeners (docusate)

Discontinue any sorbitol-containing medication

Review osmolarity of formula

Consider withdrawal from opiates

Consider change in formula, or hold tube feedings until diarrhea resolves

Stool viral studies / *Clostridia (C.) difficile*

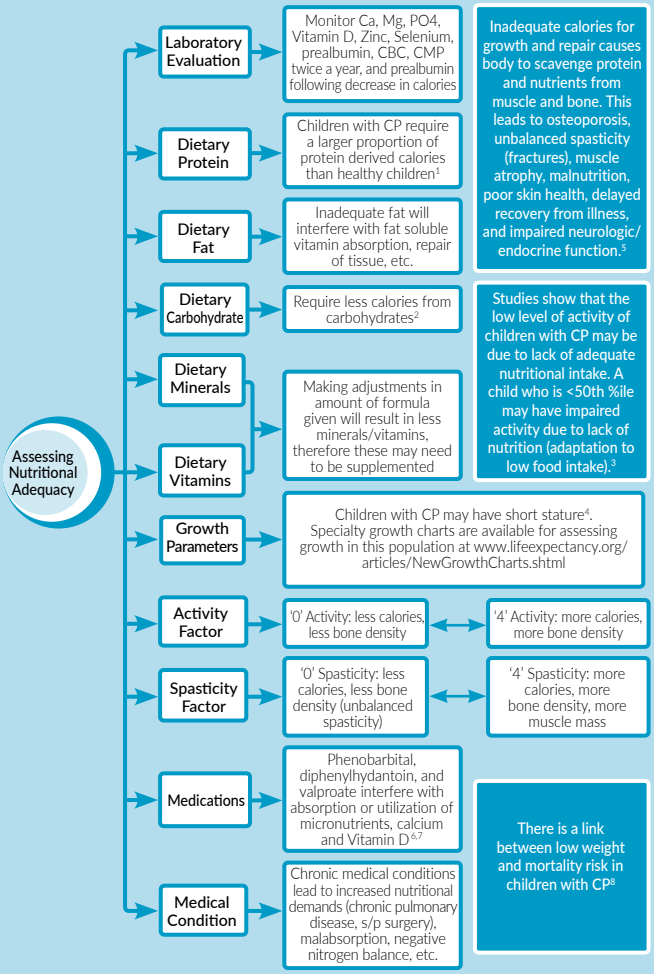
Stool *C. difficile* toxin and culture (if on antimicrobials)

Adapted from: Mehta NM. Approach to enteral feeding in the PICU. *Nutr Clin Pract* 2009;24(3):379. ©2009 American Society for Parenteral and Enteral Nutrition. Reprinted by permission of SAGE Publications.

*Rogers EJ et al. Barriers to adequate nutrition in critically ill children. *Nutrition* 2003;19:865–8.
†Heyland DK et al. Total parenteral nutrition in the critically ill patient: a meta-analysis. *JAMA* 1998;280:2013–19.

NEUROLOGIC IMPAIRMENT NUTRITION

NUTRITIONAL ASSESSMENT IN CHILDREN WITH CEREBRAL PALSY



Adapted from Brannan D., The Children's Center, 2010. Used with permission.

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NUTRITIONAL ASSESSMENT

Feeding History and Skills for Children with Neurological Impairment or Developmental Delays

ITEMS TO CONSIDER:
Developmental status
Neurologic status
Physical activity
Mobility
Feeding history
Diet history
4-day diet diary, include fluids
4-day physical activity diary
Supplemental feedings, including oral feedings, tube feedings, vitamins, and minerals
Herbal supplements
Feeding difficulties in the past
Length of time to complete a meal
Swallowing difficulties
Choking
Recurrent pneumonia
Pain when eating
Vomiting
Difficulty with textures or thickness of solids or liquids
Current use of occupational therapy/physical therapy/speech therapy
Developmental stimulation activities
School programs
Nutritional status
Caregiver's willingness to consider tube feedings
Stooling history
Surgery history

Ekvall S, Ekvall V. Nutrition Support for Children with Developmental Disabilities. In: Baker SS, Baker RD, Davis AM, eds. Pediatric Nutrition Support. Jones & Bartlett, 2007:360.

NUTRITIONAL ASSESSMENT

Indications for Nutrition Intervention

FACTORS TO LOOK FOR:		
Primary therapy for oromotor feeding difficulties		
Supportive therapy		
Preoperative nutritional rehabilitation		
Drug nutrient interactions	Vitamin D	Folic acid
Abnormalities of specific laboratory tests		
Anemia	Prolonged prothrombin time	
Hypoalbuminemia	Depressed alkaline phosphatase	
Serum mineral deficiencie	Lactose intolerance	
Serum vitamin deficiencies		
Complications of neurologic disorders		
Malnutrition	Obesity	Growth failure

Definitions for Category of Malnutrition

	Mild	Moderate	Severe
Weight for height and BMI	–1 to –1.9 z-score	–2 to –2.9 z-score	–3 or greater z-score
Mid-upper arm circumference z-core	> –1 to –1.9	> to –2.9	> –3
Weight gain velocity (<2 years)	Less than 75% of the norm for expected weight gain	Less than 50% of the norm for expected weight gain	Less than 25% of the norm for expected weight gain
Weight loss (2-20 years)	5% usual body weight	7.5% usual body weight	10% usual body weight
Declaration in weight for length/ height z-score	Decline of 1 z-score	Decline of 2 z-scores	Decline of 3 z-scores
Inadequate nutritional intake	51% - 75% estimated energy/protein need	26% - 50% estimated energy/ protein need	< 26% estimated energy/ protein need

Indications for Enteral Tube Placement

Nutritional
Inability to meet daily fluid requirement
Inability to meet daily nutrient requirements by the oral route
Moderate/severe wasting (<80% weight-for-height)
Moderate/severe linear stunting (<90% height-for-age)
Neurologic
Orofacial abnormalities associated with swallowing difficulties
Gastroesophageal reflux unresponsive to medications
Recurrent complications of swallowing difficulties (aspiration, pneumonia, esophagitis)

Ekvall S, Ekvall V. Nutrition Support for Children with Developmental Disabilities. In: Baker SS, Baker RD, Davis AM, eds. Pediatric Nutrition Support. Jones & Bartlett, 2007:363.

Energy Requirements in Children with Developmental Disabilities

CLINICAL CONDITION	CALORIE REQUIREMENT
Cerebral Palsy (age 5–11 yrs)	13.9 kcal/cm height with mild to moderate activity 11.1 kcal/cm height with severe physical restrictions
Athetoid Cerebral Palsy	up to 16.1 kcals/cm (adolescence)
Down Syndrome Boys (age 5–12 yrs) Girls (age 5–12 yrs)	 16.1 kcal/cm height 14.3 kcal/cm height
Myelomeningocele (Spina Bifida)	9–11 kcal/cm height for maintenance 7 kcal/cm for weight loss approximately 50% RDA for age after infancy
Prader-Willi Syndrome	10–11 kcal/cm height for maintenance 8.5 kcal/cm height for weight loss

1. Protein requirements – May be met by providing DRI for age
2. Fluid requirements – Attention to fluid needs is critical in these patients because many do not have, or cannot express, a thirst sensation
3. Formula choice guideline – If weight age is ≤ 13 years, use pediatric formula; if weight age is > 13 years, may use adult formula

Ekvall SW, Bandini L, Ekvall V: Obesity. In Ekvall SW (ed): *Pediatric Nutrition in Chronic Diseases and Developmental Disorders*, Oxford University Press, 1993;168.

Davis A. *Pediatrics*. In: Contemporary Nutrition Support Practice; 1998, Ch 26;356.

Energy Expenditure in Spastic CP-Bioelectrical Impedance Analysis

Variable	24-71m (n=29)	72-119m (n=23)	>120m (n=27)
REE (kcal/d)	751 (152)	904 (131)	1028 (134)
REE (kcal/kg/d)	62.3 (9.97)	53.3 (10.1)	49 (11)
TEE (kcal/d)	1038 (205)	1230 (146)	1440 (188)
Kcal/cm/d	11 (1.5)	11 (1.0)	11.3 (0.8)

REE = Resting energy expenditure; TEE = Total energy/expenditure

- 79 patients 24mo – 16 years old
- 11 Kcal/cm consistent with other studies with spastic CP

Więch P, Ćwirlej-Sozańska A, Wiśniowska-Szurlej A, Kilian J, Lenart-Domka E, Bejer A, Domka-Jopek E, Sozański B, Korczowski B. The Relationship Between Body Composition and Muscle Tone in Children with Cerebral Palsy: A Case-Control Study. Nutrients. 2020 Mar 24;12(3):864.

Estimation of Stature from Segmental Measures

ESTIMATION OF STATURE IN CENTIMETERS	
Age 0–12[1]	(4.35 x UAL) + 21.8 (3.26 x TL) + 30.8 (2.68 x KH) + 24.2
Age 6–18[2]	White male: (2.22 x KH) + 40.54 AA male: (2.18 x KH) + 39.60 White female: (2.15 x KH) + 43.21 AA female: (2.02 x KH) + 46.59

UAL = upper arm length TL = tibia length KH = knee height

1. North American Growth in Cerebral Palsy Project at http://www.healthsystem.virginia.edu.
2. Chumlea WC, Guo SS, Steinbaugh ML. Prediction of stature from knee height for black and white adults and children with application to mobility-impaired or handicapped persons. *J Am Diet Assoc* 1994;94(12):1385–8.

Diagnostic Tools in Dysphagia Evaluation

Careful history
Physical examination (especially neurologic examination)
Barium swallow
Modified barium swallow (videofluoroscopy)
Esophageal manometry
Esophageal pH monitoring
Endoscopic evaluation (hypopharynx or esophageal)

Major Patient Risk Factors for Aspiration

Previous episode of aspiration
Decreased level of consciousness
Neuromuscular diseases and structural abnormalities of the aerodigestive tract
Endotracheal intubation
Vomiting
Persistently elevated gastric residual volumes
Need for prolonged supine positioning of the patient

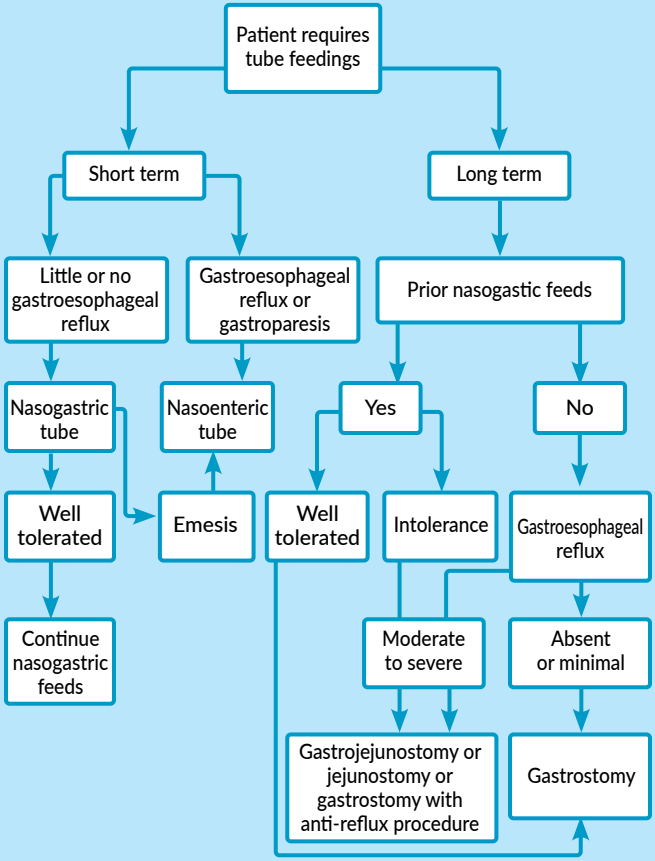
DeLegge MH. Enteral nutrition and the neurologic diseases. In: Rolandelli RH. Enteral and Tube Feeding, eds. 4th ed. Elsevier, Inc., 2005, p. 410.

Approach to Nutrition Support in Children with Developmental Disabilities

Route of tube feeding
Nasogastric
Gastrostomy
Jejunostomy
Method of formula administration
Continuous drip
Intermittent bolus
Combined continuous nighttime and intermittent daytime bolus
Amount of nutrients
Individualize energy based on ideal body weight for chronologic age (10^{th}–25^{th} percentile) in the malnourished child
Individualize energy based on multiples (1.0–1.2) of the resting metabolic rate in obese children
Source of nutrition support
Formula specific for children
Whey based formula for children with emesis

Ekvall S, Ekvall V. Nutrition Support for Children with Developmental Disabilities. In: Baker SS, Baker RD, Davis AM, eds. *Pediatric Nutrition Support*. Jones & Bartlett, 2007:364.

DECISION TREE FOR ENTERAL ACCESS



Adapted from: Marchand V. Enteral Nutrition Tube Feedings. In: Baker SS, Baker RD, Davis AM, eds. *Pediatric Nutrition Support*. Jones & Bartlett, 2007:252.

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