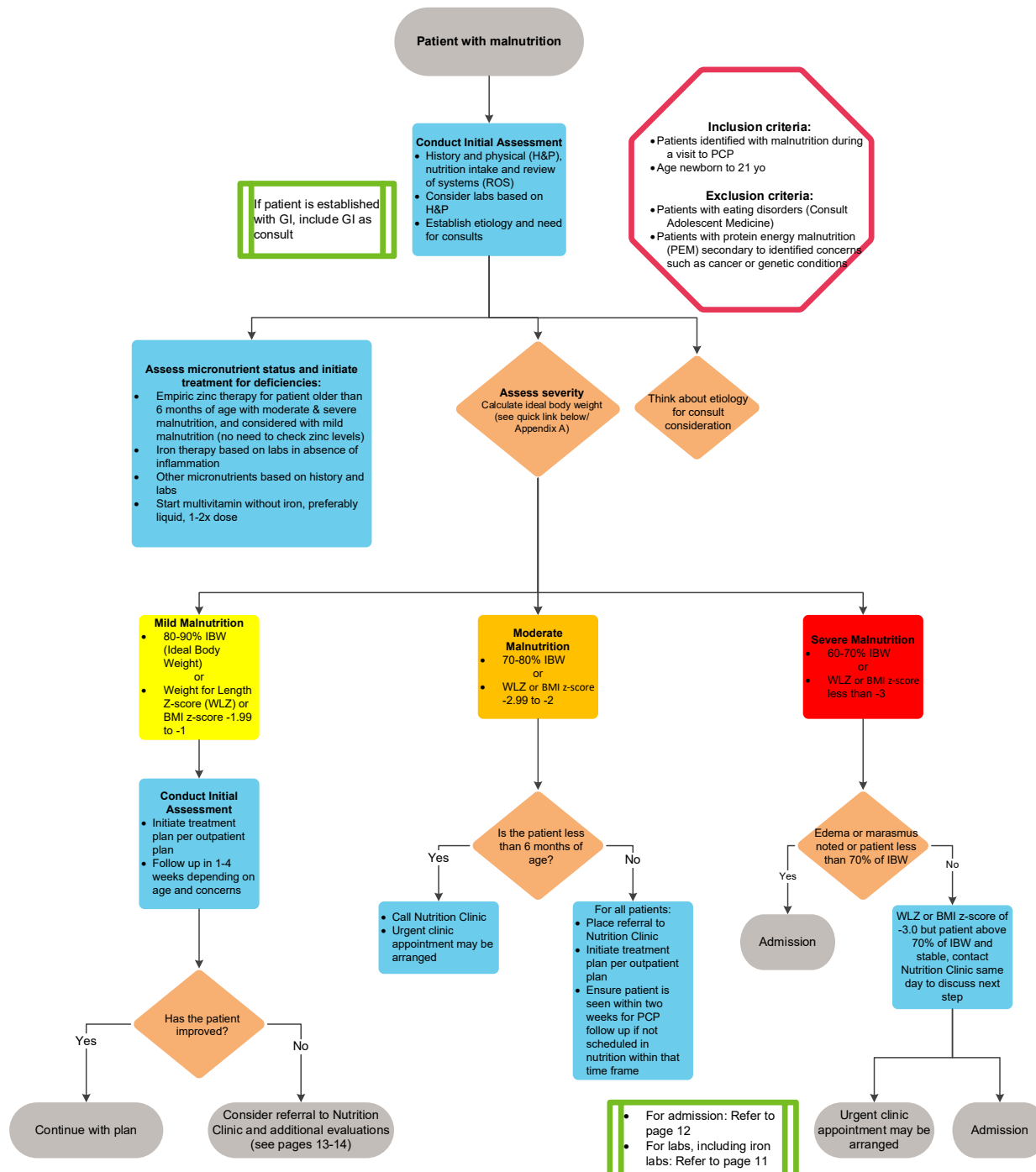


PROTEIN ENERGY MALNUTRITION

(Failure to Thrive is a stigmatizing and non-specific term)

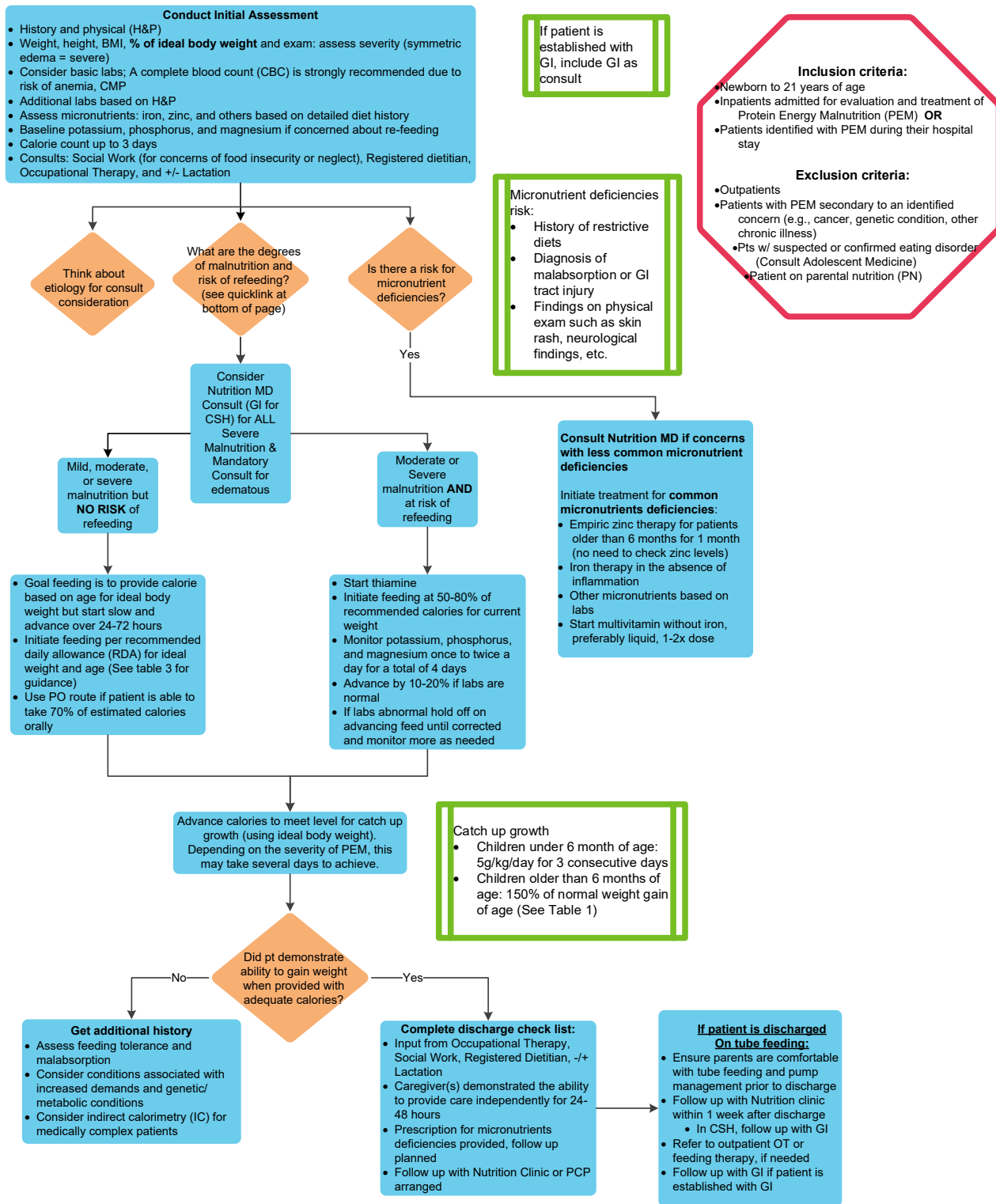
ALGORITHM- OUTPATIENT



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ALGORITHM-INPATIENT



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TARGET POPULATION

Inclusion Criteria

- Newborn to 21 years of age in the inpatient and outpatient settings who are identified with Protein Energy Malnutrition or growth faltering
- Adult patients have alternate diagnostic criteria beyond the scope of this pathway. The same diagnostic and therapeutic approach may be considered for adult patients as a starting point.

Exclusion Criteria

- Patients with PEM/Growth Faltering secondary to an identified condition (e.g., cancer, identified genetic conditions, or other chronic illness). These patients may need to have caloric goals adjusted due to identified conditions.
- Patients with a suspected or confirmed eating disorder
- Patients who need parental nutrition (PN)

DEFINITIONS AND CLASSIFICATION OF MALNUTRITION^{1, 2}:

Protein Energy Malnutrition (PEM) is defined 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. We highly recommend that the term Protein Energy Malnutrition replaces Failure to Thrive because the latter can imply emotional deprivation and can lead parents to feel accused of withdrawal or neglect.

Clinical Pearls about Growth charts:

- Weight for length is used for children less than 2 years old and BMI is used for children over 2 years old.
- Use the 2006 WHO standards (endorsed by the CDC) for infants up to 2 years of age who are measured supine for length.
- Use the CDC 2000 growth reference charts for children and adolescents (age 2-20 years) who should be measured standing for height.
- We recommend caution when using disease-specific growth charts. These charts are mostly descriptive of growth in populations with high risk for nutrition disorders such as growth faltering or obesity.
- We recommend against using the growth charts for cerebral palsy (CP) due to the high prevalence of malnutrition among patients with CP and recommend adjusting BMI or weight for length goals (aim for the 5th - 10th percentile) and taking into consideration body composition.
- Similarly, genetic conditions specific growth charts should be interpreted with caution as growth deceleration can be due to a combination of feeding problems and comorbid conditions associated with the syndrome in addition to the phenotypic-genotypic profile.
- Some of the well-studied genetic growth charts include the 2015 Down syndrome charts⁴, Turner and Noonan charts. In our practice we use them for guidance in monitoring linear growth. In many other conditions it is reasonable to use the WHO or CDC growth chart depending on the child's age and adjusting growth goals based on the clinical scenario. For example, it is not reasonable to aim for over 90% of ideal body weight for patients with Russell-Silver Syndrome and 75-85% of ideal body weight is considered appropriate per society guidelines³.
- For premature infants, use the Fenton growth chart until 50 weeks corrected gestational age, then use the WHO/CDC charts with age corrected for prematurity until 3 years of age.
- For infants, determine if the patient is Appropriate for Gestational Age (AGA), Small for Gestational Age (SGA), or Large for Gestational Age (LGA). SGA status is defined as birthweight for gestational age less than the 10th percentile. LGA is defined as birthweight for gestational age greater than the 90th percentile. AGA is defined as birth weight for gestational age between the 10-90th percentile.

Severe malnutrition (marasmus) is defined as weight for length or BMI Z-score less than -3, or patient's weight less than 70% of the ideal body weight (median reference value). **Kwashiorkor (AKA edematous malnutrition)** is defined by the presence of symmetrical edema. Marasmus and Kwashiorkor commonly coexist and a simple unified approach to clinical management can be applied to both^{5, 6}.

Moderate malnutrition is defined as weight for length or BMI Z-score between -2 to -2.9, or patient weight at 70-80% of ideal body weight.

Mild malnutrition is defined as weight for length or BMI Z-score between -1 to -1.9 or patient weight at 80-90 % of the ideal body weight. Most of the time, mild malnutrition can be managed in the outpatient setting.

SEVERITY ASSESSMENT^{1, 2}

Table 1

	Moderate Malnutrition	Severe Malnutrition														
BMI- for age or Weight-for-Length z-score	-2 to -2.9	-3 or less														
Waterlow Criteria % Ideal body weight	70-79.9%	<70%														
Length/height for age z-score	No data but z score less than -2 suggests stunting	-3 or less														
Mid upper arm circumference (MUAC) z-score *	-2 to -2.9	-3 or less														
WHO MUAC 6-59 months	115-124 mm	<115mm														
% weight loss of usual body weight (for patients greater than 2 years of age)	7.5%	≥10%														
Weight gain velocity (0- 2 years of age, g/day)	<50% of norm for expected weight gain	<25% of norm for expected weight gain														
<table border="1"> <thead> <tr> <th>Age (months)</th> <th>Grams/day</th> </tr> </thead> <tbody> <tr> <td>0-3</td> <td>20-30</td> </tr> <tr> <td>3-6</td> <td>15-20</td> </tr> <tr> <td>6-9</td> <td>10-15</td> </tr> <tr> <td>9-12</td> <td>10</td> </tr> <tr> <td>12-18</td> <td>6</td> </tr> <tr> <td>18-24</td> <td>6</td> </tr> </tbody> </table>			Age (months)	Grams/day	0-3	20-30	3-6	15-20	6-9	10-15	9-12	10	12-18	6	18-24	6
Age (months)			Grams/day													
0-3			20-30													
3-6			15-20													
6-9			10-15													
9-12			10													
12-18	6															
18-24	6															
Symmetric Edema	Presence of bilateral edema without other etiology is indicative of severe malnutrition (Kwashiorkor) and masks weight loss.															
Malnutrition in adults is not included in the scope of this pathway. We recommend evaluation for malnutrition in patients 22 years or older with BMI under 18.5 kg/m ² .																

Please refer to [Table 1](#) for Nutrition Status Assessment. Please take into consideration the following points:

- The **bolded** criteria in [Table 1](#) are the validated WHO criteria for malnutrition.
- MUAC is included in the WHO criteria to evaluate the risk of mortality due to malnutrition and determine the urgency for admission by a non-health professional. **We do not use it routinely in our practice.** The WHO 2007 reference is used for 3-60 months. For patients 5-19 years of age, there are multiple data sets (CDC and Frisncho reference) and there is a lack of consensus on the most appropriate measure for this age group.
- Consider requesting triceps skinfold measurements from RD for patients with altered body composition (for example, low muscle mass).
- Epic and most EHR calculate Z scores for weight, length or height, weight for length and BMI. Electronic applications such as Peditools can be used as well.
- When indicators (assessment tools) endorse different levels of severity, it is recommended to use the highest severity indicator to assure adequate intervention and monitoring. Physical exam can help in severity assessment and risk for micronutrient deficiencies (rash, neurological findings..)
- **Differentiate between acute vs chronic malnutrition** (note: it may be acute on chronic). Acute malnutrition is less than 3 months and chronic is greater than 3 months. The presence of linear stunting may be indicative of chronic malnutrition. Please see section below regarding patients with short stature.

Special considerations for infants less than 6 months of age:

The severity of malnutrition in infants less than 6 months of age can be assessed by wasting, weight gain velocity in addition to the above guideline. We consider malnutrition severe in infants < 75% ideal body weight; weight/length Z score < -2.5. Also exam consistent with severe wasting or cachexia is an indicator. Infants who do not gain their bwt by

2 weeks of age deserve close follow-up. Please note a MUAC <110 mm is highly associated with mortality in this age group, however MUAC is not one of the diagnostic criteria for malnutrition in this age group.^{7, 8}

INDICATIONS FOR ADMISSION

Most patients with malnutrition can be managed in the outpatient setting.⁹ **Providers in primary care are encouraged to call CHCO Nutrition Clinic (formerly known as the Growth and Parenting Clinic /GAP) and communicate with Nutrition MD on call when considering hospital admission for malnutrition. Medical providers can call One Call at 720-777-3999 to reach Nutrition MD on call.**

Admission is indicated for¹⁰:

1. Patients with edematous malnutrition and patients with marasmus
2. Physical findings suspicious for nutritional deficiency, dermatitis, eye findings, new onset neurologic deficits (e.g. Zinc, kwashiorkor, pellagra)
3. Patients with serious intercurrent infections
4. When patient safety is in question.
5. When the coordination of disciplines or diagnostic procedures is necessary and requires expedition in the inpatient setting
6. When initiation of tube feeding is considered

Admission should be considered¹⁰:

1. All patients with severe non-edematous malnutrition
2. If no improvement after 2-3 months of intensive outpatient management (Please consider referral to Nutrition Clinic before referring for direct admission)
3. Social concerns and/or need for intensive teaching

Consider PICU admission if¹¹:

1. Patient has signs of critical malnutrition such as bradycardia, hypothermia, severe dehydration, or altered mental status.
2. Patient has severe electrolyte disturbances secondary to re-feeding syndrome.

INITIAL EVALUATION

History

Diet history:

- For children under 3 years ask about breastfeeding history
- For formula fed infants: list all used formulas and ask parents to explain how they mix it.
- Recommend assessing tolerance and acceptance of age-appropriate diet
- Assess consumption of foods from each food group: fruit, vegetables, whole grains, healthy fats, meat, dairy, or appropriate dairy alternative
- Assess beverage consumption:
 - Type: Milk, Oral nutritional supplements (Pediasure, Boost, ..) Juice, soda ..
 - Volume and if taken with meals or outside meal time
- Determine frequency and duration of meals/snacks
- Assess grazing patterns/behaviors
- Inquire about feeding environment
- Consider obtaining a 24-hour diet recall of food and beverages
- Does patient take any vitamins/minerals/or any type of supplements
- Make sure to assess for food insecurity

Review of system (ROS) and physical exam (PE) :

The goals of ROS and PE are:

- 1) identification of chronic illnesses, GI history (diarrhea, vomiting)
- 2) recognition of syndromes that can affect growth
- 3) documentation of the effects of malnutrition such as the presence of visible subcutaneous fat stores vs wasting.
- 4) Identification of symptoms and signs that can be suggestive of micronutrient deficiencies (rash, neurological findings..)

Laboratory evaluation should be guided by the history, PE, ROS:

Diagnostic tests and studies to be considered in patients with malnutrition in both the inpatient and outpatient settings:

- a. CBC with differential and red cell indices (strongly recommended due to the risk of anemia and possible clues for micronutrient deficiencies)
- b. Comprehensive Metabolic Panel (sodium, potassium, chloride, bicarbonate, blood urea nitrogen (BUN), creatinine, glucose, calcium, albumin, total protein, bilirubin, alkaline phosphatase, alanine aminotransferase (ALT), aspartate aminotransferase (AST))
- c. Inflammatory markers such as erythrocyte sedimentation rate (ESR) and C reactive protein (CRP)
- d. Iron studies (Serum iron, TIBC, and transferrin) with ferritin: when obtaining Iron studies with ferritin, be sure to order an inflammatory marker (prefer a sed rate) to assist with lab interpretation

Risk Factors for Iron Deficiency¹⁰:

1. Perinatal: Prematurity, IUGR, SGA, LGA, twin, maternal diabetes, maternal obesity, immediate cord clamping, maternal anemia
 2. Milk protein allergy
 3. Chronic Proton Pump Inhibitor (PPI) or H2 acid blockers
 4. Exclusive breastfeeding without the addition of high-iron foods past 6 months of age
 5. Vegetarian and vegan diet
 6. Early cow milk and excessive cow milk intake
 7. Restricted diet, especially in patients with autism or developmental delay.
 8. Age < 24 months old
- e. **Inpatient and only when patient is at risk for refeeding syndrome:** Monitor magnesium (Mg), phosphorus (Phos), and potassium (K) for patients (the best way is to order a renal function panel (RFP) + Mg)
 - f. Vitamin D: we do not recommend routinely checking vitamin D level in either outpatient or in-patient setting. Risk factors for vitamin D deficiency include breastfed infant or toddler, child with dark skin, and/or very limited dietary intake or physical findings consistent with rickets (please refer to vitamin D pathway)
 - g. Inpatient: Please consult Nutrition MD if concerned about less common micronutrient deficiencies to guide the laboratory evaluation.

Additional laboratory evaluation can be considered based on consideration for special conditions as outlined in the next section.

CLINICAL MANAGEMENT^{1, 12}

Please refer to [Table 2](#) for a summary of the nutritional management and counseling in both inpatient and outpatient settings.

Key Principles:

- Goal weight should be considered individually for each patient and is not always the ideal body weight (for example, it is reasonable to aim for BMI or WL on the 5th percentile some patients such as SGA, lower muscle mass, etc..)
- **Enteral nutrition is strongly recommended over parenteral nutrition.**
- **Liquid Nutritional Supplements:**
 - Liquid Nutritional Supplements (LNS) are high calorie and protein drinks that are fortified with vitamins and minerals. They can have an intact protein (PediaSure, Boost, Nutren..) or can be hydrolyzed (Peptaman, PediaSure Peptide..). they can also be food based (Compleat, Kate Farms..).
 - LNS can be highly effective in the treatment of malnutrition when parents are provided guidance on daily volume and when and how to offer the supplement. LNS however do not replace therapy for micronutrient deficiencies.
 - When starting an LNS, establish a target goal weight for when to stop. Chronic prolonged use beyond the needed time to treat PEM can lead to obesity and adiposity.
 - When choosing a supplement, consider price, availability, the child preference and the presence of any intolerance or food sensitivities.
 - Not all LNS are nutritionally complete including some of the formulas that are used in tube feeding. We recommend consulting the Nutrition Team when choosing an LNS for tube feeding and for a child with a limited intake of food.

Table 2: Nutrition and feeding planning for both inpatient and outpatient settings

	Infants (0-12 months)	Children 12-59 months (1-5 years)	Children 5-18 years of age
Formula/ Food	<ul style="list-style-type: none"> • Breast Milk or Infant Formula • If a patient has a volume tolerance issue, consider concentrating feeds up to 24 kcal/ounce • Fortification Recipes: <ul style="list-style-type: none"> ○ Reference CHCO Nutrition Handouts for Fortifying Breast Milk and Formula (Patient Handouts--> Formula and Breastmilk Mixing Instructions) ○ Ensure fortification occurs with infant formula (NOT rice cereal) • If patient is breast feeding, assess adequacy of maternal milk supply through pumping history and pre and post prandial weight • For infants>6 months old 	<ul style="list-style-type: none"> • Diet of appropriate texture. Consider SLP/OT input for patients with special needs requiring texture modification or feeding assistance • Recommend a varied diet with foods from a variety of food groups (protein, fruit, vegetables, whole grains, healthy fats, dairy or appropriate dairy alternative) • Provide LNS in addition to meals/snacks if patient is not able to consume sufficient calories in meals/snacks alone <p>Meal Planning:</p> <ul style="list-style-type: none"> • Meals: 4-5 hands of food (child's hand) from different food groups+ 2-3 oz of a nutritious drink (milk, appropriate milk alternative, oral supplement) from a cup • Scheduled snacks 2-3 hands of food + nutritious drink in a cup 	<ul style="list-style-type: none"> • Regular, varied diet with foods from a variety of food groups (protein, fruit, vegetables, whole grains, healthy fats, dairy or appropriate dairy alternative) • Provide LNS with meals • The recommended volume of LNS varies depending on the child's oral skills and preference. Consider using concentrated oral nutritional supplements such as Boost 1.5 or Nutren 2.0 for patients who dislike the taste and prefer a smaller volume

	include complimentary food that is high in calorie and protein if developmentally ready		
Schedule	<ul style="list-style-type: none"> Recommend feeding every 2-3 hours (with the exception of breastfeeding infants younger than 3 months of age who may nurse every 1-3 hours) For infants older than 3 months of age, avoid feeding more frequently than every 2 hours (grazing), as this often contributes to a disconnect with patient's hunger and satiety cues, leading to decreased intake overall Limit total oral feeding time to 30 minutes maximum. The need for night feeding needs to be decided on a case-by-case basis depends on the patient's age, feeding method (breast of formula) and the risk for hypoglycemia 	<ul style="list-style-type: none"> Children need to eat 3 meals and 2-3 <u>scheduled</u> snacks per day Allow 2-3 hours before lunch and before dinner with no snacks to maximize hunger at mealtime. Milk and LNS should be provided at the table or highchair with meals. Make sure to ask about and counsel against having a sippy cup with milk available all the time Having a regular bedtime is essential to improve eating during the day Do not provide bottle or sippy cup overnight Limit meals to 30 minutes. 	<ul style="list-style-type: none"> Offer 3 meals with 2-3 snacks on a consistent schedule Avoid grazing throughout the day. This includes LNS and calorie containing beverages Limit meals to 30 minutes
Feeding environment	<ul style="list-style-type: none"> Feed in a calm, supportive position If patient experiences reflux, keep patient upright after feed for 15-30 minutes Ensure that POC stop feeding when patient signals that they are finished. It is important to make sure POC provide comfort for patients in other ways than feeding 	<ul style="list-style-type: none"> Provide meal with patient seated at highchair or at a table Ensure the environment is distraction free Avoid "on the go" meals and snacks if they are outside of the scheduled meal/snack times 	<ul style="list-style-type: none"> Provide meal with patient seated at table with the family Discourage eating in the bedroom Ensure the environment is distraction free
Additional points for inpatients	<ul style="list-style-type: none"> Please discuss Enteral Formulary options with RD for CHCO provided formula When making recommendations for pre and post prandial weights (if indicated), aim for 24 hours to better assess human milk transfer. Please work with RD, lactation consultants, 	<ul style="list-style-type: none"> Please discuss LNS choice and amounts with RD Please consider OT and SLP recommendations about food texture Please reach out to RD to coordinate structured meal planning with the Dietitian Assistants. The goal of meal planning is to demonstrate 	<ul style="list-style-type: none"> Please make sure to consult RD about the choice of oral nutritional supplement Please make sure to involve the patient with meal planning Calorie count may

	<p>and bedside RN</p> <ul style="list-style-type: none"> • Calorie count may not be needed in this group since most of the consumed calories are in liquid form • Strict Is & Os 	<p>proper portion sizes and support a schedule for patients/family</p> <ul style="list-style-type: none"> • Please make sure to order calorie count to quantify PO intake, especially if patient is at a refeeding risk • Communicate to RN to bring in high chair, remove tray after 30 minutes, and to turn off screens in the room at meal time. • Strict Is & Os 	<p>be needed to quantify oral intake</p> <ul style="list-style-type: none"> • Strict Is & Os
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OUTPATIENT

Energy Needs:

- Energy needs should be taken into consideration when managing patients with malnutrition. The medical provider may have a targeted caloric intake in mind, but we often do not recommend setting a calorie goal with families as it may lead to intrusive feeding and anxiety. Goal setting with families should be focused on offering age-appropriate portions of food/formula on a structured schedule and in a calm and healthy atmosphere. Please refer to [Table 3](#) for the recommended RDA for caloric intake.

Table 3 : Approximate energy needs based on age

Age	Range of energy needs (Kcal/kg/day)
Preterm	110-130
Term 0-6 months	90-120
7-12 months	90-120
1-3 years	75-100
4-6 years	65-90
7-10 years	55-70
11-14 years	40-55
15-18 years, males	40-55
15-18 years, females	30-40
Adult	25-35

Oral Feeding and tube feeding:

- In children with age-appropriate oral feeding skills we recommend limiting caloric provision from an LNS to 30-40% of estimated needs (about 30-40 mL per kg for children under 5 years of age). The supplement should be provided in small amounts (2-4 ounces) with meals. This strategy will encourage intake of age-appropriate food.
- Children with sensory difficulties and delayed oral skills may need to consume a larger percentage of calories from an LNS. Please make sure to use a complete oral nutritional supplement for this group of patients (caloric needs should be considered when recommending an amount).
- Tube feeding should be considered if a patient is taking less than 70% of the caloric target orally. To initiate tube feeding we recommend a hospital admission. If a patient is on tube feeding and is malnourished, the provider

should use a precise calculation of caloric provision and consider referral to Nutrition Clinic for outpatient nutrition support/follow up.

Goals and monitoring:

- The accepted goal for catch up growth is 150% of the average weight gain for age (see [Table 1](#))
- We recommend weekly or monthly monitoring depending on the severity of malnutrition and the family's need for support.

INPATIENT:

For patients admitted to the hospital for malnutrition, refer to outpatient management (above) and escalations needed (below):

1. Multidisciplinary Approach:
 - Ensure a Registered Dietitian is performing a nutrition assessment* **and that the medical team notifies the dietitian prior to discharge.**
 - Please note: many patients with growth faltering screen at high nutrition risk which triggers a nutrition assessment. If you are doubtful of RD involvement, place a nutrition consult and RD will see the patient within 24 hours.
 - Consider collaborating with the following teams, when applicable: **Nutrition MD for all severe and complex cases of malnutrition**, social work, occupational and speech therapists, case management, and lactation consultants when applicable.¹³
2. Dehydration and Fluid Requirements:
 - Due to fluid and electrolyte shifts in malnourished children, enteral hydration (oral or via nasogastric tube) is preferred over IV hydration except in cases of hemodynamic instability (hypotension., tachycardia, etc). Use standard pediatric electrolyte solutions.(such as Pedialyte).The recommended rate for rehydration is 5-10 mL/kg/hour for 2-12 hours. Continuous assessment is needed to change rate to maintenance.¹
 - IV hydration should only be used in patients with hemodynamic instability: Refer to [Intravenous Fluid Therapy Pathway](#). Ensure slow initiation and advancement of IV rehydration in patients with malnutrition. Patients with malnutrition are at increased risk of fluid overload (including the development of heart failure) and third spacing.
 - Fluid requirements: as appropriate for age. For edematous malnutrition, keep fluids at or less than maintenance.
3. Energy needs: **Be sure to collaborate with the dietitian when making a nutrition plan.**
 - Please refer to [Table 2](#) for energy needs based on Recommended Daily Allowance (RDA) for age.
 - For patients at risk of refeeding syndrome start at 50-80 % of their caloric RDA based on actual weight. Aim for catch up growth and base calculation on ideal body weight when they are no longer at risk for refeeding syndrome.
 - The calculation of ideal body weight is explained in the appendix The calculations below can be used in consultation with the registered dietitian (RD).
- Method #1¹⁴
 - Step 1: Calculate the ideal body weight as explained in the appendix
 - Step 2: Give the estimated calorie needs for age based on ideal body weight (not actual weight/sufficient for weight gain)
 - Example: a child with severe malnutrition weighs 10 kg, ideal body weight is 14 kg. Based on RDA 100 kcal per kg per day, caloric goal for catch up growth is 1400 kcal per day not 1000 kcal per day

- Method #2
 - Consider the total weight deficit and the amount of time desired to achieve an acceptable weight goal for discharge (can be 80% of ideal body weight)
 - The energy cost of each gram of new growth is 5 Kcal¹⁵
 - Patients older than 2: *Extra Kcal/kg/day needed*= [weight deficit (g) x5 kcal/g] / days to correct
 - Example: a child with severe malnutrition weighs 10 kg, ideal body weight is 14 kg. Goal for discharge is 11 kg. You are basing your calculation on RDA of 100 kcal per kg per day
 1. 100 kcal per kg per day= 1000 kcal
 2. Caloric deficit for goal of 11 kg = 1000 g * 5 kcal/g = 5000 kcal
 3. To provide the additional 5000 kcal over 2 weeks: 5000/14days = 357 kcal *extra* per day
 4. Total calorie needed = 1357 kcal per day
- 4. Advancing nutrition in the setting of [refeeding syndrome](#)
 - When there is concern for refeeding syndrome, initiate nutrition at 50-80% of estimated caloric needs for current weight and advance slowly by 10-20% per day to caloric goal IF electrolytes are stable.
 - Patients on oral feeds who are at risk for refeeding syndrome may transition to PO ad lib once tolerating full caloric goal.
 - Once the patient is stable and is no longer at risk of refeeding, there is no need to restrict intake. It is normal for patients recovering from malnutrition to consume over 200% of RDA for age.
 - For patients at risk for refeeding, it is often easier to establish nutrition with LNS paired with a calorie count to quantify meals/snacks (if applicable). It is also often better tolerated in cases of severe malnutrition due to the slower gastric and intestinal motility.
- 5. Monitoring and goals:
 - Daily weight: in the morning, pre-prandial, post-void on appropriate scale (infant scale or standing scale)
 - Monitor average weight gain over 2-5 days. Daily fluctuations in weight may be due to fluid shifts and scale variations, so it is recommended to evaluate trends.
 - Infant weight gain is much easier to monitor than adolescent weight gain. In older patients, it may take a few days (3-5 days) to see weight trends, so please be mindful in setting expectations for inpatient weight gain.
 - Accepted goal for catch up growth is 150% of the average weight gain for age.¹⁴
 - Calorie goals will require adjustments based on how well the patient is gaining weight. Some patients with severe malnutrition may require very high caloric intake to initiate weight gain. It may take 2-14 days to initiate catch up growth, depending on severity of malnutrition
 - Recommend weekly length and head circumference (for patients <2 years old) Please obtain infant lengths on length board. Weekly height for patients > 2 years old.
 - Recommend a 3 to 5-day calorie count for patients consuming significant calories from solids or purees (for exclusively formula fed patients, can use I/O flow sheet to track calories)

MICRONUTRIENTS:

- Iron and Zinc are the most common micronutrient deficiencies in patients with PEM. Thiamine is depleted in patients with severe PEM and requires repletion only in inpatient settings.
- A detailed diet history is essential to assess additional micronutrient deficiencies. We strongly recommend referral to Nutrition Clinic for patients on a restricted diet (vegan or vegetarian diet, limited acceptance of food due to ASD..)
- For indications and dosing of micronutrients, please refer to [Table 4](#)

Table 4. Most Common Micronutrient Deficiencies Associated with PEM:

Medication	Recommended Dose	Indications for Use	Clinical Pearls
Zinc⁷	PO: 1 mg/kg/day elemental zinc divided 1-3 times/day for 1 month. Adult dose: 50 mg three times daily for 1 month.	Over 6 months of age. Zinc supplementation should be initiated empirically for any patient with malnutrition.	Larger doses may be needed with impaired absorption or excessive loss of zinc in the intestines. Treat for 1 month
Iron¹⁰	PO: 3-6 mg/kg/day elemental iron divided 1-4 times daily for 2-3 months. Adult dose: 300 mg given 2-4 times daily or 250 mg (extended release) 1-2 times daily for 2-3 months.	Initiate when ferritin is less than 20 with no inflammation (not for use during acute phase of illness)	Separate from other supplements by 1-2 hours for maximal absorption. Treat for 2 months then recheck CBC , iron studies, ferritin and sed rate.
Vitamin D	Age 0-9: 25(OH)D Level <ul style="list-style-type: none"> • <10 ng/mL: 50 mcg • 10 to 20 ng/mL: 25 mcg • 20 to 30 ng/mL: 10-20 mcg 	Refer to Vitamin D Deficiency Clinical Pathway for details.	
	Age 10-18: <ul style="list-style-type: none"> • 25(OH)D<10 ng/mL: 100 • 10 to 20 ng/mL: 50 mcg • 20 to 30 ng/mL: 20 mcg 		
Thiamine [inpatient]	IM/IV: 10-25 mg/dose daily PO: 10-50 mg/dose orally every day for 2 weeks, then 5-10 mg/dose orally daily for 1 month	Initiate thiamine for all patients with severe malnutrition at risk for refeeding syndrome	Give thiamine IV/IM for critically ill patients with malnutrition.

REFEEDING SYNDROME (INPATIENT)¹⁶

Risk factors

The following risk factors were developed by the National Institute for Health and Care Excellence (NICE) in England and Wales for adults, we recommend taking them into consideration when managing pediatric patients.

Patients are at risk for refeeding syndrome if they have one or more of the following:

- Severe malnutrition (marasmus or kwashiorkor)
- Weight loss $\geq 15\%$ in the past three to six months.
- Little or no nutritional intake for >10 days.
- Low levels of potassium, phosphate, or magnesium before feeding

Patients are at risk for refeeding syndrome if they have two or more of the following:

- Moderate malnutrition
- Weight loss $\geq 10\%$ in the past three to six months
- Little or no nutritional intake for ≥ 5 days
- History of alcohol misuse or drugs, including insulin, chemotherapy, antacids, or diuretics

Pathophysiology and Features

During refeeding, increased glucose levels lead to increased insulin and decreased secretion of glucagon. Insulin stimulates the absorption of potassium into the cells through the sodium-potassium ATPase symporter, which also transports glucose into the cells. Magnesium and phosphate are also taken up into the cells. Water follows by osmosis. These processes result in a decrease in the serum levels of phosphate, potassium, and magnesium, all of which are already depleted. The clinical features of the refeeding syndrome occur because of the functional deficits of these electrolytes and water retention (congestive cardiac failure, pulmonary edema, and cardiac arrhythmia).

Prevention and Monitoring

- Gradual feed advance and avoidance of aggressive hydration are keys to preventing refeeding syndrome.
- Please note that 1) IV Dextrose is a more potent precipitant of refeeding syndrome than enteral but 2) If a patient has acute hypoglycemia, please DO use IV dextrose for treatment..
- Empiric Thiamine supplementation (thiamine is an important cofactor in carbohydrate metabolism and is depleted in patients with PEM)
- Check refeeding labs (magnesium, potassium, phosphorus) once or twice a day for at least 4 days. The risk of refeeding syndrome is minimal after 4 days of feeding.

Treatment

- When electrolyte abnormalities occur (ie low Phos, K, and/or Mg), do not advance the feed. Correct the abnormalities and check electrolytes at least twice daily.
- Once electrolytes are stable in the normal range, even with a modest amount of electrolyte supplementation, the caloric advance can be resumed.
- For enteral dosing recommendations, refer to [Table 5](#).

Table 5. Enteral Electrolyte Replacement

Note: Discuss need for dose reduction with pharmacy in the setting of renal insufficiency

Electrolyte	Enteral Dosing Recommendations	Clinical Pearls	Formulations
Phosphorus	2-3 mMol/kg/day divided three or four times daily. Adult dose: 50-150 mMol/day divided three or four times daily.	1 mmol =31 mg Enteral phosphorus replacement can be given as a sodium salt, potassium salt, or a combination of both salt forms	K-phos neutral: 8 mmol phos, 13 mEq Na, 1.1 mEq K per tab Phos-NaK powder: 8 mmol phos, 6.9 mEq Na, 7.1 mEq K per packet Sodium Phosphate: 3 mmol phos, 4 mEq Na per mL Potassium Phosphate: 3 mmol phos, 4.4 mEq K per mL
Magnesium	PO: 10-20 mg/kg/dose elemental magnesium 4 times/day Adult dose: 300 mg elemental magnesium 4 times daily	Separate from phosphorus supplementation 1-2 hours to ensure maximal absorption. May cause diarrhea.	Magnesium Oxide 140 mg cap= 84.5 mg elemental Magnesium, Magnesium Hydroxide 500 mg elemental magnesium per 15 mL, Magnesium Gluconate 54 mg elemental magnesium per 5 mL
Potassium	PO: 2-5 mEq/kg/day in 2-4 divided doses Adult: 40-100 mEq/day in 2-4 divided doses	Liquid formulations should be diluted to minimize gastric irritation. Take tabs/caps with a full	Potassium Chloride liquid: 20 mEq/15 mL (10%) or 40 mEq/15 mL (20%) KCL Extended Release Caps: 8 or 10 mEq caps (also available in sprinkle cap)

		glass of water. Max single dose: 20-25 mEq	KCL Extended Release Tabs: 8, 10, 15, or 20 mEq tabs
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ADDITIONAL EVALUATION AND CONSIDERATION FOR CONSULTS OR REFERRALS:

Nutrition MD

Anschutz:

- Outpatient: Nutrition Clinic accepts referrals for patients with any degree of malnutrition. Primary care physicians are also encouraged to communicate with the Nutrition MD on call when considering admission to see if an expedited clinic appointment is an option.
- Inpatient: Consult Nutrition M.D. in all cases of severe edematous malnutrition (Kwashiorkor), and for patients on highly restrictive or unusual diets with possible micronutrient deficiencies.
- If patient is established with GI at Anschutz or the Network of Care, please reach out to the GI team in both inpatient and outpatient settings. However, Nutrition MD can still be consulted to manage the severe and edematous malnutrition and for patients on highly restrictive or unusual diets with possible micronutrient deficiencies.

Colorado Springs:

- Outpatient: Primary care providers in the outpatient settings are encouraged to refer patients with malnutrition to our Nutrition outpatient clinic especially if they require extensive nutritional counseling or if there are concerns about micronutrient deficiencies. If the patient is already established with the Gastrointestinal (GI) team, they will oversee the evaluation and management with the support of a dietitian.
- Inpatient: The GI team in Colorado Springs is currently managing all consults for patients with malnutrition.

Social Work¹⁷

- Social work must be notified when there is a concern for the child's safety or neglect is suspected. Social work and patient navigators can also assist with resources when food insecurity and poverty are identified.

Endocrine¹⁸

- When considering endocrine etiologies for poor growth, please assess linear growth. Short stature (stunting) is defined as length or height z score less than -2. Severe stunting is defined as Z score less than -3
- Please take into consideration family history, parents' height, parents' puberty history, and being small for gestational age when evaluating linear growth.
- For patients with short stature or deceleration in linear growth, the following preliminary work up can be considered: CBC, iron studies, ESR, CRP, TSH, celiac screen (TTG-IgA and IgA), IgF1 and IgF binding protein 3, and a bone age
- Short stature is potentially due to malnutrition when associated with weight for length or BMI z score less than -2.
- Consultation with endo should be considered in patients with abnormal linear growth velocity or short stature with normal weight for length/BMI.

Genetics¹⁹

Consider inborn errors of metabolism and genetic conditions in patients with malnutrition and²⁰:

- History of acute life-threatening symptoms like ketoacidosis and hypoglycemia
- Recurrent attacks of vomiting, lethargy, and diarrhea

- Liver dysfunction (however please note that liver enzymes can be elevated due to malnutrition alone, as in starvation hepatitis)
- Developmental delay, hypotonia, stroke, ataxia
- Cardiomyopathy, myopathy
- Hearing loss or visual impairment
- Organomegaly
- Dysmorphic features
- Pancytopenia and recurrent infections

When concerned about a metabolic or genetic etiology, we recommend a genetics consult or referral for additional testing. Waiting for metabolic test results can lead to delay in diagnosis and genetic testing can diagnose most of the metabolic conditions where the presenting symptom is poor weight gain.

Gastroenterology

Consider a GI consult if:

- The patient has persistent/chronic diarrhea
- The patient has evidence of fat malabsorption such as greasy stools (fat droplets in toilet), floating and malodorous stools
- The patient has bloody stools and GIP is negative for infectious etiology
- The patient has persistent reflux/vomiting, feeding difficulty (dysphagia, food impaction), limitation in intake due to feeding difficulty
- The patient has chronic/difficult to manage constipation
- The patient has evidence of liver disease (jaundice, elevated LFTs, abnormal clotting, cholestasis, etc.)
- In Colorado Springs: Please consult GI if a patient requires placement of an NGT or G-tube, if patient is meeting criteria listed above for inpatient nutrition consultation or is already established with CHCO GI.

Labs to consider based on physical exam, history, and family history:

- Celiac screen (TTG IgA and total IgA level)
- IgE Allergy testing (IgE and Pediatric allergen panel with appropriate additions)
- Fecal fat (qualitative) and fecal elastase (can't be done on liquid stool). (Fecal fat is best done with an experienced provider at a microscope to evaluate for increases in neutral and split fat that would indicate concerns for pancreatic disease. Consider repeating after 6 months of age if concerns persist.)
- Occult blood +/- fecal calprotectin (if concerned for IBD)
- Osmolality and stool electrolytes (if looking for congenital diarrhea).
- GI consultant will determine if Upper GI +/- small bowel follow through or Upper Endoscopy +/- Colonoscopy are indicated

Renal:

Renal tubular acidosis is a rare cause of PEM and presents as a non-anion gap metabolic acidosis in a patient without diarrhea. Prior to consulting nephrology, please use a venous blood gas to determine serum bicarbonate concentration²¹. If acidosis is confirmed on VBG and the patient does not have an anion gap or diarrhea, consider consulting nephrology for suspected RTA.

Adolescent Medicine:

Please consult Adolescent Medicine if there is any suspicion of an eating disorder.

DISCHARGE

Literature review did not yield evidence-based criteria for discharge readiness. It is our group consensus to consider the following factors in addition to the patient demonstrating consistent weight gain in the hospital for 2-3 days

- Caregivers should demonstrate the ability to provide responsive feeding and understanding of hunger and satiety cues.
- Caregivers should demonstrate mastery of preparing formula using the teach-back method.
- Consider room-in for 24 hours (especially for new tube feeding) where caregivers provide all feeds with no assistance from staff when there is concern about caregiver ability to follow plan.
- Please make sure that the home feeding plan on discharge instructions aligns with the recommendations from the nutrition team (RD or Nutrition MD)
- Follow up is planned with either CHCO Nutrition Clinic, PCP, or GI within one week from discharge. Consider weekly weight checks with PCP until growth goals are met.
- For patients treated for severe malnutrition or new tube feeding, we strongly recommend referral to Nutrition clinic for management post-discharge. Inpatient team to communicate referral details with PCP.
- In Colorado Springs, patients established with GI (before or during the hospitalization) or with a new tube should follow up with GI clinic.

RELATED DOCUMENTS

- [Vitamin D Deficiency Clinical Pathway](#)
- [Intravenous Fluid Therapy clinical pathway](#)
- [Nutrition Screening, Assessment, and Reassessment Policy](#)
- [Naso/Orogastic Tubes: Education for Outpatient Nasogastric Tube Placement](#)
- [Parent/Family Nutrition Handouts](#)

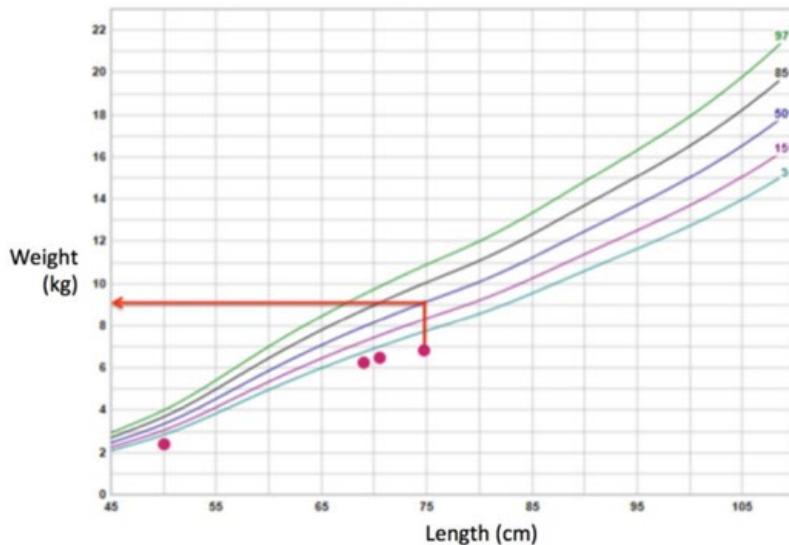
OUTCOME MEASURES:

1. Increased communication between community providers and the Nutrition Clinic leading to decreased rate of hospital admission
2. Documentation of severity in the problem list
3. Use of pathway in both inpatient and outpatient settings
4. Reduced use of the term: Failure to Thrive

APPENDIX A: CALCULATING IDEAL BODY WEIGHT (IBW)

Figure 1.1

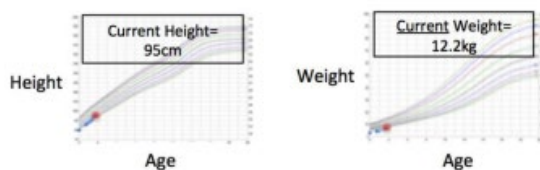
Calculating % of Ideal Body Weight from a Weight-For-Length Curve (Birth-23mo)



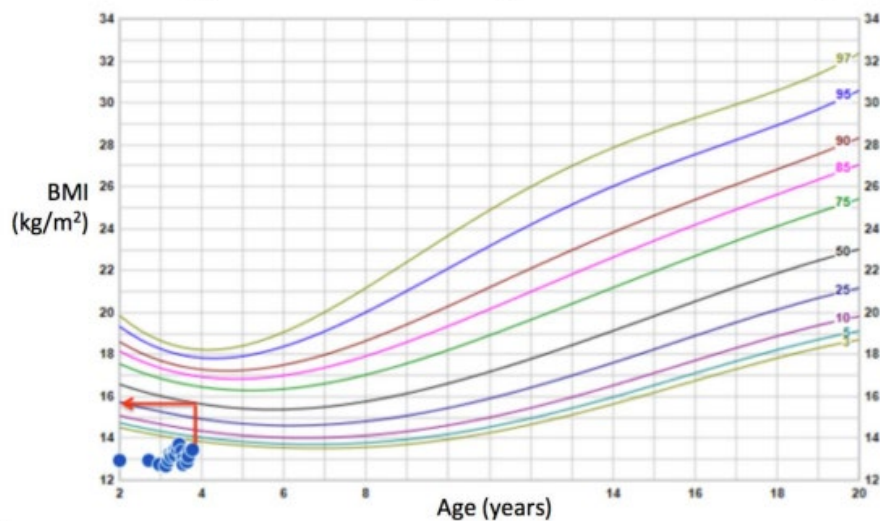
STEP 1: Using the weight for length curve, find the 50th%ile weight for your point of interest by drawing a line vertically until it hits the 50th%ile. Then look across to the y-axis to see what weight this corresponds to (arrow). This is your IBW. Here, IBW= 9kg

STEP 2: Divide current weight by IBW x 100= % of ideal body weight. Here, Current (6.8kg) /IBW (9kg) x 100 = 76% of IBW

Figure 1.2



Calculating % of Ideal Body Weight from a BMI Curve (≥2yo)



STEP 1: Using the BMI curve, find the 50th%ile BMI for your point of interest by drawing a line vertically until it hits the 50th%ile. Then look across to the y-axis to see what BMI this corresponds to (arrow). This is your ideal (median) BMI. Here, the ideal BMI= 15.7kg/m²

STEP 2: Use the BMI equation: $BMI = Wt(kg)/Ht^2 (m)$ to solve for weight (this will be your IBW). Use the 50th%ile BMI from Step 1 for the BMI term and find the Height from the same day as your selected point (convert the height to meters and square it). Here, current height= 95cm = 0.95m = 0.9025m² . So: 50th%ile BMI (15.7kg/m²) = IBW / Height (0.9025m²). $IBW = 15.7kg/m^2 \times 0.9025m^2$. $IBW = 14.2kg$.

STEP 3: Divide current weight by ideal body weight x 100= % of Ideal Body Weight. Here, Current (12.2kg)/IBW (14.2kg) x 100 = 86% of IBW

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APPROVALS

Clinical Pathway and Measures Committee – September 26, 2022
 Pharmacy & Therapeutics Committee – October 6, 2022

MANUAL/DEPARTMENT	Clinical Care Guidelines/Quality
ORIGINATION DATE	March 9, 2017
LAST DATE OF REVIEW OR REVISION	September 26, 2022
COLORADO SPRINGS REVIEWED BY	 Michael DiStefano, MD Chief Medical Officer, Colorado Springs
APPROVED BY	 Lalit Bajaj, MD, MPH Chief Quality, Equity, and Outcomes Officer

REVIEW | REVISION SCHEDULE

Scheduled for full review on September 26, 2026

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