**What is Growth Failure?**

- Otherwise known as failure to thrive, undernutrition, malnutrition, faltering growth, or weight faltering.
- Prevalence: About 5% of US infants meet the criteria for moderate or severe malnutrition
  - Acute or chronic disorders can cause growth failure at even higher rates.¹
- Malnutrition in infants is an imbalance between nutrient requirement and intake resulting in cumulative deficits of energy, protein, or micronutrients which potentially leads to negative effects on growth, development, and clinical outcomes.² See Figure 1.

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**Figure 1. Defining Malnutrition in Hospitalized Children: Key Concepts**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>WHO MGRS (0-2 yrs)</th>
<th>CDC 2000 (2-20 yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistic Z-scores</td>
<td></td>
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**Primary Indicators of Pediatric Malnutrition When Single Data Point is Available**

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<th>Indicator</th>
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<td>Weight-for-height z score</td>
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</tr>
<tr>
<td>Mid-upper arm circumference</td>
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Nutrition Management of Infant Growth Failure

Ideal protein-energy ratio for optimal catch-up growth is 8.9-11.5%.

- At least 126 kcal/kg/d and 8.9% energy from protein (i.e. 2.8 g/kg/d) are needed to support infant growth recovery with appropriate lean to fat tissue deposition at 10 g/kg/d.
- All rates of catch-up, there will be some increase in the ratio of protein to energy requirement, over and above that appropriate to the age of the child.

Challenges with feeding infants with growth failure:

Osmolality – Modulars increase osmolality and can cause intolerance.

Nutrition Profile – Standard infant formula macronutrient distribution is not designed for infants with growth failure — these infants need higher protein:calorie ratio.

Mixing Errors – Powders and complex recipes can lead to mixing errors.

Catch-up growth may need additional protein/energy intake:

Calorie Needs for Growth Failure:

\[
\text{Kcal/kg/day} = \frac{\text{IBW (kg)} \times \text{DRI for age (DRI for age)}}{\text{Actual wt (kg)}}
\]

Protein Needs for Growth Failure:

2-3g/kg/day (illness/surgery)

Suggest Energy-Dense Formula to Manage Growth Failure

- 30 kcal/fluid ounce to support high energy needs and fluid restriction
- 2.6 g of protein/100 kcal
- Lower osmolarity (AAP suggests <400mOsm/L)
- Well-tolerated and supports growth
- Ready-to-feed sterile liquid
- Nutritionally complete
- Can be used to supplement infants consuming breastmilk

Consensus-based Pre-operative Nutrition Pathway

- Growing well-tracking birth centile
- Able to meet nutritional requirements orally
- Local team to monitor growth/feeding progress

- Not growing well (e.g., 1-2 centile below birth centile)
- CHD lesion with higher nutrition risk but drinks well
- Finishes >75% of feeds daily
- Fluid < 120 mL/kg/day

Review every 2 weeks

Step 2 growth – using an appropriate growth chart
Step 3 – how an infant is eating or drinking
Step 4 – what and how much is eaten or drunk

- Not growing (e.g., >2 centile below birth centile)
- CHD lesion with higher nutrition risk
- Requires NGT/NIT for feeding
- Fluid intake <100 mL/kg/day

Review every week

Step 2 growth – using an appropriate growth chart
Step 3 – how an infant is eating or drinking
Step 4 – what and how much is eaten or drunk

- May be fluid restricted
- Approximately 10-20% extra energy 120-150 kcal/kg (protein contributing 10-15% energy)
- Approximately 50-100% more protein (up to 4g/kg protein-check renal function)
- Breastmilk or standard infant formula in addition to 50-100% of nutrition requirements as energy/ nutrient dense infant formula or as overnight or nasogastric feeds


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