PEDIATRIC COMPLEX CARE PLATFORM
منصة رعاية الأطفال ذوي الحالات الطبية المعقدة

CLINICAL GUIDELINE · FLASH CARDS

Nutritional Assessment and Management in Children with Medical Complexity

Version 1 | Published October 2026 | Review due October 2028

OWNER
Pediatric Complex Care Platform

APPLIES TO
Pediatric patients

FORMAT
21 cards

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Intended for healthcare professionals as a clinical reference. Apply with clinical judgment and in line with local protocols.

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CARD 1

Measure growth

How do I weigh and measure this child?

Weight	Wheelchair, sitting or hoist scales, depending on mobility and positioning needs.
Height	**Standing height:** stadiometer for children who can stand upright. **Recumbent length:** length board for children who can lie straight. **Otherwise:** segmental measurements (below).

Segmental measurements: estimated stature (cm)

Measurement	Equation
Upper arm length (UAL)	$S = 4.35 \times UAL + 21.8$
Tibial length (TL)	$S = 3.26 \times TL + 30.8$
Knee height (KH)	$S = 2.69 \times KH + 24.2$

- Use to estimate stature when standing height or recumbent length cannot be obtained due to contractures, scoliosis or other physical limitations.
- Developed for children with **CP aged 0–12 years**; accuracy may vary in other populations.
- Perform using standardized techniques by trained healthcare professionals.
- Avoid using estimated stature to calculate BMI or weight-for-length when the reliability of the estimate is uncertain.

Other anthropometry

When standard anthropometry is unreliable or additional assessment is required: **MUAC**; **triceps and subscapular skinfolds**. Provide additional information about muscle and fat stores.

Body composition

Examine for **muscle wasting** and **loss of subcutaneous fat**, plus MUAC and skinfolds. **DXA** is a reference method: only when clinical assessment is difficult; not routine.

CARD 2

Interpret growth

Is this child growing well?

Growth velocity (typically developing children)

Age	Weight (g/day)	Length (cm/month)
<3 months	25–35	2.6–3.5
3–6 months	15–21	1.6–2.5
6–12 months	10–13	1.2–1.7
1–3 years	4–10	0.7–1.1
4–6 years	5–8	0.5–0.8
7–10 years	5–12	0.4–0.6

Approximate values; may not apply to all CMC.

Growth charts

- **Children aged 0–5 years:** use WHO Child Growth Standards, available on the WHO website.
- **Children aged >5 years:** use appropriate national growth references.
- **Disease-specific charts:** supplementary only; limited for identifying malnutrition.
- **Z-scores** preferred over percentiles, particularly at ≤5 years.
- **BMI or weight-for-length:** interpret cautiously in CMC; altered body composition affects reliability.
- **Growth evaluation:** use serial weight and length/height against age- and sex-appropriate growth charts; isolated measurements alone do not diagnose malnutrition. Include additional anthropometric measures when indicated.
- **MUAC, triceps and subscapular skinfolds:** reference standards available on the WHO website; interpret cautiously in CMC.

CARD 3

Take a feeding history

What do I ask about tube and oral feeding?

Tube feeding

- ✓ **Route:** gastric (GT, NGT) or post-pyloric (GJ, NJT, J-tube)
- ✓ **Feed:** commercial formula or blended diet
- ✓ **Schedule:** bolus, intermittent/cyclic or continuous
- ✓ **Intake vs requirements:** calories, protein, fiber, fluid (with dietitian)
- ✓ **Positioning** during and after feeds
- ✓ **Flushes:** frequency and volume
- ✓ **Venting:** indication, frequency, technique
- ✓ **Tolerance:** symptoms of intolerance

Oral feeding

- ✓ **72-hour intake diary:** foods, fluids, quantities, textures, consistencies, frequency, timing
- ✓ **Intake vs requirements** (with dietitian)
- ✓ **Duration/endurance:** meal time, pacing, fatigue
- ✓ **Positioning** and postural support
- ✓ **Equipment:** utensils, cups, bottles, adaptive devices
- ✓ **Oral-motor/swallowing:** skills, dysphagia, aspiration signs
- ✓ **Previous** swallow assessments and advice
- ✓ **Caregiver assistance** needed
- ✓ **Tolerance/behavior:** discomfort, refusal, mealtime stress
- ✓ **Caregiver concerns and goals**

Important: always ask about oral feeding; the child may be receiving both.

! **Warning:** absence of coughing does not exclude aspiration, particularly in neurological impairment.

CARD 4

Medical history & examination

What should I review and examine?

Anthropometry

- Weight, length/height, BMI or weight-for-length, growth trends; MUAC and skinfolds as indicated.
- Muscle wasting and loss of subcutaneous fat.

Monitoring: anthropometry at least **every 6 months**; more often in infants, malnutrition or after nutritional interventions.

System	History	Examination
Respiratory	Aspiration, recurrent pneumonia, respiratory support, choking/coughing or fatigue with oral feeds	Work of breathing, respiratory compromise
GI	GERD, vomiting, distension, constipation, diarrhea, malabsorption, dysmotility	Distension, tenderness
Genitourinary	Hydration, urine output, renal disease	Dehydration, edema
Neurological	Seizure control, tone, involuntary movements, feeding-related pain/irritability	Tone, involuntary movements
Musculoskeletal	Mobility, contractures, scoliosis	Contractures, scoliosis, positioning
Infectious	Recurrent/chronic infections	—
HEENT	Sialorrhea, oral health, swallowing	Oral/dental health, oral-motor dysfunction
Skin	Pressure injuries, poor healing	Skin integrity
CVS	—	Poor peripheral perfusion

Medications: review effects on appetite, tolerance, GI function, hydration and nutrient absorption/metabolism.

CARD 5

Nutrition labs

Which tests should I consider?

Area	Tests (as clinically indicated)
Hematology	CBC, iron profile (Fe, TIBC, TSAT, transferrin) / ferritin
Electrolytes	Na, K, Cl, Ca, Mg, phosphate
Organ function	Renal function; liver biochemistry
Bone metabolism	ALP, 25-OH vitamin D ± PTH
Trace elements	Zinc, copper, selenium
Vitamins	A, E, B12, folate
Carnitine	Particularly if at risk of deficiency
Serum proteins	Albumin, prealbumin
Urine	Calcium/creatinine ratio, when indicated
Inflammation	CRP, to interpret inflammation-sensitive markers

Important considerations

- **Individualize:** not all tests are needed routinely; base on nutritional status, conditions and risk factors.
- **Frequency:** micronutrient status **annually**; more often when clinically indicated.
- Albumin and prealbumin are affected by inflammation: **do not** use alone to diagnose malnutrition.

Post-pyloric feeding: consider iron, copper, zinc, selenium, calcium, vitamin D, vitamin B12 and folic acid.

CARD 6

Red flags for malnutrition

When should I worry?

ESPGHAN warning signs: one or more

- **Physical signs** of undernutrition: decubitus ulcers, skin problems, poor peripheral circulation.
- Weight-for-age **Z-score <−2**.
- Triceps skinfold thickness **<10th centile** for age and sex.
- Mid-upper arm fat or muscle area **<10th centile**.
- **Faltering weight** and/or failure to thrive.

Any warning sign → **comprehensive nutritional assessment** with dietitian involvement.

Warning: excessive weight gain or adiposity should also prompt nutritional reassessment, particularly in nonambulatory children.

CARD 7

Resting energy expenditure

Which equation do I use for REE?

WHO (kcal/day)

Age	Male	Female
0–3 y	60.9W − 54	61.0W − 51
3–10 y	22.7W + 495	22.5W + 499
10–18 y	17.5W + 651	12.2W + 746

Schofield, weight and height (kcal/day)

Age	Male	Female
0–3 y	0.167W + 1517.4H − 617.6	16.25W + 1023.2H − 413.5
3–10 y	19.60W + 130.3H + 414.9	16.97W + 161.8H + 371.2
10–18 y	16.25W + 137.2H + 515.5	8.365W + 465H + 200

Schofield, weight only (kcal/day)

Age	Male	Female
0–3 y	59.51W − 30.4	58.29W − 31.05
3–10 y	22.7W + 505	20.3W + 486
10–18 y	17.7W + 659	13.4W + 693

W = weight (kg); H = height (m).

CARD 8

Calculate energy needs

How many calories does this child need?

1. Calculate **REE** (WHO or Schofield)
2. Multiply by **activity factor**
3. Start; adjust by **5–10%** and reassess

Activity factor	Functional status
1.1	Bedbound
1.2	Wheelchair-dependent
1.3	Ambulatory with motor impairment

- Children with neurological impairment often need less energy, but requirements vary considerably.
- Consider extra adjustments for muscle tone, involuntary movements, respiratory effort and support, increased expenditure and nutritional rehabilitation.
- Predictive equations are estimates; **indirect calorimetry** is preferred when available and indicated.
- Use the result as a **starting point**; adjust to clinical response and feeding tolerance.

! **Warning:** activity factors apply mainly to **neurological impairment**. In other CMC, individualize energy requirements based on nutritional status.

Formula energy density

20 kcal/oz **0.67 kcal/mL**	**22** kcal/oz **0.73 kcal/mL**	**24** kcal/oz **0.8 kcal/mL**	**27** kcal/oz **0.9 kcal/mL**	**30** kcal/oz **1.0 kcal/mL**

Daily calories = total volume × energy density. Use the manufacturer's declared composition.

CARD 9

Increase calories

The child needs more energy. What can I add?

First: increase feed volume if tolerated. If not feasible: energy-dense formula · caloric modules (MCT oil, Duocal) · concentration adjustment (dietitian) · nocturnal continuous + daytime bolus feeds.

MCT oil

Fat (medium-chain triglycerides) · ~7.7 kcal/mL (check label)

Dosing (≥2 years)

Step	Dose
Start	5 mL once daily with feeding
Titrate	+5 mL/day every 2–3 days
Target	15–20 mL/day in 2–3 feeds
Max	No universal pediatric maximum

Avoid in medium-chain fatty acid oxidation disorders, including MCAD deficiency.

Duocal

Carbohydrate + fat · ~5 kcal/g · scoops 1.2 g (≈6 kcal) / 5 g (≈25 kcal)

Dosing (≥2 years)

Step	Dose
Start	0.5 g/kg/day (~2.5 kcal/kg)
Titrate	+0.5 g/kg/day every 2–3 days
Target	1–2 g/kg/day (~5–10 kcal/kg)
Max	No universal pediatric maximum

Mix thoroughly into feeds; confirm tube compatibility and flush per protocol.

For MCT oil and Duocal

- Dosing schedules are proposed practical approaches, not established evidence-based regimens: individualize to requirements and tolerance with dietitian guidance.
- Monitor GI tolerance (diarrhea, vomiting, bloating, discomfort), weight and growth, and overall nutritional adequacy; adjust accordingly.

Energy

CARD 10

Fluid requirements

How much fluid does this child need?

Age	mL/kg/day
0–3 months	125–160
3–6 months	125–160
6–12 months	130–155
1–3 years	115–135
4–6 years	100–125
≥7 years	100–50–20 rule

Practical start: CMC with severe neurological impairment often need **75–100%** of calculated maintenance.

- **Individualize** to hydration status, losses (drooling, sweating, respiratory) and fluid restrictions; consider secretion thickness.
- Calculate **total fluid intake** from formula, oral fluids, medications and tube flushes.
- **Monitor** urine output, mucous membranes, weight trends and secretion characteristics.

CARD 11

Protein & fiber

How much protein and fiber per day?

Protein DRI (g/kg/day)

Age	g/kg/day
0–6 months	1.52*
7–12 months	1.2
1–3 years	1.05
4–8 years	0.95
9–13 years	0.95
14–18 years	0.85

*AI; others RDA. Source: Health Canada DRIs.

- CMC may be at risk of inadequate protein intake.
- Use DRIs for typically developing children.
- More protein in malnutrition, pressure injuries or catabolic states.
- Consider a **protein module** if intake is inadequate; monitor adequacy and response.

Fiber

- **≥2 years: age (years) + 5 g/day**, individualized to GI function, tolerance and fluid intake.
- **Types:** soluble (e.g., psyllium) absorbs water and softens stool; insoluble adds bulk and promotes movements. Choose by bowel symptoms and tolerance.
- Increase **gradually**; monitor distension, bloating, discomfort and stool consistency.
- Ensure adequate fluid, especially with constipation. Fiber does not replace constipation treatment.

! **Warning:** gastroparesis or intestinal pseudo-obstruction: high-fiber diets may worsen symptoms; seek specialist guidance.

CARD 12

Micronutrients

Who is at risk, and how much is needed?

- **At risk:** CMC, especially on **post-pyloric** feeds. Concerns: iron, zinc, copper, selenium, calcium, vitamin D, B12, folate.
- Compare formula composition and **actual** daily intake with age-appropriate DRIs.
- Supplement when indicated by dietary assessment, clinical risk or confirmed deficiency.

Daily DRIs (RDA / AI)

Age	Zinc	Iron	Selenium	Copper (UL)
0–6 mo	2 mg	0.27 mg	15 mcg	200 (N/A)
7–12 mo	3 mg	11 mg	20 mcg	200 (N/A)
1–3 y	3 mg	7 mg	20 mcg	340 (1,000)
4–8 y	5 mg	10 mg	30 mcg	440 (3,000)
9–13 y	8 mg	8 mg	40 mcg	700 (5,000)
14–18 y	M 11 · F 9 mg	M 11 · F 15 mg	55 mcg	890 (8,000)

Copper in mcg/day. Same values for both sexes unless shown (M/F).

Note: RDA and AI are daily intake references, **not treatment doses** for deficiency.

CARD 13

Micronutrients & inflammation

Can I trust this low level?

Micronutrient	Reported change
Zinc	−10% to −40%
Selenium	−20% to −65%
Copper	+10% to +15%
Vitamin A	−10% to −65%
Vitamin D	0% to −40%
Vitamin E	0% to −10%
Vitamin B2	−10% to −60%
Vitamin B6	0% to −70%
Vitamin B12	0% to −25%
Vitamin C	0% to −75%

- **Inflammation** can change circulating levels independent of intake or body stores.
- Interpret results **cautiously** during inflammation; check **CRP**.
- Consider **repeat testing** after inflammation resolves.

CARD 14

Calcium

How much calcium, and when to supplement?

Age	Recommended (mg/day)	Upper limit (mg/day)
0–6 months	200	Not established
7–12 months	260	Not established
1–3 years	700	2,500
4–8 years	1,000	2,500
9–18 years	1,300	3,000

Total daily **elemental** calcium from diet, enteral formulas and supplements. The upper limit is a safety threshold, not a target.

Supplementation

- ✓ Prioritize dietary and enteral sources.
- ✓ Supplement when intake is below requirements; calculate from the **deficit**.
- ✓ Divide larger doses: generally **≤500 mg elemental calcium per dose**.

! **Warning:** individualize in chronic kidney disease, hypercalcemia, hypercalciuria or nephrolithiasis.

CARD 15

Vitamin D

Maintenance, target and treatment

Maintenance

Age	IU/day
0–12 months	400
1–18 years	600
High-risk*	800–1,000

*E.g., non-ambulatory CP or long-term antiseizure medicines; count intake from formula and supplements.

25-OH vitamin D

- **≥50 nmol/L** generally adequate.
- Higher targets in selected metabolic bone disorders.

Treating nutritional deficiency

Age	Oral dose	Duration
<1 year	2,000 IU/day	6–12 weeks
1–18 years	2,000–6,000 IU/day	6–12 weeks

- Individualize dose to severity, presentation and risk factors; severe deficiency or malabsorption may need specialist-supervised higher or longer treatment.
- Recheck 25-OH D and calcium after 6–12 weeks (± phosphate, ALP, PTH), then continue maintenance with adequate calcium.

! **Warning:** upper doses are for severe deficiency or rickets. **Confirmed rickets** needs a specific protocol, generally ≥12 weeks, with adequate calcium.

CARD 16

Blended tube feeding: who?

Is this child suitable for blended feeds?

- **BTF:** blended whole foods through an enteral tube, usually a **gastrostomy**.
- **Types:** homemade or commercially prepared.
- **Reasons:** desire for whole-food nutrition, family-style meals, avoiding formula ingredients, and perceived better tolerance.

Inclusion	Exclusion
Medically stable, on gastrostomy feeds	Medical instability or acute illness
Preferably ≥1 year (specialist planning if younger)	Frequent hospitalizations
Persistent reflux-related symptoms	Significant malnutrition or recent weight loss
Needs can be met by a planned blended diet	Rapidly changing requirements

Note: decide through **shared decision-making**, with dietitian involvement for nutritional adequacy and safe administration.

CARD 17

Blended tube feeding: how?

Tube, method and caregiver readiness

Area	Recommendation
Route	Gastrostomy preferred; generally not via NG, NJ or GJ tubes.
Tube size	Prefer **≥14 Fr**; minimum 12 Fr depending on blend and tube.
Method	Bolus preferred; continuous may be considered.
Formula history	Previous formula type does not by itself determine eligibility.
Safety	Blend well, right consistency, safe administration, flush to prevent blockage.

Applies mainly to homemade blends; commercial blenderized formulas follow manufacturer instructions.

Before starting, caregivers should:

- ✓ Understand benefits, limitations and risks.
- ✓ Be willing and able to prepare and give feeds safely.
- ✓ Receive food hygiene, preparation and storage education.
- ✓ Understand nutritional adequacy and consistency.
- ✓ Have dietitian support and follow-up.
- ✓ Share in decisions about the feeding plan.

Feeding methods

CARD 18

Post-pyloric feeding: when?

Indications and contraindications

Indications

- **Severe GERD**, especially with reflux-related aspiration despite optimal therapy.
- **Gastroparesis** with inadequate intake despite medical therapy.
- **Gastric outlet obstruction** or upper GI anomaly (distal function preserved).
- **Failed gastric feeding** in critically ill children.
- **Persistent intolerance** to oral/gastric feeding.
- **PIPO:** trial when gastric feeding fails.

Contraindications

Absolute	Relative
Paralytic ileus; mechanical ileus; intestinal obstruction; perforation; NEC	Preterm; dysmotility; toxic megacolon; peritonitis; GI bleeding; high-output fistula; intractable diarrhea; immunocompromise

Oral feeding first if safe and adequate; if tube feeding is needed, **gastric first** if safe and tolerated. Refer to the algorithm (Card 20) to assist decision-making.

! **Warning:** post-pyloric feeding does **not** prevent aspiration of saliva or secretions.

CARD 19

Post-pyloric feeding: how?

Before starting, and how to advance

Before starting: try continuous gastric feeding with a hydrolyzed or elemental formula, and at least one prokinetic.

How to start and advance

- Confirm tube position per institutional policy.
- Start at an individualized rate (age, nutrition, stability, prior tolerance); advance gradually while monitoring tolerance.
- Give **continuously by pump** (maximum time off ~6 hours); individualize interruptions.
- Monitor for displacement, obstruction and complications.

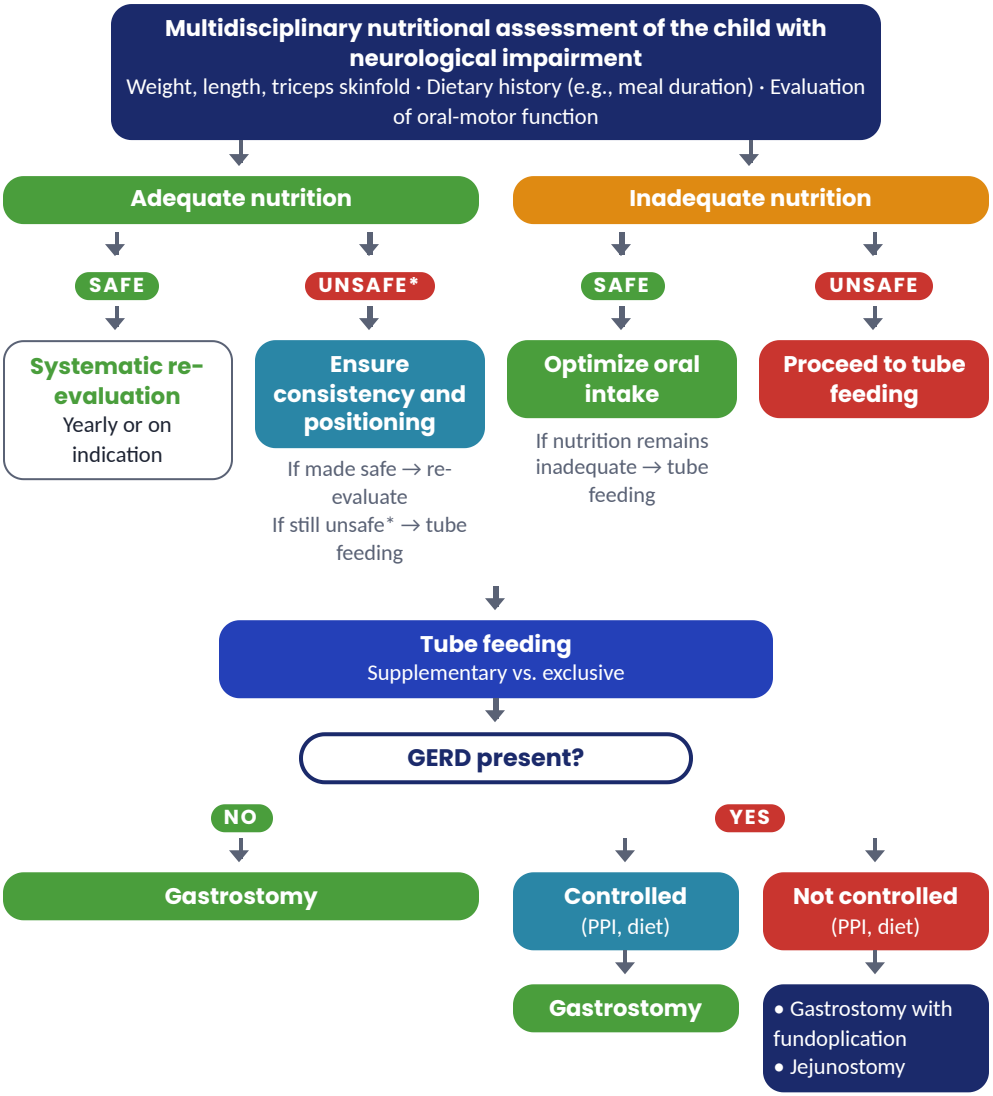
Suggested rates

Age	Initial	Advance	Tolerated
Preterm	0.5–2 mL/kg/h	0.2–1 mL/kg q8h	4–8 mL/kg/h
Infant	1–2 mL/kg/h	1–2 mL/kg q8h	5–6 mL/kg/h
1–6 years	1 mL/kg/h	1 mL/kg q2–8h	1–5 mL/kg/h
≥7 years	25 mL/h	25 mL q2–8h	100–150 mL/h

CARD 20

Feeding management algorithm

Adequate or inadequate? Safe or unsafe?



* **Unsafe:** careful attention should be given to any swallowing, dental or orthopedic issues that may make oral feeding unsafe. Partial or full enteral feeding should be considered if there is any concern about safety.

Adapted from ESPGHAN Advice Guide (2019), based on Romano C, et al. *JPGN* 2017;65:242–264. © ESPGHAN.

Algorithm

CARD 21

References

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