ECHO Summary,19/JULY/2024
Session Title: Approach to a Child with Severe Acute Malnutrition

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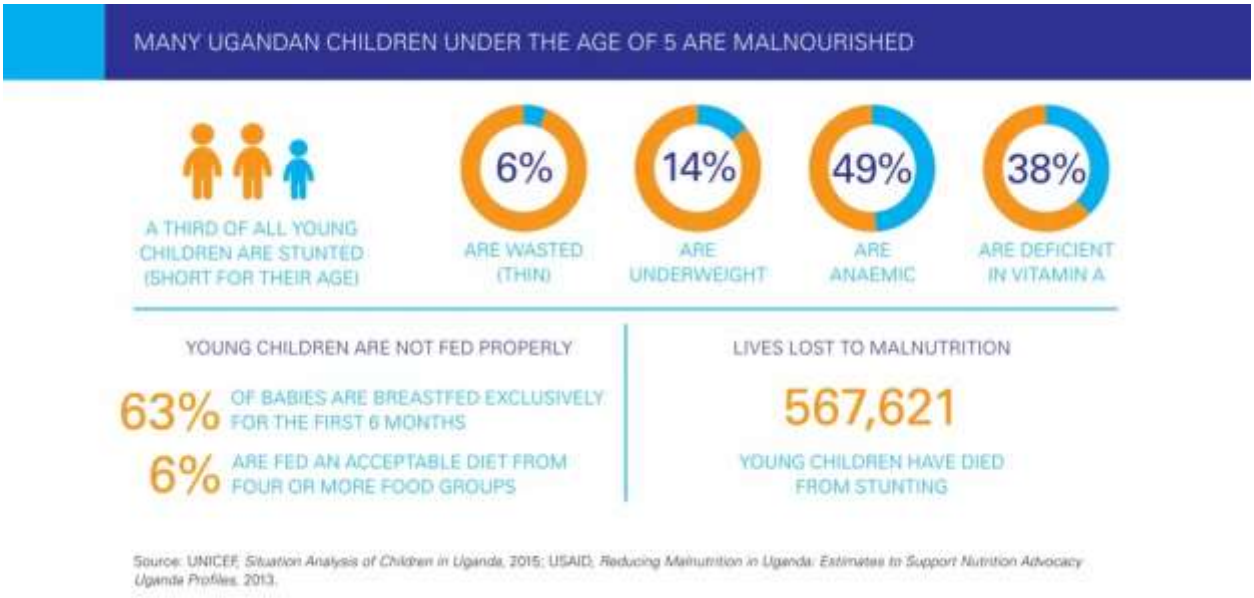
Definition

- Malnutrition refers to imbalance between energy supply (in the form of ingested nutrients) and the body's energy demand.
- Note that we no longer subdivide malnutrition into protein-energy and micronutrient malnutrition since there is so much overlap between the two.
- Need to differentiate acute vs. chronic
    - Chronic: growth is stunted
    - Acute: ~ loss of body fat, severe wasting. Can be thinner than their counterparts who are of the same height. Classified into moderate/severe based on measurements[1]

Epidemiology



Malnutrition is a MAJOR contributor to morbidity and mortality in children < 5 living in Uganda.[1]

Risk Factors

- Immediate causes:
    - Inadequate quantity and quality of food
    - Lack of knowledge on appropriate foods provided to children, poor food preparation, food taboos
    - Infections (reduced appetite, increased energy/nutrient utilization, limited ability to absorb/retain nutrients)
- Root causes:
    - Food insecurity
    - Poor health services
    - Poor environmental sanitation
    - Natural disasters
    - Excessive workload for women

    - Poor weaning practices
    - Culture
    - Inadequate water supply
    - Low literacy levels
    - Low nutrition advocacy/education
- Underlying causes:
    - Poverty
    - Corruption
    - Poor governance
    - Poor infrastructure[1]

Clinical features

- **AIRWAY**:
    - These children can present lethargic, unconscious, or even convulsing. Secure the airway with intubation if needed.
- **BREATHING**:
    - Infection can be both a cause and a result of malnutrition. Assess effort of breathing, auscultate the lungs, and monitor O2 for signs of respiratory infection. Give O2 if necessary and manage infection as indicated below.
    - It is especially important to monitor breathing as the child is being fed and rehydrated, as worsening shortness of breath can signify pulmonary edema secondary to heart failure.
- **CIRCULATION**:
    - Refeeding and rehydrating a severely malnourished child must be done slowly and cautiously, as there is a risk of heart failure if done too quickly. Monitor for worsening edema, shortness of breath, or decreased level of consciousness as signs of heart failure.
- **DISABILITY:**
    - Always suspect hypoglycemia in a severely malnourished child with a decreased level of consciousness and treat accordingly (see treatment below).
- **EXPOSURE**:
    - Check temperature to assess for hypothermia and manage accordingly (see below).
    - Children may manifest with:
        - Marasmus - “severe wasting, old man’s face, excess skin hangs around the buttocks, ribs and zygoma bones are prominent, scapular blades and extremities (limbs), eyes are sunken”[1]
            - May not have skin or hair changes
            - NO organomegaly
        - Kwashiorkor - “pitting feet edema, skin desquamation, hair changes, presence of bilateral pitting edema (edema of both feet), moon face”[1]
            - Skin changes include dermatosis (flaky) or dermatitis - you may see ulcerations, changes in pigmentation

- Hair changes include thinning and straightening; can be easily plucked
- Hepatosplenomegaly common

Diagnostics

- Infants < 6 months
  - Weight for length (WFL)
    - < -3 Z score
  - Presence of bilateral pitting edema
- Children 6-59 months
  - Weight for length/height (WFL/H)
    - < -3 Z score
  - Mid-Upper Arm Circumference (MUAC)
    - < 11.5 cm (115 mm)
  - Presence of bilateral pitting edema
- Children and adolescents from 5-19 years
  - BMI
  - MUAC
    - Ages 5-9 years: < 13.5 cm (135 mm)
    - Ages 10-14 years: < 16.0 cm (160 mm)
    - Ages 15-19 years: < 18.5 cm (185 mm)
  - Presence of bilateral pitting edema

- Signs of visible severe wasting, including but not limited to…
  - Sparse hair growth, nail changes
  - Cheilosis at angles of mouth
  - Corneal ulcerations, Bitot's spots, pus in the eyes
  - Dermatosis (do not mistake this for a burn!)
  - Flabby skin over the buttocks

- Labs:
  - *RAPID GLUCOSE* is essential to look for hypoglycemia
  - Complete blood count (CBC) - hemoglobin and RBC indices
  - Check for infection - malaria, tuberculosis, HIV, urinalysis, blood cultures
    - Remember common sites of infection in kids: ears, throat, skin, lungs, urine
    - Consider stool microscopy for ova and cysts, occult blood, and parasites[1]
  - Prealbumin and albumin - Surrogate markers for short and long-term dietary protein intake respectively
  - Cellular immunity - total lymphocyte count < 1000 reveals effects of nutrition disorders on immunity
  - Vitamins/minerals

- Appetite test

- Should be conducted in all children > 6 months at initial visit and subsequent visits.
- Give the child 30 minutes to see if they can consume at least ⅓ of the packet of ready-to-use therapeutic food (RUTF).
  - If a child with severe acute malnutrition fails the appetite test, they need to be hospitalized.
  - If they pass the appetite test, they may be able to undergo treatment with RUTF at home (if the RUTF is available).[1]

Treatment

- Indications for admission
  - Pitting edema
  - Signs of organ damage or other medical complications
  - Failure of appetite test

Table 1. 10-Point Management of Severe Acute Malnutrition (SAM)

	Phase		
	Stabilization		Rehabilitation
	Days 1-2	Days 3-7	Weeks 2-6
1. Hypoglycemia	✓		
2. Hypothermia	✓		
3. Dehydration	✓		
4. Electrolytes	✓	✓	✓
5. Infection	✓	✓	
6. Micronutrients	✓*	✓*	✓**
7. Cautious feeding	✓	✓	
8. Catch-up growth			✓
9. Sensory stimulation	✓	✓	✓
10. Prepare for follow-up			✓

*__No__ iron (can worsen infections)

**With iron

- Stabilization phase → Transition phase → Rehabilitation phase

- Address the acute issues that can kill the child quickly.
    - Hypoglycemia: random blood sugar (RBS) < 3 mmol
        - Always suspect in a child with a decreased level of consciousness (i.e. lethargic, unconscious, convulsing)
        - If the child is conscious, give 50mL of sugar water (1 rounded tablespoon in 50mL water) by mouth. Give F-75 half an hour after glucose and continue every half hour for the first 2 hours
        - If the child is unconscious, give IV 10% glucose 5mL/kg OR sugar water via NGT. Repeat RBS in 30 minutes and repeat above if still < 3 mmol.
        - If glucose sticks are unavailable, treat for hypoglycemia. Giving sugar to a child will not kill them, but hypoglycemia can!
        - Help prevent hypoglycemia by routinely giving sugar to all children who have just arrived at the facility, especially those who have traveled long distances, those who develop hypothermia, and those who are in septic shock (regardless of blood sugar levels)
    - Hypothermia: axillary temp < 35.0℃ or rectal temp < 35.5℃.
        - Feed the child immediately (sugar water for possible hypoglycemia followed by F-75).
        - Cover the child with warm clothes. Make sure children who still wet their nappies/pampers are regularly checked and kept dry.
        - Encourage kangaroo mother care (skin-to-skin).
        - Make sure the child is in a draft-free room. Close windows if necessary.
        - Do NOT use a hot water bottle, as this can burn their fragile skin.
    - Dehydration:
        - Do not use IV fluids for rehydration, except in shock. Instead, rehydrate slowly with ReSoMal via mouth or NGT.
        - Watch for signs of overhydration including worsening edema, shortness of breath, rapid increase in urinary frequency/stool and vomit volume, increase in hepatomegaly, or decreased level of consciousness. Do not give diuretics!
        - Dehydrated child *without* shock (usually due to severe diarrhea): ReSoMal 10mL/kg/hr by mouth or NGT for the first 2 hours
            - If weight gain and clinical improvement - continue ReSoMal 10mL/kg/hr until hitting target weight and then switch to F-75
            - If weight gain but clinically worse - STOP rehydration
            - If weight loss - increase ReSoMal to 20mL/kg/hr and reassess
            - If no change in weight - increase ReSoMal to 15mL/kg/hr and reassess
        - Dehydrated child *with* shock: IV 15 mL/kg Half Strength Darrows or Ringers Lactate with 5% dextrose (1:1) in 1 hour then reassess
            - If clinical improvement and child is conscious - give ReSoMal 10mL/kg/hr

- If better but not alert - repeat IV fluids 15mL/kg in 1 hour then reassess
- If weight loss or no weight change - repeat IV fluids 15mL/kg in 1 hour then reassess
- If weight gain with no clinical improvement - STOP IV fluids and look for cause of shock

- Infection considerations
  - Vaccinate against measles if NOT in shock.
  - Wait to treat parasitic worm infections until the rehabilitation phase.
  - For newly-diagnosed HIV, wait to start ART until metabolic complications are stabilized.[1]
- Septic shock
  - Broad-spectrum antibiotics such as cefotaxime or ceftriaxone 100mg/kg/day.
    - If the child is not improving, add ciprofloxacin 30mg/kg/day in 3 doses OR gentamicin 5mg/kg/day.
    - *NOTE: the above recommendations were given during the ECHO session. Per the Uganda Clinical Guidelines, the following are the recommendations for broad-spectrum antibiotics:*
      - Benzylpenicillin 50,000 IU/kg IM or IV every 6 hours OR ampicillin 50 mg/kg every 6 hours for 2 days followed by oral amoxicillin 25-40 mg/kg every 8 hours for 5 days
      - PLUS gentamicin 7.5 mg/kg once a day for 7 days.[1]
  - Treat/prevent hypoglycemia and hypothermia.
  - If conscious, F-75 by mouth or NGT.
  - If unconscious/lethargic, IV 10mL/kg Ringer's lactate + D5% (1:1) in 1 hour; monitor every 10 minutes.
    - If no improvement in 30 minutes - reduce to 4mL/kg/hr
    - If some improvement - repeat same fluids for the second hour and reassess
    - As soon as the child improves and level of consciousness increases, stop all IV fluids and switch to F-75 diet by NGT.
- Severe anemia: < 4g/dL or PCV < 12% in < 48 hours
  - Give 5-7mL of packed RBCs or 10mL/kg whole blood slowly over 3 hours
  - Furosemide 1mg/kg
  - Do not feed for at least 3 hours after transfusion

- <u>Stabilization phase</u>: Once the child is acutely stabilized, continue to feed and hydrate cautiously. You do not want to overwhelm the child's system.
  - In a child with no dehydration but watery diarrhea, prevent dehydration from developing by giving ReSoMal after every loose stool. Dose according to age.
  - In children < 6 months *with* edema and in children ≥ 6 months, begin with starter formula F-75. Offer every 2 hours. You should not expect weight gain on F-75. It

is low in protein and calories. Its job is to stabilize the child physiologically and metabolically.
- In children < 6 months *without* edema, begin with specially diluted therapeutic milk (SDTM). Offer every 3 hours.
- *If a child is breastfeeding, continue breastfeeding but supplement it with F-75* (see Table 2)

Table 2. Volumes of F-75 formula to administer in addition to breastfeeding.[1]

Days	Frequency (hours)	Volume/kg/feed (mL)	Volume/kg/day
1-2	2	11	130
3-5	3	16	130
6	4	22	130

- Transition phase: This phase can begin when the child is recovering, medical complications are resolving, and the child's appetite is back. This phase should last about 3 days.
  - In children ≥ 6 months, transition with ready-to-use therapeutic food (RUTF). Give according to body weight. If the child cannot tolerate RUTF, use F-100.
  - Monitor weight daily. The child should be gaining weight in this phase.
  - Play with the children to mentally stimulate them.

Table 3. RUTF amounts by weight.

Child's weight (kg)	Transition phase	Rehabilitation phase	
	Packets per day (92 g, 500 Kcal)	Packets per day (92 g, 500 Kcal)	Packets per week
4-4.9	1.5	2	14
5-6.9	2.1	2.5	18
7-8.4	2.5	3	21
8.5-9.4	2.8	3.5	25
9.5-10.4	3.1	4	28
10.5-11.9	3.6	4.5	32
>12	4.0	5	35

- Rehabilitation phase: After the child transitions and is out of danger. This phase includes ongoing nutrition support and transition to normal foods. Outpatient.
    - < 6 months - breastfeed and supplement appropriately if necessary
    - ≥ 6 months - Kitobero foods (animal protein, plant protein, carbohydrates) from locally available foods. Steam and mash together. Give 5 meals a day.

Table 4. How to make F-75 and F-100 formulas if you do not have access to pre-mixed versions.[1]

Ingredient	F-75	F-100
Dried skim milk	25 g	80 g
Sugar	70 g	50 g
Cereal flour	35 g	N/A
Vegetable oil	27 g	60 g
Electrolyte/mineral solution mix	20 g	20 g
Water	1000 mL	1000 mL

Note: cook for 4 minutes, THEN add mineral/ vitamin mix

Complications

- Acute, life-threatening complications: hypoglycemia, hypothermia, dehydration, septic shock (see above for management)
- Electrolyte imbalances (especially potassium and magnesium)
    - ReSoMal is used instead of ORS because it has a more appropriate electrolyte combination for children with severe malnutrition.
- Infections - due to suppressed immune system; treat appropriately
- Micronutrient deficiencies
    - Vitamin A deficiency - only give vitamin A if corneal ulcerations or history of measles.
        - Give vitamin A on day 1, day 2, and day 14.
        - Child < 6 months: 50,000 IU
        - Child 6-12 months: 100,000 IU
        - Child > 12 months: 200,000 IU
    - Iron deficiency - do NOT replace iron during the stabilization phase, as this can worsen any existing infections. Do not replace iron while giving RUTF, as it already has enough iron in it. F-100 does not contain iron, so supplementation is needed.
    - Folate, zinc, and copper deficiencies - F-75, F-100, and RUTF contain these.
    - Mental delay - encourage mental stimulation of recovering children via play.

Disposition

- Once the child's medical complications have resolved and their appetite is back, they can begin the transition phase. If they've tolerated their feeds well and gained weight appropriately, they can then enter the rehabilitation phase and start being managed outpatient.

Special Notes

- When using pediatric weight for length/height charts, make sure you are using the chart for the right age and gender.
- When taking MUAC, use the child's *non-dominant* arm to obtain a more accurate measurement (their dominant arm will be larger due to more use).
- Ciprofloxacin is not routinely used in children < 12 years old due to musculoskeletal side effects, but it is not absolutely contraindicated.

Collaborating Partners

1. Ministry of Health of the Republic of Uganda
2. Seed Global Health
3. Techies Without Borders

References

1. The Republic of Uganda Ministry of Health. *Uganda Clinical Guidelines 2023: National Guidelines for Management of Common Health Conditions.;* 2023. Accessed July 22, 2024. The Republic of Uganda Ministry of Health - 2023 - Uganda Clinical Guidelines 2023 National Guidelin.pdf