MODULE 2
PRINCIPLES OF CARE

REPUBLIC OF GHANA
MINISTRY OF HEALTH

GHANA HEALTH SERVICE
Your Health • Our Concern

Training Course on Inpatient Management of Severe Acute Malnutrition

(Adapted from the 2002 WHO *Training course on the inpatient management of severe acute malnutrition*)

Children 6–59 Months with SAM and Medical Complications

March 2012

This modified version of the 2002 World Health Organisation's *Training Course on Inpatient Management of Severe Acute Malnutrition (SAM)* is the practical application of the 2010 MOH/GHS *Interim National Guidelines for Community-Based Management of Severe Acute Malnutrition in Ghana*. The training course was modified by the MOH/GHS SAM Support Unit in collaboration with the MOH/GHS Regional SAM Support Teams. USAID/Ghana, FANTA-2 Bridge project, UNICEF/Ghana and WHO/Ghana provided technical and financial support to review and modify the training course. This revised training course is made possible by the generous support of the American people through the support of USAID/Ghana and the Office of Health, Infectious Diseases, and Nutrition, Bureau for Global Health, United States Agency for International Development (USAID), under terms of Cooperative Agreement No. AID-OAA-A-11-00014, through the FANTA-2 Bridge, managed by FHI 360.

Illustrations for modules: Susan Kress

Contents

Acronyms and Abbreviations

BMI	Body Mass Index
CCP	Critical Care Pathway
cm	Centimetre(s)
CMAM	Community-Based Management of Acute Malnutrition
CMV	Combined Mineral and Vitamin Mix
F-75	Formula 75 Therapeutic Milk
F-100	Formula 100 Therapeutic Milk
g	Gram(s)
GHS	Ghana Health Services
Hb	Haemoglobin
HFA	Height-for-Age
IgA	Immunoglobulin A
IGF-1	Insulin Growth Factor 1
IU	International Unit(s)
IV	Intravenous
kcal	Kilocalorie(s)
kg	Kilogram(s)
L	Litre(s)
mg	Milligram(s)
ml	Millilitre(s)
MOH	Ministry of Health
mOsmol	Milliosmol(s)
mm	Millimetre(s)
mmol	Millimole(s)
MUAC	Mid-Upper Arm Circumference
µg	Microgram(s)
ORS	Oral Rehydration Solution
ReSoMal	Rehydration Solution for Malnutrition
RUTF	Ready-to-Use Therapeutic Food
SAM	Severe Acute Malnutrition
SD	Standard Deviation(s)
WFA	Weight-for-Age
WFH	Weight-for-Height
WHO	World Health Organisation
WHZ	Weight-for-Height Z-Score
°C	Degrees Celsius
>	Greater Than
<	Less Than

Introduction

This module describes how to recognise a child with severe acute malnutrition (SAM) and outlines the essential components of care. A child with SAM is likely to have many serious health problems in addition to malnutrition. In many cases, these problems may not be clinically apparent. In some cases, the usual treatment for a problem may be harmful or even fatal for a child with SAM. This module describes how the physiology of a child with SAM is different from a child without SAM and how these differences affect care.

Learning Objectives

This module will describe and allow you to practise the following skills needed to identify children with SAM:

- Define SAM
- Recognise clinical signs of SAM
- Weigh and measure the child
  - Determining weight
  - Measuring mid-upper arm circumference (MUAC)
  - Measuring height or length
- Identify a child with SAM
  - Presence of oedema
  - Severe wasting based on MUAC
  - Severe wasting based on low weight-for-height[1] z-score (WHZ)
- Recommended criteria for managing SAM
- How the physiology of SAM affect care of a child
  - What reductive adaptation is
  - How reductive adaptation affects care of the child
- Overview of the essential components of care
  - Feeding formulas
  - Procedures for successful management of SAM in Inpatient Care
  - Important things **not** to do and why
- Recommended criteria for referral and discharge
  - Criteria for referral and discharge
  - Referral to Outpatient Care
  - Discharge after full recovery

[1] Though the terms 'length' and 'height' are often used interchangeably in the text of these modules, it should be understood that if a child is under 2 years of age (or if a child's age is not known and he or she is less than 87 cm tall), recumbent length is measured. If a child is 2 years or older (or if a child's age is not known and he or she is 87 cm tall or taller), standing height is measured. If a child 2 years or older or 87 cm or taller is unable to stand, measure recumbent length and subtract 0.7 cm from the length to arrive at a comparable height.

1. Define SAM

Nutrition is a broad term referring to processes involved in eating, digestion, and utilisation of food by the body for growth and development, reproduction, physical activity, and maintenance of health.

Malnutrition occurs when the dietary intake of an individual does not cover their nutritional needs, harming health, wellbeing, and/or productivity. Malnutrition includes **undernutrition** and **overnutrition**. Undernutrition is defined as a lack of nutrients caused by inadequate dietary intake and/or disease. It encompasses a range of conditions, including acute malnutrition, chronic malnutrition, or stunting; a mixed form of acute and chronic malnutrition or underweight; and deficiencies of micronutrients, such as vitamin A, iron, iodine, and zinc. Overnutrition occurs when the body takes in more nutrients than required for normal growth, leading to excessive fat accumulation, presenting a risk to health. Overnutrition can lead to overweight and obesity.

These training modules focus on SAM, which is a condition defined by severe wasting (thinness) and/or presence of bilateral pitting oedema. The milder form of acute malnutrition, moderate acute malnutrition (MAM), is defined by moderate wasting.

A child with SAM is highly vulnerable to illness and has an increased risk of death. A medical complication in the presence of SAM further increases the risk of death and needs immediate specialised hospital care, which differs from the standard treatment protocol.

2. Recognise Clinical Signs of SAM

You may be familiar with the conditions related to SAM that are listed in this section. Clinical signs and anthropometric indicators are used to determine whether or not a child has SAM and should be admitted for treatment and whether the child should be treated in Outpatient Care or Inpatient Care. Some other clinical signs are used to determine the needed treatments.

We will first learn about the clinical signs and subsequently about the anthropometric indicators.

2.1. Visible Severe Wasting

A child with severe wasting has lost fat and muscle and appears like 'skin and bones'. A clinical term used for this condition is marasmus. To look for severe wasting, remove the child's clothes. Look at the front view of the child.

- Is the outline of the child's ribs easily seen?
- Does the skin of the upper arms look loose?
- Does the skin of the thighs look loose?

Look at the back view of the child.

- Are the ribs and shoulder bones easily seen?
- Is flesh missing from the buttocks?

When wasting is extreme, there are folds of skin on the buttocks and thighs. It looks as if the child is wearing 'baggy pants'.

Because a wasted child has lost fat and muscle, he or she will weigh less than healthy children of the same height, therefore having a low weight-for-height (WFH). The child's MUAC reading will also be low.



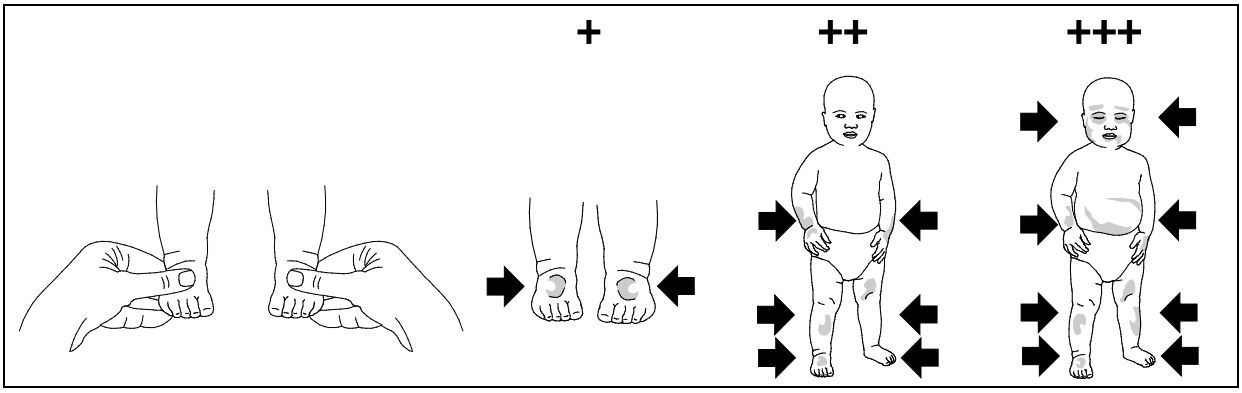
2.2. Bilateral Pitting Oedema

Oedema is an accumulation of fluid in the tissues. Oedema of nutritional origin is characterised by being bilateral and pitting and is seen in the feet, lower legs, and arms. In severe cases, it may also be seen in the upper limbs and face.

To check for oedema, grasp a foot so that it rests in your hand with your thumb on top of the foot. Press your thumb gently for a few seconds. Do the same to the other foot. The child has bilateral pitting oedema if a pit (dent) remains in both feet when you lift your thumb.

To be considered a sign of SAM, oedema must appear in both feet. If the swelling is in only one foot, it may just be sore or infected. The extent of oedema is commonly graded as:

0	no bilateral pitting oedema
+	mild: both feet
++	moderate: both feet plus lower legs, hands, or lower arms
+++	severe: generalised oedema, including both feet, legs, hands, arms, and face



Note: *Bilateral pitting oedema is a characteristic of kwashiorkor, which is a form of SAM. The term kwashiorkor will not be used in this course. This course will simply refer to the signs of bilateral pitting oedema.*

Pictures of Bilateral Pitting Oedema

Mild (Grade +) This child has grade + bilateral pitting oedema (mild). However, the child might have grade ++ or +++, so legs and face will also need to be checked.	
Moderate (Grade ++) In this child, both feet plus the lower legs, hands, and lower arms are swollen. This is grade ++ bilateral pitting oedema (moderate).	
Severe (Grade +++) This child has grade +++ bilateral pitting oedema (severe). It is generalised, including both feet, legs, arms, hands, and face.	

2.3. Dermatosis

Dermatosis is a condition of the skin. In cases of SAM, it is more common in children that have bilateral pitting oedema than in wasted children. A child with dermatosis may have patches of skin that are abnormally light or dark in colour; shedding of skin in scales or sheets; and ulceration of the skin of the perineum, groin, limbs, behind the ears, and in the armpits. There may be weeping lesions. There may be a severe rash in the nappy area. Any break in the skin can let dangerous bacteria into the body. When the skin is raw and weeping, this risk is very high.

The extent of dermatosis is described as:

+	mild: discolouration or a few rough patches of skin
++	moderate: multiple patches on arms and/or legs
+++	severe: flaking skin, raw skin, fissures (openings in the skin)

Treatment of dermatosis is discussed in **Module 5, Daily Care**.

2.4. Eye Signs

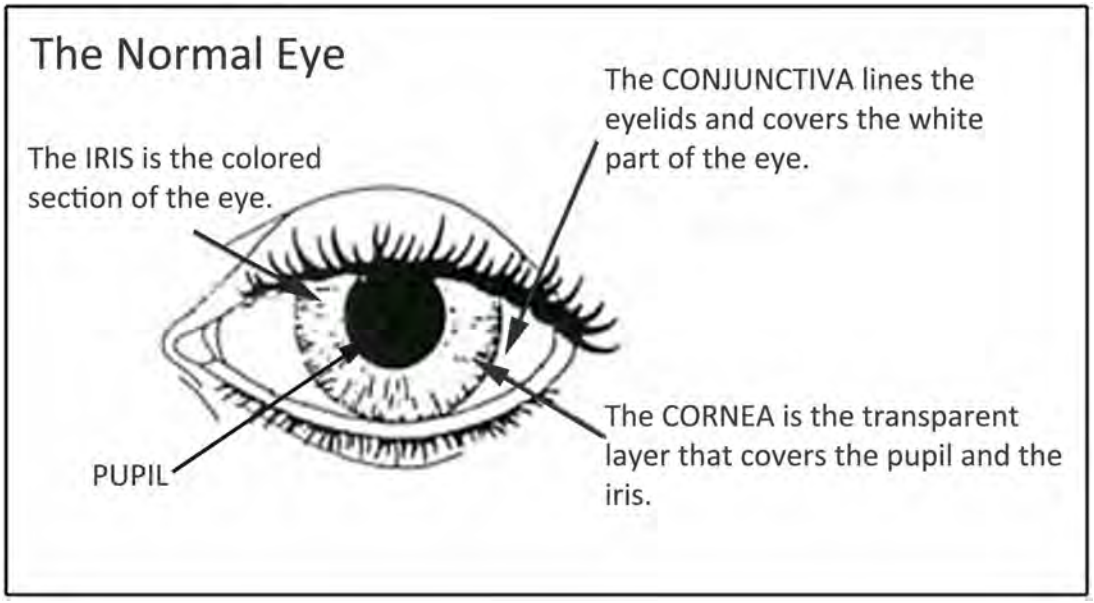
Children with SAM may have signs of eye infection and/or vitamin A deficiency.

- **Bitot's spots** are superficial foamy white spots on the conjunctiva (white part of the eye). These are associated with vitamin A deficiency.

- **Pus and inflammation** (redness) are signs of eye infection.

- **Corneal clouding** is seen as an opaque appearance of the cornea (the transparent layer that covers the pupil and iris). It is a sign of vitamin A deficiency.

- **Corneal ulceration** is a break in the surface of the cornea. It is a sign of severe vitamin A deficiency. If not treated, the lens of the eye may push out and cause blindness. Corneal ulceration is urgent and requires immediate treatment with vitamin A and atropine (to relax the eye).



Treatment of all eye signs will be discussed in **Module 3, Initial Management** and **Module 5, Daily Care**.

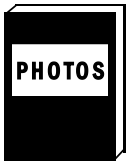
2.5. Medical Complications in the Presence of SAM

Children with SAM and medical complications are at high risk of death. Medical complications must be identified and addressed with urgency and the child must be hospitalised and treated by staff with specialised skills in the Inpatient Care management of SAM. The treatment of medical conditions of patients with SAM differs from traditional protocols of medical treatment.

The medical complications in the presence of SAM requiring immediate medical attention are:

- Anorexia, poor appetite
- Intractable vomiting
- Convulsions
- Lethargy, not alert
- Unconsciousness
- Hypoglycaemia
- High fever (> 38.5°C axillary)
- Hypothermia (< 35°C axillary)
- Severe dehydration
- Lower respiratory tract infection
- Severe anaemia
- Eye signs of vitamin A deficiency
- Skin lesion (dermatosis)

The signs and treatment of medical complications in the presence of SAM are addressed in **Module 3, Initial Management**.



Exercise A

In this exercise, you will look at photographs of children and identify signs related to SAM.

Open your photo booklet. Each photo is numbered. For each photo listed in this exercise, write down all of the following signs you see:

- Severe wasting
- Bilateral pitting oedema
- Dermatosis
- Eye signs (Bitot's spots, pus, inflammation, corneal clouding, corneal ulceration)

If the child has dermatosis or oedema, try to estimate the degree of severity (+, ++, or +++). If you see none of the signs, write NONE. When everyone in the group has finished, there will be a discussion of the photographs. Photo 1 is described below as an example.

Photo 1: Moderate (++) oedema, seen in feet and lower legs
Severe wasting of upper arms; ribs and collar bones clearly show.

Photo 2:

Photos 3 and 4 (front and back view of same child):

Photo 5:

Photo 6:

Photo 7:

Photo 8:

Photo 9:

Photo 10:

Photo 11:

Photo 12:

Photo 13:

Photo 14:

Photo 15:

When you have completed this exercise,
tell a facilitator that you are ready for the group discussion.

3. Weigh and Measure the Child

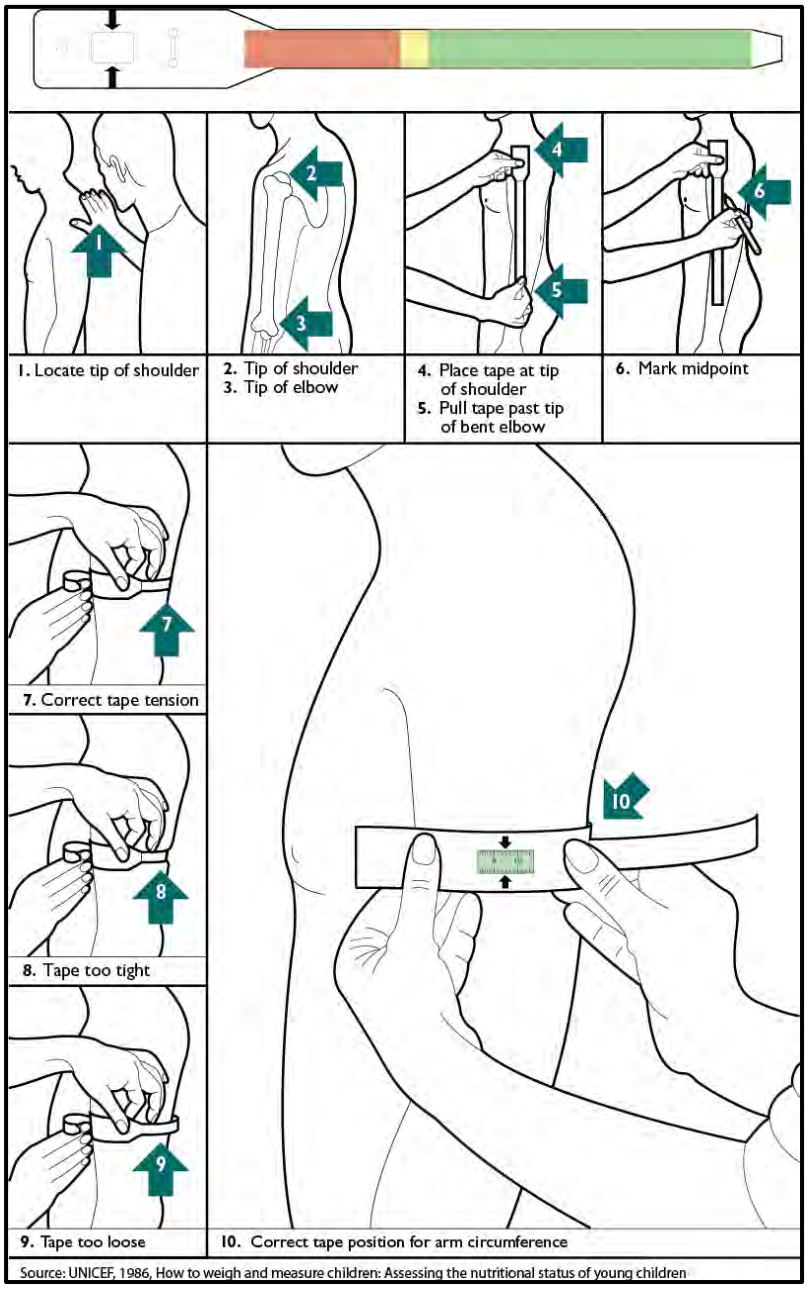
In addition to looking for clinical signs of SAM, it is important to weigh and measure the child, the measurement of human body parts is also known as anthropometric measurement. Then the child's WFH can be compared to the weight of children of the same height and sex in the World Health Organisation (WHO) Child Growth Standards.

3.1. Measure the Mid-Upper Arm Circumference

MUAC is a very useful body measurement used for children 6–59 months of age. MUAC correlates well with muscle mass and, hence, with body nutritional reserves. Moreover, evidence supports the fact that MUAC correlates better with risk of death than WFH.

How to Measure MUAC

1. Always measure MUAC on the left arm.
2. Measure the length of the child's upper arm, between the bone at the top of the shoulder [2] and the tip of the elbow [3] (the child's arm should be bent to easily locate the tip).
3. Find the midpoint of the upper arm and mark it with a pen [6]. It is easier to use a string instead of the MUAC tape to find the midpoint.
4. The child's arm should then be relaxed, falling alongside his or her body.
5. Wrap the MUAC tape around the child's arm, such that all of it is in contact with the child's skin [7]. It should be neither too tight [8] nor too loose [9].
6. Feed the end of the tape through the first opening and then through the second opening. The measurement is read from the window where the arrows point inward [10].



7. Record the MUAC reading with a precision of 0.1 cm.

3.2. Weigh the Child

Weigh the child as soon as possible after he or she arrives. If the child is admitted, weigh the child once daily, preferably at about the same time each day. The weighing time should be about 1 hour before or after a feed.

It is recommended to weigh children using a scale with the following features:

- Solidly built and durable
- Electronic (digital reading)
- Measures up to 150 kg
- Measures to a precision of 0.1 kg (100 g)
- Allows tared weighing

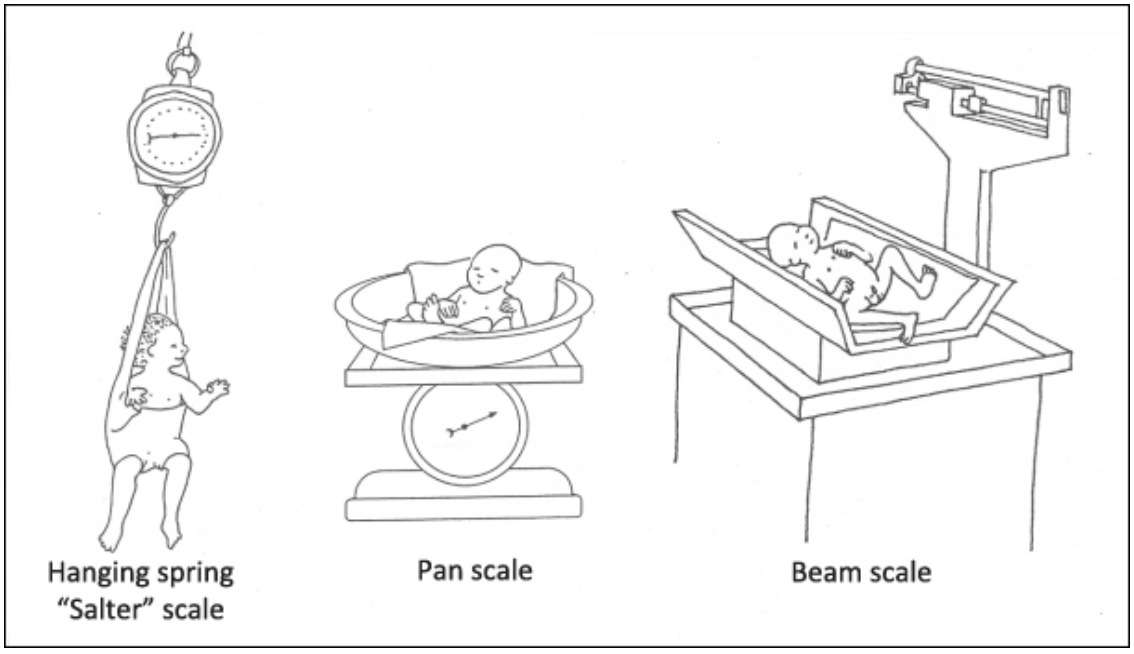
'Tared weighing' means that the scale can be reset to zero ('tared') with the person just weighed still on it. Thus, a mother can stand on the scale, be weighed, and the scale tared. While remaining on the scale, if she is given her child to hold, the child's weight alone appears on the scale.

Tared weighing has two clear advantages:

- There is no need to subtract weights to determine the child's weight alone (reducing the risk of error).
- The child is likely to remain calm when held in the mother's arms for weighing.

Types of Scales

There are many types of scales currently in use. The UNISCALE has the recommended features listed above. It is recommended to use a UNISCALE where it is available.



Weigh the Child under 2 Years of Age

If the child is under 2 years of age or is unable to stand, you will do tared weighing. Explain the tared weighing procedure to the mother as follows. Stress that the mother must stay on the scale until her child has been weighed in her arms.

Be sure that the scale is placed on a flat, hard, even surface. It should not be placed on a loose carpet or rug, but a firm carpet that is glued down is acceptable. Since the scale is solar powered, there must be enough light to operate the scale.

1. To turn on the scale, cover the solar panel for a second. When the number 0.0 appears, the scale is ready [1].
2. Check to see that the mother has removed her shoes. You or someone else should hold the naked baby wrapped in a blanket.
3. Ask the mother to stand in the middle of the scale, feet slightly apart (on the footprints, if marked), and remain still [2]. The mother's clothing must not cover the display or solar panel.
4. Remind her to stay on the scale even after her weight appears, until the baby has been weighed in her arms.
5. With the mother still on the scale and her weight displayed, tare the scale by covering the solar panel for a second. The scale is tared when it displays a figure of a mother and baby and the number 0.0 [3].
6. Gently hand the naked baby to the mother and ask her to remain still [4].
7. The baby's weight will appear on the display. Record this weight on the Critical Care Pathway (CCP) chart [5]. You will learn more about the CCP in **Module 3, Initial Management**.
8. Be careful to read the numbers in the correct order (as though you were viewing while standing on the scale rather than upside-down).

Weigh the Child over 2 Years of Age

If the child is 2 years or older, you will weigh the child alone if the child will stand still.

Explain that the child will need to step on the scale alone and stand very still. Undress the child. Explain that child needs to remove outer clothing in order to obtain an accurate weight. A wet diaper, or shoes and jeans, can weigh more than 0.5 kg. Babies should be weighed naked; wrap them in a blanket to keep them warm until weighing. Older children should remove all but minimal clothing, such as their underclothes.

If the UNISCALE is not available, a pan scale or hanging scale can be used to weigh the child.

1. Remove the child's clothes, but keep the child warm with a blanket or cloth while carrying him or her to the scale.

2. Put a cloth in the scale pan to prevent chilling the child.

3. Adjust the scale to zero with the cloth in the pan. (If using a scale with a sling or pants, adjust the scale to zero with that in place.)

4. Place the naked child gently in the pan (or in the sling or pants).

5. Wait for the child to settle and the weight to stabilise.

6. Measure weight to the nearest 0.01 kg (10 g) or as precisely as possible. Record immediately on CCP.

7. Wrap the child immediately to re-warm.

3.3. Standardise Scales

Standardise scales daily or whenever they are moved.

1. Set the scale to zero.

2. Weigh three objects of known weight (e.g., 5, 10, and 15 kg) and record the measured weights. (A container filled with stones and sealed may be used if its weight is accurately known.)

3. Repeat the weighing of these objects and record the weights again.

4. If there is a difference of 0.01 kg or more between duplicate weighings or if a measured weight differs by 0.01 kg or more from the known standard, check the scales and adjust or replace them if necessary.

3.4. Measure the Child's Length or Height

Depending on a child's age and ability to stand, measure the child's length or height. A child's length is measured while he or she is lying down (recumbent). Height is measured while the child is standing upright.

- If a child is under 2 years of age or if a child is less than 87 cm tall and his or her age is not known, measure length. Use the Weight-for-Height/Length Reference Table in **Annex B**.
- If a child is 2 years or older or if a child is 87 cm or taller and his or her age is not known, measure standing height. If a child 2 years or older or 87 cm or taller is unable to stand, measure recumbent length and **subtract 0.7 cm** from the length to arrive at a comparable height. Use the Weight-for-Height/Height Reference Table in **Annex B**.

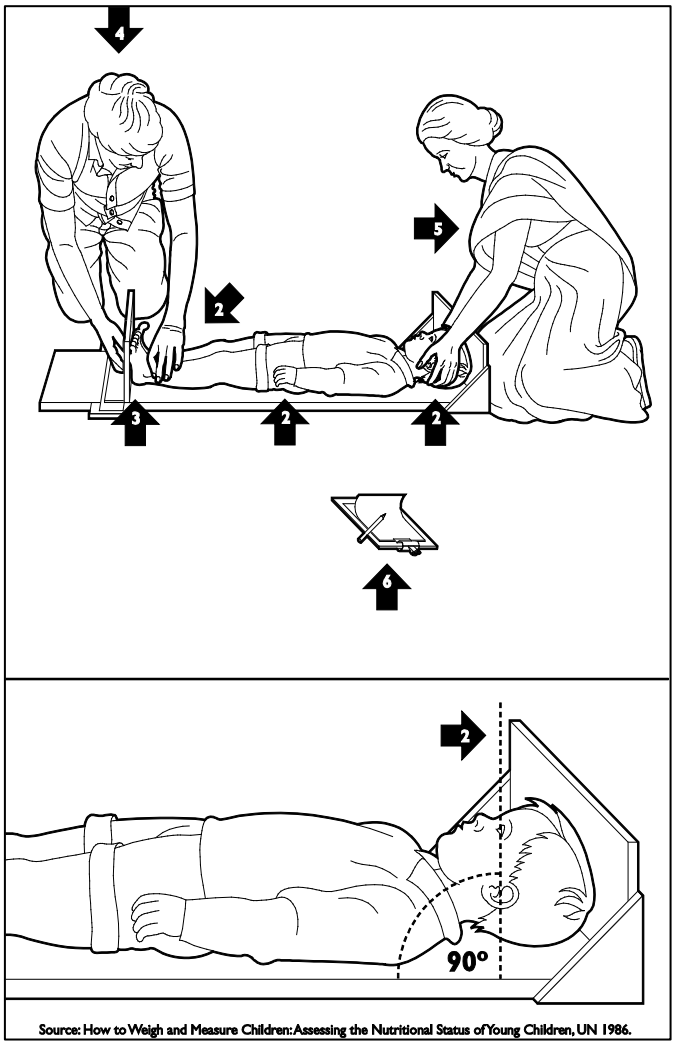
Whether measuring length or height, the mother should be nearby to soothe and comfort the child.

Use a Length Board to Measure the Child's Length

Use a length board to measure length for a child under 2 years of age, less than 87 cm tall when the child's age is not known, or 2 years or older or 87 cm or taller who is unable to stand.

1. Place the length board on the ground and remove the child's shoes.
2. Place the child on his or her back in the middle of board, head facing straight up, arms at the child's sides, and feet at 90 degree angles to board. [2, 3]
3. While holding the child's ankles or knees, move the sliding board up against the bottom of the child's feet. [3]
4. Ask an assistant [5] to hold the child's head in place [2].
5. Take measurement to nearest 0.1 cm and read out loud. Have the assistant repeat the measurement for verification.
6. Record the length measurement on the CCP immediately to the nearest 0.1 cm. [6]

***Note:** If the child is 2 years old or older or is 87 cm or greater while standing up, be sure to subtract 0.7 cm from measurement.*



Source: How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children, UN 1986.

Use a Height Board to Measure the Child's Height

Use a height board to measure the height of a child 2 years or older or at 87 cm or taller who is able to stand.

1. Remove the child's shoes and place him or her on the height board, standing upright in the middle of the board with arms at his or her sides [1].

2. Make sure that the child's feet are close together with heels and soles touching the bottom of the board (that is, not standing tiptoe) [2].

3. The back of the child's ankles and knees should be firmly pressed toward the board [3].

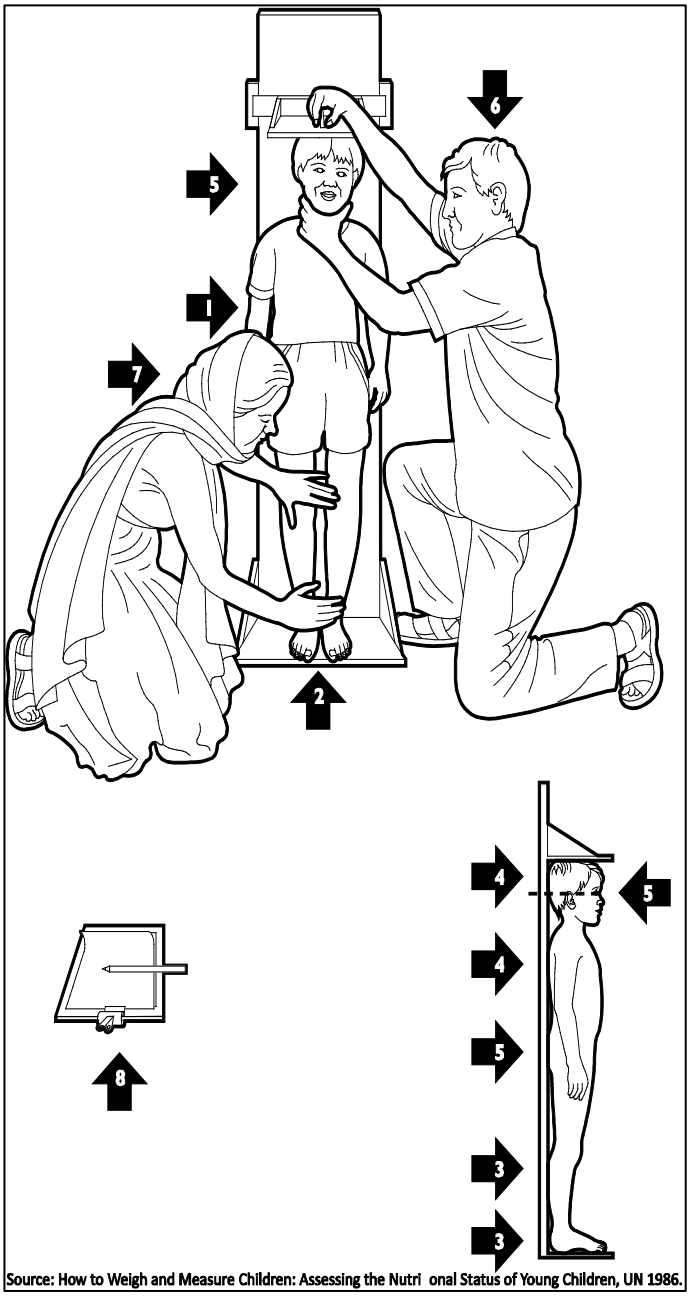
4. The child should stand straight, with heels, back of legs, buttocks, shoulder blades, and head touching the back of the board [3, 4, 5].

5. Hold the child's head straight [6]. The child's line of vision should be parallel to the floor [5].

6. Have an assistant hold the child's legs and feet [7].

7. Read measurement out loud to nearest 0.1 cm. Have the assistant repeat the measurement for verification.

8. Record the height to the last completed 0.1 cm immediately on the CCP.



Source: How to Weigh and Measure Children: Assessing the Nutri onal Status of Young Children, UN 1986.

3.5. Standardise Length/Height Board

Once a month, measure rods of known length on the measuring board and length/height board. For the measuring board, measure rods of 50 cm and 100 cm. For the length/height board, measure rods of 100 cm and 150 cm.

If there is 0.3 cm or more difference between the rod's known length and the measured length, recalibration may be needed. Get a second person to recheck your measurements before recalibrating. Also check that:

- The measuring tape is flat on the board, not buckled, in correct position, and reading 0 cm at headboard end
- The sliding foot piece is not too loose on the board (less than 0.2 cm wobble)
- The base of the board is not warped and that runners are straight and secure

4. Identify the Child with SAM

4.1. Determine the Presence of Bilateral Pitting Oedema

Bilateral pitting oedema is a form of SAM. It is a characteristic of kwashiorkor. A combination of bilateral pitting oedema and wasting is a severe condition (marasmic-kwashiorkor).

For determining the presence of bilateral pitting oedema, see **Section 2.2. Bilateral Pitting Oedema**.

4.2. Determine Severe Wasting Based on Mid-Upper Arm Circumference

Children 6–59 months of age are classified as severely wasted based on MUAC if their MUAC reading is less than 11.5 cm.

4.3. Determine Weight-for-Height Z-Score based on the Child's Weight and Length/Height

What is a z-score?

A z-score is a way of comparing a measurement, in this case a child's WFH, to an 'average' (median). The 'averages' used are the WHO 2006 Child Growth Standards. In the WHO standard population, all children of the same height are distributed around the median weight, some heavier and some lighter. For each height group, there is a standard deviation (SD) among the children of the WHO standard population. This SD is expressed as a certain number of kg at each height. The WHZ of a child being measured is the number of SD the child's weight is away from the median weight of the WHO standard population at that height group.

The Weight-for-Height/Length Reference Table in **Annex B** shows the z-scores for boys and girls of different weights and lengths or heights.

Optional: To learn more about z-scores, how they are calculated, and what they mean, refer to **Annex A** of this module.

It is important to consider a child's WFH rather than weight-for-age (WFA). The latter is also affected by stunting. Stunting may cause low WFA when a child has an adequate WFH. Therapeutic feeding can correct wasting but cannot easily correct stunting.

To use the Weight-for-Height/Length Reference Table:

1. Find the child's length or height in the middle column of the table.

2. If the length or height is between those listed, round up or down as follows: If the height/length is 0.5 or more cm greater than the next lower height/length, round up. Otherwise, round down.

3. Look in the left columns for boys or the right columns for girls to find the child's weight.

4. Look at the top of the column to see what the child's z-score is.

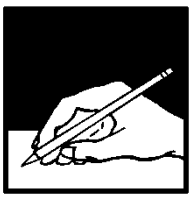
The child's weight may be between two weights listed in the table and therefore between two z-scores. If so, indicate that the weight is between these scores by writing less than (<) the higher score. For example, if the score is between −1 z-score and −2 z-score, write < −1 z-score.

Examples of Weight-for-Height Z-Scores

- A boy is 80.0 cm in length and weighs 9.2 kg. His z-score is above −2 and below −1. Record his z-score as < −1 z-score.

- A girl is 76.5 cm in length and weighs 7.4 kg. Round her length to 77.0 cm. Her z-score is −3 z-score.

- A girl is 90.0 cm in height and weighs 10.3 kg. Her weight is between −2 z-score and −3 z-score. Record her z-score as < −2 z-score.



Exercise B

Refer to the Weight-for-Height/Length Reference Table in **Annex B** or the job aids. Indicate the WHZ for each child listed below.

1. Shana, girl, length 63.0 cm, weight 5.0 kg

2. Rico, boy, height 101.0 cm, weight 11.8 kg

3. Tonya, girl, length 69.8 cm, weight 6.3 kg

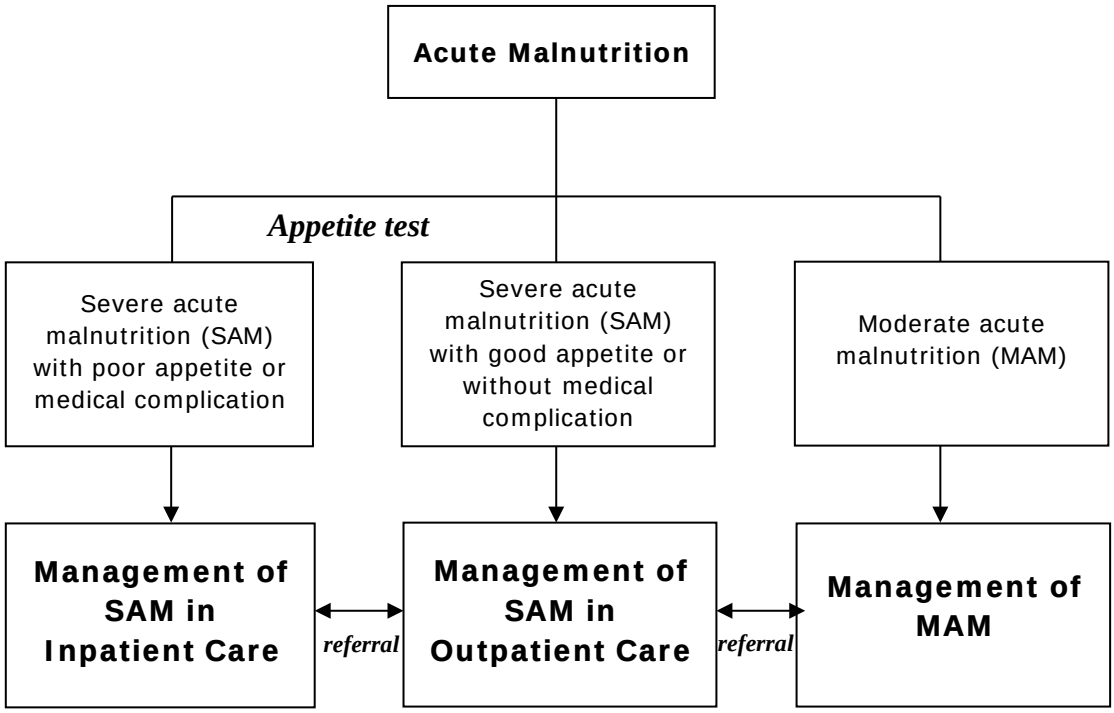
4. Kareem, boy, length 82.0 cm, weight 8.5 kg

When you have completed this exercise,
please discuss your answers with a facilitator.

4.4. Recommended Criteria for the Management of SAM

In 2007, Ghana adopted Community-Based Management of Acute Malnutrition (CMAM) as the approach for treating SAM. With CMAM, children with SAM without medical complications can be treated in decentralised **Outpatient Care**. These children receive routine medications and RUTF and continue treatment at home. Follow-up visits are conducted at the health facility every week or every two weeks. Children with SAM and medical complications are admitted to **Inpatient Care**, but are referred to Outpatient Care as soon as their medical complications are resolving and continue treatment until full recovery at home.

WHO 2007 Classification for the Management of Acute Malnutrition in Children 6–59 Months



Admission Criteria for SAM in Children 6–59 Months of Age for Treatment in Inpatient Care or Outpatient Care

Inpatient Care SAM with Medical Complications	Outpatient Care SAM without Medical Complications
Bilateral pitting oedema +++ **OR** Any grade of bilateral pitting oedema with severe wasting (*MUAC < 11.5 cm) **OR** SAM <u>with any</u> of the following medical complications: • Anorexia, poor appetite • Intractable vomiting • Convulsions • Lethargy, not alert • Unconsciousness • Hypoglycaemia • High fever (> 38.5°C axillary) • Hypothermia (< 35°C axillary) • Severe dehydration • Persistent diarrhoea • Lower respiratory tract infection • Severe anaemia • Eye signs of vitamin A deficiency • Skin lesion (dermatosis)	Bilateral pitting oedema + or ++ **OR** Severe wasting (*MUAC < 11.5 cm) **AND** • Appetite (appetite test passed) • No medical complication • Clinically well and alert

Ghana has also adopted the use of MUAC as an independent criterion for SAM for children 6 months and older. *This makes case detection of SAM in the community and the health facility simple and effective. MUAC is also a better indicator of mortality risk associated with acute malnutrition than WHZ (WHO standards)*[2].

Reasons for the criteria for SAM

- If the child has a MUAC < 11.5 cm, he or she is severely wasted.

- If there is oedema in both feet (+ or worse), the child has SAM even though retained fluid may add to the child's weight, making the MUAC > 11.5 cm.

[2] See WHO, WFP, UN/SCN, and UNICEF. 2007. *Community-based management of severe acute malnutrition: A Joint Statement by the World Health Organization, the World Food Programme, the United Nations System Standing Committee on Nutrition and the United Nations Children's Fund.* and WHO and UNICEF. 2009. *WHO child growth standards and the identification of severe acute malnutrition in infants and children: A Joint Statement by the WHO and UNICEF*.

- **All** children with SAM and medical complications, such as anorexia, no appetite, intractable vomiting, convulsions, lethargy, not alert, and severe dehydration, should be managed in Inpatient Care.

- Children with severe oedema (+++) or marasmic-kwashiokor should also be managed in Inpatient Care.

- Children with SAM (MUAC < 11.5 cm or oedema + or ++) and good appetite and no medical complications should be managed in Outpatient Care.

Children with SAM are in danger of death from hypoglycaemia, hypothermia, fluid overload, and undetected infections. They cannot be treated like other children. Their feeding and fluids must be carefully controlled or they could die.

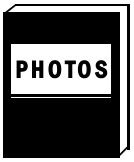
To ensure the proper feeding and treatment routines, it is critical to keep these children in Inpatient Care until the medical conditions have stabilised and are resolving and the appetite has returned. Any health problem and infection should be treated while in Inpatient Care. As soon as medical complications stabilise and appetite returns the child should be referred to Outpatient Care to continue with treatment.

Note about young infants: *Infants under 6 months with acute malnutrition or over 6 months and weighing less than 4 kg should be treated in Inpatient Care. You will learn more on how to manage these infants in* ***Module 4, Feeding****.*

Low-birth-weight babies are not usually severely wasted or oedematous and so are unlikely to meet the criteria for SAM. Management of low-birth-weight babies is not taught in this course. Low-birth-weight babies should be breastfed.

Complementarities between Inpatient Care and Outpatient Care for the Management of SAM

Independent Additional Criteria	• No Appetite • Medical complications		• Appetite • No medical complications
Type of Therapeutic Care	**INPATIENT CARE**		**OUTPATIENT CARE**
Intervention	F-75 RUTF or F-100, and 24-hour medical care		RUTF, and basic medical care
Discharge Criteria ***(Referral criteria from inpatient care to outpatient care and discharge from outpatient care)***	Reduced bilateral pitting oedema Good appetite (a child eats at least 75% of RUTF ration for the day)	referral	15–20% weight gain



Exercise C

In this exercise you will look at photographs and consider information about a child in order to determine if the child should be classified as having SAM and if the child should be managed in Outpatient Care or Inpatient Care. Use the recommended criteria given in **Section 4.4, Page 22** of this module. Refer to the Weight-for-Height/Length Reference Table in your job aids or **Annex B** as needed.

Photo 18: This child is a girl, 20 months old. She is 67.0 cm in length, weighs 6.5 kg, and has a MUAC of 11.8 cm. Should she be classified as having SAM? Where should she be managed, Inpatient Care or Outpatient Care? Why or why not?

Photo 19: This child is a girl, 6 months old. She is 60.0 cm in length, weighs 4.0 kg, and has a MUAC of 10.4 cm. Should she be classified as having SAM? Where should she be managed, Inpatient Care or Outpatient Care? Why or why not?

Photo 20: This child is a boy, 18 months old. He is 65.0 cm in length, weighs 4.8 kg, and has a MUAC of 10.8 cm. Should he be classified as having SAM? Where should he be managed, Inpatient Care or Outpatient Care? Why or why not?

When you have completed this exercise,
tell a facilitator that you are ready for the group discussion and drill.

5. How the Physiology of SAM Affects Care of the Child

A child with SAM must be treated differently than other children because his or her physiology is seriously abnormal due to **reductive adaptation.**

5.1. Reductive Adaptation

The systems of the body begin to 'shut down' with SAM. The systems slow down and do less so that the body can survive on limited calories. This slowing down is known as reductive adaptation. As the child is treated, the body's systems must gradually 'learn' to function fully again. Rapid changes (such as rapid feeding or fluids) could overwhelm the systems, so feeding must be slowly and cautiously increased.

Optional: To learn more about how reductive adaptation affects the body's systems, refer to **Annex C**. A simplified explanation of the implications for care is provided in **Section 5.2**.

5.2. How Reductive Adaptation Affects Care of a Child

Reductive adaptation affects treatment of a child in a number of ways. Three important implications for care are described below.

Presume and Treat Infection

Nearly all children with SAM have bacterial infections. However, as a result of reductive adaptation, the usual signs of infection may not be apparent because the body does not use its limited energy to respond in the usual ways, such as inflammation or fever.

Examples of common infections in the child with SAM are ear infection, urinary tract infection, and pneumonia. Assume that infection is present and treat all children with SAM with broad spectrum antibiotics. If a specific infection is identified (e.g., shigella, giardiasis), add specific appropriate antibiotics to those that have already being given.

Note: *Choices of antibiotics will be discussed in* ***Module 3, Initial Management*** *and are described in the job aids* ***Medicine Protocols and Vaccines for Children under 5 with SAM in Inpatient Care****.*

Do Not Give Iron Early in Treatment

Due to reductive adaptation, a child with SAM makes less haemoglobin (Hb) than usual. Iron that is not used for making Hb is put into storage. Thus, there is 'extra' iron stored in the body, even though the child may appear anaemic. Giving iron early in treatment will not cure anaemia, as the child already has a supply of stored iron.

Giving iron early in treatment can also lead to 'free iron' in the body. Free iron can cause problems in three ways.

SHORT ANSWER EXERCISE

1. Free iron is highly reactive and promotes the formation of free radicals, which may engage in uncontrolled chemical reactions with damaging effects.

2. Free iron promotes bacterial growth and can make some infections worse.

3. The body tries to protect itself from free iron by converting it to ferritin. This conversion requires energy and amino acids and diverts these from other critical activities.

Later, as the child recovers and begins to build new tissue and form more red blood cells, the iron in storage will be used and supplements might be needed.

Provide Potassium and Restrict Sodium

Normally, the body uses a lot of energy maintaining the appropriate balance of potassium inside the cells and sodium outside the cells. This balance is critical to maintaining the correct distribution of water inside the cells, around the cells, and in the blood.

In reductive adaptation, the 'pump' that usually controls the balance of potassium and sodium runs slower. As a result, the level of sodium in the cells rises and potassium leaks out of the cells and is lost (for example, in urine or stools). Fluid may then accumulate outside of the cells (as in oedema) instead of being properly distributed through the body.

All children with SAM should be given potassium to make up for what is lost. (They should also be given magnesium, which is essential for potassium to enter the cells and be retained.) Children with SAM already have excess sodium in their cells, so sodium intake should be restricted.

If a child has severe and/or persistent diarrhoea and/or dehydration, a special rehydration solution called Rehydration Solution for Malnutrition (ReSoMal) should be used instead of regular or low-osmolarity oral rehydration solution (ORS). ReSoMal has less sodium and more potassium than regular or low-osmolarity ORS.

Briefly answer these questions as a review of the previous section.

1. When a child has SAM, why is it important to begin feeding slowly and cautiously?

2. Why should all children with SAM be given antibiotics?

3. Why is it dangerous to give iron early in treatment?

4. Why is ReSoMal preferable to regular or low-osmolarity ORS for children with SAM who have severe and/or persistent diarrhoea and/or dehydration?

Tell the facilitator when you are ready to discuss these questions with the group. Check your own answers to this exercise by comparing them to the answers given at the end of this module on page 53.

6. Overview of the Essential Components of Care

6.1. Feeding Formulas: F-75 and F-100

F-75 is the 'starter' formula (therapeutic milk) to use during initial management, beginning as soon as possible and continuing for 2–7 days until the child is stabilised. Children with SAM cannot tolerate usual amounts of protein and sodium at this stage (during stabilisation) or high amounts of fat. They may die if given too much protein or sodium. They also need glucose, so they must be given a diet that is low in protein and sodium and high in carbohydrates. F-75 is specially made to meet the child's needs without overwhelming the body's systems in the initial stage of treatment. Use of F-75 prevents deaths. **F-75 contains 75 kcal and 0.9 g protein per 100 ml.**

As soon as the child is stabilised on F-75, F-100 or RUTF are used as a 'catch-up' formula to rebuild wasted tissues. **F-100 contains more calories and protein: 100 kcal and 2.9 g protein per 100 ml.** RUTF is similar in composition to F-100. The only difference is that RUTF has iron added to it.

The compositions of F-75, F-100, and RUTF are described in **Annex D**. Several recipes for preparing F-75 and F-100 locally are given in the table on the next page. The choice of recipe may depend on the availability of ingredients, particularly the type of milk, and the availability of cooking facilities.

The principle behind the recipes is to provide the energy and protein needed for stabilisation and catch-up. For stabilisation (F-75), it is important to provide a formula with the energy and protein as shown (no less and no more). For catch-up (F-100), the recipes show the minimum energy and protein contents needed.

The first three recipes given for F-75 include cereal flour and require cooking. The second part of the table shows recipes for F-75 that can be used if there is no cereal flour or no cooking facility. However, the recipes with no cereal flour have a high osmolarity (415 mOsmol/L) and may not be tolerated well by some children with diarrhoea.

The F-100 recipes do not require cooking as they do not contain cereal flour. (RUTF is 'ready to use' and does not require prior preparation.)

More instructions on how to prepare F-75 and F-100 (and administer RUTF) will be given in **Module 4, Feeding**.

It is hoped that one or more of the recipes can be made in your hospital for treatment in Inpatient Care. If your hospital cannot use any of the recipes due to lack of ingredients, seek expert help to modify a recipe using available ingredients.

Recipes for F-75 and F-100

If you have cereal flour and cooking facilities, use one of the top three recipes for F-75.

Alternatives	Ingredients	Amount for F-75
If you have dried skimmed milk	Dried skimmed milk Sugar Cereal flour Vegetable oil Combined mineral and vitamin mix (CMV)* *Water to make 1,000 ml*	25 g 70 g 35 g 30 g ½ level scoop *1,000 ml***
If you have dried whole milk	Dried whole milk Sugar Cereal flour Vegetable oil CMV* *Water to make 1,000 ml*	35 g 70 g 35 g 20 g ½ level scoop *1,000 ml***
If you have fresh cow's milk or full-cream (whole) long-life milk	Fresh cow's milk or full-cream (whole) long-life milk Sugar Cereal flour Vegetable oil CMV* *Water to make 1,000 ml*	300 ml 70 g 35 g 20 g ½ level scoop *1,000 ml***

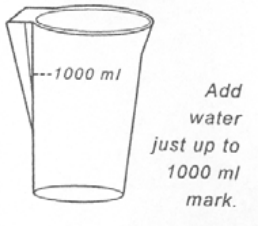
If you do not have cereal flour or there are no cooking facilities, use one of the following recipes for F-75,

No cooking is required for F-100,

Alternatives	Ingredients	Amount for F-75	Amount for F-100
If you have dried skimmed milk	Dried skimmed milk Sugar Vegetable oil CMV* *Water to make 1,000 ml*	25 g 100 g 30 g ½ level scoop *1,000 ml***	80 g 50 g 60 g ½ level scoop *1,000 ml***
If you have dried whole milk	Dried whole milk Sugar Vegetable oil CMV* *Water to make 1,000 ml*	35 g 100 g 20 g ½ level scoop *1,000 ml***	110 g 50 g 30 g ½ level scoop *1,000 ml***
If you have fresh cow's milk or full-cream (whole) long-life milk	Fresh cow's milk or full-cream (whole) long-life milk Sugar Vegetable oil CMV* *Water to make 1,000 ml*	300 ml 100 g 20 g ½ level scoop *1,000 ml***	880 ml 75 g 20 g ½ level scoop *1,000 ml***

* The contents of CMV are listed in **Annex D**.

** Important note about adding water: Add just the amount of water needed to make 1,000 ml of formula. (This amount will vary from recipe to recipe, depending on the other ingredients.) Do not simply add 1,000 ml of water, as this will make the formula too dilute. A mark for 1,000 ml should be made on the mixing container for the formula so that water can be added to the other ingredients up to this mark.



6.2. Ready-to-Use Therapeutic Food

RUTF is an energy-dense, mineral- and vitamin-enriched food that is equivalent to F-100. RUTF is used in Inpatient Care during transition and continued during rehabilitation in Outpatient Care. RUTF is an integral part of Outpatient Care, as it allows children to be treated at home rather than at centre-based Inpatient Care treatment facilities.

There are currently two forms and several commercial types of RUTF: a lipid-based spread, such as Plumpy'nut®, and a biscuit bar, such as BP 100®. Several countries are producing their own lipid-based RUTF. Their products have similar nutritional quality as F-100 and have been shown to be physiologically similar to commercial forms of F-100 and RUTF.

Plumpy'nut® is a ready-to-eat therapeutic spread presented in individual packets. It is a paste composed of vegetable fat, groundnut/peanut butter, skimmed milk powder, lactoserum, maltodextrin, sugar, and combined mineral and vitamin mix (CMV).

Instructions for Use

Clean drinking water must be made available to children while they consume RUTF. The product should be given only to children that can express their thirst.

Recommendations for Use

It is recommended to use the product for the dietetic management of SAM in the transition and rehabilitation phases.

Storage and Packaging

Plumpy'nut® has a shelf life of 24 months from manufacturing date and should be stored in a cool and dry place. It often comes in a 92 g packet that contains 500 kcal. A carton (around 15.1 kg) contains 150 packets.

To learn more, see **Annex D**.

6.3. Vitamin and Mineral Mix

A commercial product called CMV is used to provide the necessary minerals and vitamins that is included in each recipe for F-75 and F-100. It is also used in making ReSoMal. The contents of the CMV are listed later in the module. The mix contains potassium, magnesium, and other essential minerals.

In case the commercial F-75 or F-100 is not used, CMV **must** be added to the local preparation of F-75 and F-100 to correct the electrolyte and vitamin imbalance.

CMV specifications are provided later in this module. To learn more, see **Annex D**.

If the commercial product CMV is not available, a mineral mix can be prepared at the hospital and multivitamin drops can be given to children.

Prepare the Mineral Mix at Your Facility

The contents of the mineral mix are listed in **Annex D** of this module. The mix contains potassium, magnesium, and other essential minerals. It **must** be included in F-75 and F-100 to correct electrolyte imbalance. The mineral mix may be made in the pharmacy of the hospital.

Note: *20 ml of the mineral mix prepared is equivalent to ½level scoop of Commercial product CMV.*

Vitamins

In addition to the minerals, vitamins are also needed in or with the feed. The vitamin mix cannot be made in the hospital pharmacy because amounts are so small. Thus, children are usually given multivitamin drops as well. Recommended vitamins to be included in the multivitamin preparation are listed in **Annex D** of this module. The multivitamin preparation should **not** include iron.

If CMV is used, separate multivitamin drops are not needed.

Whether using CMV or multivitamin drops, extra folic acid and Vitamin A if the child has eye signs are needed. These additional requirements will be discussed in **Module 3, Initial Management** and **Module 5, Daily Care**.

SHORT ANSWER EXERCISE

Briefly answer these questions as a review of the previous section.

1. What are two important differences between F-75 and F-100 (and RUTF)?

2. Why is it important to have different formulas (F-75, F-100, and RUTF) for managing SAM?

3. CMV is included in F-75, F-100, and RUTF to correct electrolyte imbalances. What are two important minerals in this mix and why?

4. If F-75 and F-100 are made with mineral mix instead of CMV, what must the child be given in addition to the feeds?

5. What is the difference between F-100 and RUTF?

Tell the facilitator when you are ready to discuss these questions with the group.
Check your own answers to this exercise by comparing them to the answers given at the end of this module on page 53.

6.4. Procedure for Successful Management of Children with SAM in Inpatient Care

The following process is essential for successful management of a child with SAM. You will learn how to do these important steps in **Module 3, Initial Management**; **Module 4, Feeding**; and **Module 5, Daily Care**. (See also the job aid and wall chart **10 Steps for Inpatient Care**).

1 – 2. Treat/prevent hypothermia and hypoglycaemia (which are often related) by feeding, keeping warm, and treating infection.

3. Treat/prevent dehydration using ReSoMal.

4. Correct electrolyte imbalance (by giving feeds and ReSoMal prepared with mineral mix or CMV).

5. Presume and treat infection with antibiotics.

6. Correct micronutrient deficiencies (by giving feeds prepared with CMV, if CMV is not available, by giving mineral mix, and by giving extra vitamins and folic acid as needed).

7. Start cautious feeding with F-75 to stabilise the child (usually 2–7 days).

8. Rebuild wasted tissues through higher protein and calorie feeds (RUTF or F-100).

9. Provide stimulation, play, and loving care.

10. Prepare mothers for referral and follow up in Outpatient Care to continue treatment (or proper feeding and stimulation after discharge if full recovery is attained in Inpatient Care).

Overview Treatment of Children with SAM (10 Steps According to the WHO 1999 Protocol for the Management of SAM)[3]

	Stabilisation Phase		Rehabilitation Phase
Steps	***Days 1-2***	***Days 2-7***	***Weeks 2-6***
1. Hypoglycaemia	→		
2. Hypothermia	→		
3. Dehydration	→		
4. Electrolytes	→	→	→
5. Infections	→	→	
6. Micronutrients	**Without iron** →	→	**With iron** →
7. Cautious feeding	→	→	
8. Catch-up growth			→
9. Sensory stimulation	→	→	→
10. Prepare for follow-up			→

SAM is both a medical and a social disorder. That is, the medical problems of the child result, in part, from the social problems of the home in which the child lives. Malnutrition is the end result of chronic nutritional and, frequently, emotional deprivation by caregivers who, because of poor understanding, poverty, or family problems, are unable to provide the child with the nutrition and care he or she requires.

Successful management of SAM in children requires that both medical and social problems be recognised and corrected. If the illness is viewed as being only a medical disorder, the child is likely to relapse when he or she returns home and other children in the family will remain at risk of developing the same problem.

Management of the child with SAM is divided into three phases.

1. **Initial treatment (stabilisation):** Life-threatening problems are identified and treated in a hospital or residential care facility, specific deficiencies are corrected, metabolic abnormalities are reversed, and feeding is begun.

2. **Transition:** This prepares the child for Outpatient Care and can last up to 3 days. RUTF is gradually introduced in this phase.

3. **Rehabilitation and follow up:** Intensive feeding is given to recover most of the lost weight, emotional and physical stimulation are increased, and, in most cases, rehabilitation will take place in Outpatient Care using RUTF. During rehabilitation in

[3] WHO 1999. *Management of severe malnutrition: A manual for physicians and other senior health workers.*

Outpatient Care, the mother and child are followed up to prevent relapse and to assure the continued physical, mental, and emotional development of the child.

Successful management of children with SAM does not require sophisticated facilities and equipment or highly qualified personnel. It does, however, require that each child be treated with proper care and affection and that each phase of treatment be carried out properly by appropriately trained and dedicated health workers. When this is done, the risk of death can be substantially reduced and the opportunity for full recovery greatly improves.

6.5. Important Things NOT to Do and Why

Be sure that personnel in the emergency treatment area of the hospital know these important things NOT to do, as well as what to do.

- **Do not give diuretics to treat oedema.** The oedema is due partly to potassium and magnesium deficiencies that may take up to 2 weeks to correct. The oedema will go away with proper feeding that includes potassium and magnesium. Giving a diuretic will worsen the child's electrolyte imbalance and may cause death.

- **Do not give iron during the initial feeding phase.** Add iron only after the child has been on F-100 for 2 days (usually during Week 2). As described earlier, giving iron early in treatment can have toxic effects and interfere with the body's ability to resist infection. There is no need to add iron when the child is on RUTF.

- **Do not give high-protein formula** (over 1.5 g protein per kg daily). Too much protein in the first days of treatment may be dangerous because the child with SAM is unable to deal with the extra metabolic stress involved. Too much protein could overload the liver, heart, and kidneys and may cause death.

- **Do not give intravenous (IV) fluids routinely.** IV fluids can easily cause fluid overload and heart failure in a child with SAM. Give IV fluids only to children with signs of shock. (Treatment will be described in **Module 3, Initial Management**.)

SHORT ANSWER EXERCISE

Fill in the blanks based on your reading in the module.

1. Two conditions that are related and must be treated immediately in a child with SAM are _____ and _____.

2. Cautious feeding with _____ is necessary at first to stabilise the child. Later, _____ or _____ is given to rebuild wasted tissues and gain weight.

3. To correct electrolyte imbalance, it is important to give feeds prepared with a product called _____.

4. If a child with SAM has diarrhoea, a special rehydration solution called _____ should be given. This solution has less _____ and more _____ than regular or low-osmolarity ORS.

Indicate in the blank whether the statement is true or false.

5. _____ Giving iron too early in treatment can have toxic effects.

6. _____ All children with SAM and medical complications should be given antibiotics.

7. _____ Giving IV fluids too quickly can cause heart failure in a child with SAM.

8. _____ Diuretics should be given to reduce oedema.

9. _____ Unless CMV is used to prepare feeds, the child needs multivitamin drops.

Check your own answers to this exercise by comparing them to the answers given at the end of this module on page 54.

7. Recommended Criteria for Referral and Discharge

7.1. Understanding Criteria for Referral and Discharge from the Management of SAM

The Interim *National Guidelines for CMAM in Ghana* recommends that a child be kept in Inpatient Care until his or her condition is stabilised and appetite regained. Once medical complications have stabilised and appetite has returned, the child should be referred to a health facility providing Outpatient Care services to continue with the management of SAM until full recovery.

In special cases where there is no access to RUTF or when a child remains in Inpatient Care until full recovery, a child is ready for discharge as **cured** from Inpatient Care if the discharge criteria are met. The table below provides a summary of the referral and discharge criteria from Inpatient Care and Outpatient Care.

Recommended Criteria for Referral and Discharge in CMAM for Children 6–59 Months of Age

Inpatient Care	Outpatient Care
Referred to Outpatient Care: • Appetite returned (passed appetite test) • Medical complication resolving • Severe bilateral pitting oedema decreasing • Clinically well and alert If admitted due to bilateral pitting oedema and severe wasting (marasmic-kwashiokor), additional criterion for referral is bilateral pitting oedema resolved. Discharged cured (for special cases who stay until full recovery): • 15% weight gain maintained for 2 consecutive weeks • Oedema-free for 2 consecutive weeks • Clinically well and alert	Discharged cured: • 15% weight gain maintained for 2 consecutive weeks (of admission weight or weight free of oedema) • Oedema-free for 2 consecutive weeks • Clinically well and alert Children are referred to receive supplementary feeding if available.

Other children that are discharged but did not meet the discharged cured criteria (thus did not recover) are children that:

- **Died** while in treatment
- **Defaulted** or were absent for the third day
- **Non-Recovered** or did not meet the discharge criteria after 4 months in treatment; during the treatment, these children would have shown signs of non-response to treatment and been referred for further medical investigations

7.2. Referral to Outpatient Care

If Outpatient Care for the management of SAM without medical complications is in place, the Ministry of Health/Ghana Health Services (MOH/GHS) recommends that children be kept in Inpatient Care until their condition is stabilised. It usually requires about 5–10 days for the medical complications to stabilise if medical care and dietary feeding recommendations are followed.

The child should then be referred to Outpatient Care if the following criteria are met.

- Appetite has returned.
- Medical complications are resolving.
- Bilateral pitting oedema is decreasing.
- The child is clinically well and alert.

If a child leaves before being stabilised, he or she is likely to get worse and have to return, or he or she may die.

If no Outpatient Care sites for the management of SAM without medical complications are in place in a health facility closer to the child's place of residence, but RUTF is available, the MOH/GHS recommends that the hospital treats the child in its outpatient department serving as Outpatient Care for the management of SAM until the child fully recovers.

7.3. Discharge after Full Recovery

If no Outpatient Care sites for the management of SAM without medical complications are in place in a health facility closer to the child's place of residence and RUTF is not available, the MOH/GHS recommends that a child be kept in Inpatient Care until full recovery. The following discharge criteria should be met:

- Fifteen percent weight gain maintained for 2 consecutive weeks (of the admission weight or weight free of oedema)
- No bilateral pitting oedema for 2 consecutive weeks
- Clinically well and alert

Full recovery usually takes about 2–6 weeks for a child to achieve the target weight if feeding recommendations are followed. It may be difficult to keep children for this long, but the risks of early discharge are great. If a child leaves **before** achieving the discharge criteria, he or she is likely to get worse and have to return.

If early discharge is necessary, many preparations must be made to ensure that the mother can continue care at home. Follow-up visits are essential. There will be a discussion exercise about early discharge situations in **Module 7, Involving Mothers in Care**.

Tell the facilitator when you have reached this point in the module. There will be a brief video showing signs of SAM and the transformations that can occur when children with SAM are correctly managed. You will also discuss photos 21–29, which show children before and after treatment for SAM. Look at these photos while waiting for the video.

Annex A. Explanation of Z-Scores

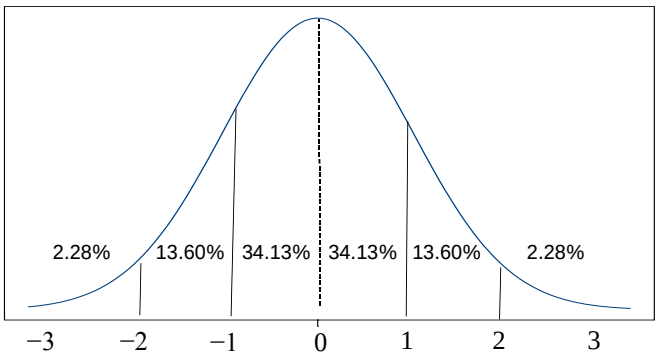
What Does a Z-Score Tell Us?

The lines on the growth charts are called z-score lines based on z-scores, also known as SD scores. Z-scores are used to describe how far a measurement is from the median (or average in a normal distribution). For example a WHZ of –2.33 means that the child's weight is 2.33 SD below the expected median weight of children of the same height. The child has a lower weight for his or her height compared to the standard, and he or she is classified as 'wasted'. A positive z-score indicates that the child's weight is to the right of the median, i.e., the child is heavier compared to the standard.

Z-scores are calculated differently for measurements that are distributed normally and non-normally in the standard population.

Normally Distributed Measurements

The concept of a normal distribution is helpful for understanding what a z-score is. In a normal distribution, most values are grouped around the middle as shown below.



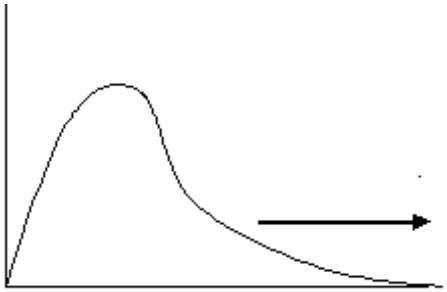
The distribution of heights of all boys (or all girls) of a given age forms a bell-shaped curve, or a normal (or almost normal) distribution. Each segment on the horizontal axis represents 1 SD or z-score, and the z-scores −1 and 1 are at equal distances in opposite directions from the median. The distance from the median to 1 is half of the distance from the median to 2.

The z-score of an observed point in this distribution is calculated as follows.

$$\text{z-score} = \frac{(\text{observed value}) - (\text{median reference value})}{\text{z-score of the reference population}}$$

Non-Normally Distributed Measurements

Unlike the distribution of height, the distribution of weight has a shape that when graphed looks like a 'deformed' bell whose right side is longer than the left and is described as right-skewed (not normal).



It is more difficult to calculate z-scores for weight-based indicators. Unlike in a normal distribution, distances between adjacent z-scores are not constant.

Calculating the z-score of an observed point involves a series of mathematical calculations that take into account the non-normal distribution of measurements in the standard population. The following formula is used.

$$\text{z-score} = \frac{(\text{observed value} \div \text{M})^{\text{L}} - 1}{\text{L x S}}$$

In this formula, *M*, *L*, and *S* are values for the standard population. *M* is the standard median value that estimates the population mean. *L* is the power needed to transform the data to remove skewness (i.e., to normalise the data). *S* is the coefficient of variation (or equivalent).

This formula (sometimes called the LMS formula) is used to calculate z-scores for WFA, WFH, and body mass index (BMI)-for-age.

To select children for interventions if they are below specified WFH cutoffs based on WHO standards, the simplified field tables of **Annex B** should be used.

Annex B. World Health Organisation Child Growth Standards

Weight-for–Height/Length Reference Table (*less than* 87 cm)

Boys Weight (kg)					Height/Length (cm)	Girls Weight (kg)				
−4 SD	−3 SD	−2 SD	−1 SD	Median		Median	−1 SD	−2 SD	−3 SD	−4 SD
1.7	1.9	2.0	2.2	2.4	**45**	2.5	2.3	2.1	1.9	1.7
1.8	2.0	2.2	2.4	2.6	**46**	2.6	2.4	2.2	2.0	1.9
2.0	2.1	2.3	2.5	2.8	**47**	2.8	2.6	2.4	2.2	2.0
2.1	2.3	2.5	2.7	2.9	**48**	3.0	2.7	2.5	2.3	2.1
2.2	2.4	2.6	2.9	3.1	**49**	3.2	2.9	2.6	2.4	2.2
2.4	2.6	2.8	3.0	3.3	**50**	3.4	3.1	2.8	2.6	2.4
2.5	2.7	3.0	3.2	3.5	**51**	3.6	3.3	3.0	2.8	2.5
2.7	2.9	3.2	3.5	3.8	**52**	3.8	3.5	3.2	2.9	2.7
2.9	3.1	3.4	3.7	4.0	**53**	4.0	3.7	3.4	3.1	2.8
3.1	3.3	3.6	3.9	4.3	**54**	4.3	3.9	3.6	3.3	3.0
3.3	3.6	3.8	4.2	4.5	**55**	4.5	4.2	3.8	3.5	3.2
3.5	3.8	4.1	4.4	4.8	**56**	4.8	4.4	4.0	3.7	3.4
3.7	4.0	4.3	4.7	5.1	**57**	5.1	4.6	4.3	3.9	3.6
3.9	4.3	4.6	5.0	5.4	**58**	5.4	4.9	4.5	4.1	3.8
4.1	4.5	4.8	5.3	5.7	**59**	5.6	5.1	4.7	4.3	3.9
4.3	4.7	5.1	5.5	6.0	**60**	5.9	5.4	4.9	4.5	4.1
4.5	4.9	5.3	5.8	6.3	**61**	6.1	5.6	5.1	4.7	4.3
4.7	5.1	5.6	6.0	6.5	**62**	6.4	5.8	5.3	4.9	4.5
4.9	5.3	5.8	6.2	6.8	**63**	6.6	6.0	5.5	5.1	4.7
5.1	5.5	6.0	6.5	7.0	**64**	6.9	6.3	5.7	5.3	4.8
5.3	5.7	6.2	6.7	7.3	**65**	7.1	6.5	5.9	5.5	5.0
5.5	5.9	6.4	6.9	7.5	**66**	7.3	6.7	6.1	5.6	5.1
5.6	6.1	6.6	7.1	7.7	**67**	7.5	6.9	6.3	5.8	5.3
5.8	6.3	6.8	7.3	8.0	**68**	7.7	7.1	6.5	6.0	5.5
6.0	6.5	7.0	7.6	8.2	**69**	8.0	7.3	6.7	6.1	5.6
6.1	6.6	7.2	7.8	8.4	**70**	8.2	7.5	6.9	6.3	5.8
6.3	6.8	7.4	8.0	8.6	**71**	8.4	7.7	7.0	6.5	5.9
6.4	7.0	7.6	8.2	8.9	**72**	8.6	7.8	7.2	6.6	6.0
6.6	7.2	7.7	8.4	9.1	**73**	8.8	8.0	7.4	6.8	6.2
6.7	7.3	7.9	8.6	9.3	**74**	9.0	8.2	7.5	6.9	6.3
6.9	7.5	8.1	8.8	9.5	**75**	9.1	8.4	7.7	7.1	6.5
7.0	7.6	8.3	8.9	9.7	**76**	9.3	8.5	7.8	7.2	6.6
7.2	7.8	8.4	9.1	9.9	**77**	9.5	8.7	8.0	7.4	6.7
7.3	7.9	8.6	9.3	10.1	**78**	9.7	8.9	8.2	7.5	6.9
7.4	8.1	8.7	9.5	10.3	**79**	9.9	9.1	8.3	7.7	7.0
7.6	8.2	8.9	9.6	10.4	**80**	10.1	9.2	8.5	7.8	7.1
7.7	8.4	9.1	9.8	10.6	**81**	10.3	9.4	8.7	8.0	7.3
7.9	8.5	9.2	10.0	10.8	**82**	10.5	9.6	8.8	8.1	7.5
8.0	8.7	9.4	10.2	11.0	**83**	10.7	9.8	9.0	8.3	7.6
8.2	8.9	9.6	10.4	11.3	**84**	11.0	10.1	9.2	8.5	7.8
8.4	9.1	9.8	10.6	11.5	**85**	11.2	10.3	9.4	8.7	8.0
8.6	9.3	10.0	10.8	11.7	**86**	11.5	10.5	9.7	8.9	8.1

Weight-for-Height/Length Reference Table (*greater than* 87cm)

Boys Weight (kg)					Height/Length (cm)	Girls Weight (kg)				
−4 SD	**−3 SD**	**−2 SD**	**−1 SD**	**Median**		**Median**	**−1 SD**	**−2 SD**	**−3 SD**	**−4 SD**
8.9	9.6	10.4	11.2	12.2	**87**	11.9	10.9	10.0	9.2	8.4
9.1	9.8	10.6	11.5	12.4	**88**	12.1	11.1	10.2	9.4	8.6
9.3	10.0	10.8	11.7	12.6	**89**	12.4	11.4	10.4	9.6	8.8
9.4	10.2	11.0	11.9	12.9	**90**	12.6	11.6	10.6	9.8	9.0
9.6	10.4	11.2	12.1	13.1	**91**	12.9	11.8	10.9	10.0	9.1
9.8	10.6	11.4	12.3	13.4	**92**	13.1	12.0	11.1	10.2	9.3
9.9	10.8	11.6	12.6	13.6	**93**	13.4	12.3	11.3	10.4	9.5
10.1	11.0	11.8	12.8	13.8	**94**	13.6	12.5	11.5	10.6	9.7
10.3	11.1	12.0	13.0	14.1	**95**	13.9	12.7	11.7	10.8	9.8
10.4	11.3	12.2	13.2	14.3	**96**	14.1	12.9	11.9	10.9	10.0
10.6	11.5	12.4	13.4	14.6	**97**	14.4	13.2	12.1	11.1	10.2
10.8	11.7	12.6	13.7	14.8	**98**	14.7	13.4	12.3	11.3	10.4
11.0	11.9	12.9	13.9	15.1	**99**	14.9	13.7	12.5	11.5	10.5
11.2	12.1	13.1	14.2	15.4	**100**	15.2	13.9	12.8	11.7	10.7
11.3	12.3	13.3	14.4	15.6	**101**	15.5	14.2	13.0	12.0	10.9
11.5	12.5	13.6	14.7	15.9	**102**	15.8	14.5	13.3	12.2	11.1
11.7	12.8	13.8	14.9	16.2	**103**	16.1	14.7	13.5	12.4	11.3
11.9	13.0	14.0	15.2	16.5	**104**	16.4	15.0	13.8	12.6	11.5
12.1	13.2	14.3	15.5	16.8	**105**	16.8	15.3	14.0	12.9	11.8
12.3	13.4	14.5	15.8	17.2	**106**	17.1	15.6	14.3	13.1	12.0
12.5	13.7	14.8	16.1	17.5	**107**	17.5	15.9	14.6	13.4	12.2
12.7	13.9	15.1	16.4	17.8	**108**	17.8	16.3	14.9	13.7	12.4
12.9	14.1	15.3	16.7	18.2	**109**	18.2	16.6	15.2	13.9	12.7
13.2	14.4	15.6	17.0	18.5	**110**	18.6	17.0	15.5	14.2	12.9
13.4	14.6	15.9	17.3	18.9	**111**	19.0	17.3	15.8	14.5	13.2
13.6	14.9	16.2	17.6	19.2	**112**	19.4	17.7	16.2	14.8	13.5
13.8	15.2	16.5	18.0	19.6	**113**	19.8	18.0	16.5	15.1	13.7
14.1	15.4	16.8	18.3	20.0	**114**	20.2	18.4	16.8	15.4	14.0
14.3	15.7	17.1	18.6	20.4	**115**	20.7	18.8	17.2	15.7	14.3
14.6	16.0	17.4	19.0	20.8	**116**	21.1	19.2	17.5	16.0	14.5
14.8	16.2	17.7	19.3	21.2	**117**	21.5	19.6	17.8	16.3	14.8
15.0	16.5	18.0	19.7	21.6	**118**	22.0	19.9	18.2	16.6	15.1
15.3	16.8	18.3	20.0	22.0	**119**	22.4	20.3	18.5	16.9	15.4
15.5	17.1	18.6	20.4	22.4	**120**	22.8	20.7	18.9	17.3	15.6

Annex C. Pathophysiology Basis for Treatment of SAM[4]

Affected Organ or System	Effects	Derived Treatment Principle
Cardiovascular System	• Cardiac output and stroke volume are reduced. • Blood pressure is low. • Renal perfusion and circulation time are reduced. • Plasma volume is usually normal, and red cell volume is reduced.	• If the child appears dehydrated, give ReSoMal and continue feeding with F-75; do not give fluids intravenously unless the child is in shock. • Restrict blood transfusion to 10 ml/kg and give a diuretic. • Restrict the use of infusion of saline unless hypovolemic shock, because any increase in blood volume can easily produce acute heart failure.
Genitourinary System	• Glomerular filtration is reduced. • Capacity of kidney to excrete excess acid or water load is greatly reduced. • Urinary phosphate output is low. • Sodium excretion is reduced.	• Do not give the child more protein than is required to retain tissues. • Ensure that high-quality proteins are given, with balanced amino acids. • Avoid nutrients that give an acid load, such as magnesium chloride. • Restrict dietary sodium. • Ensure that water intake is sufficient but not excessive.
Gastrointestinal System	• Production of gastric acid is reduced. • Intestinal motility is reduced. • Pancreas is atrophied, production of digestive enzymes is reduced, insulin levels are reduced, and glucose intolerance is increased. • Small intestinal mucosa is atrophied, and secretion of digestive enzymes is reduced. • Absorption of nutrients is reduced when large amounts of food are eaten.	• Give the child small, frequent feeds. • If absorption is poor, increase the frequency and reduce the size of each feed. • If there is malabsorption of fat, treatment with pancreatic enzymes may be useful.

[4] Adapted from WHO. 1999. *Management of severe malnutrition: a manual for physicians and other senior health workers.*

Affected Organ or System	Effects	Derived Treatment Principle
Liver	• Synthesis of all proteins is reduced. • Abnormal metabolites of amino acids are produced. • Capacity of liver to take up, metabolise, and excrete toxins is severely reduced. • Energy production from substrates, such as galactose and fructose, is much slower than normal. • Gluconeogenesis is reduced, which increases the risk of hypoglycaemia during infection. • Bile secretion is reduced.	• Do not give the child large meals. • Ensure that the amount of protein given does not exceed the metabolic capacity of the liver, but is sufficient to support synthesis of proteins (1–2 g/kg/day). • Reduce the dose of drugs that depend on hepatic disposal or are hepatoxic. • Ensure that sufficient carbohydrate is given to avoid the need for gluconeogenesis. • Do not give iron supplements, which may be dangerous because transferrin levels are reduced.
Immune System	• All aspects of immunity are diminished. • Lymph glands, tonsils, and the thymus are atrophied. • Cell-mediated (T-cell) immunity is severely depressed. • Immunoglobulin A (IgA) levels in secretions are reduced. • Complement components are low. • Phagocytes do not kill ingested bacteria efficiently. • Tissue damage does not result in inflammation or migration of white cells to the affected area. • Acute phase immune response is diminished. • Urinary tract infection is common.	• Treat all children with broad-spectrum antimicrobials. • Prevent and treat hypoglycaemia and hypothermia because they are common signs of severe infection and are usually associated with septic shock. • Because of the risk of transmission of infection, ensure that newly admitted children are kept apart from children that are recovering from infection. • Prevent further tissue breakdown by treating any infections and providing adequate energy (80–100 kcal per day). • Provide routine antibiotics because typical signs of infection, such as an increased white cell count and fever, are frequently absent.
Endocrine System	• Insulin levels are reduced, and the child has glucose intolerance. • Insulin-like growth factor 1 (IGF-1) levels are reduced. • Growth hormone levels are increased. • Cortisol levels are usually increased.	• Give the child small, frequent feeds. • Do not give steroids.

Affected Organ or System	Effects	Derived Treatment Principle
Metabolism and Cellular Function	• Basic metabolic rate is reduced by about 30%. • Energy expenditure due to activity is very low. • Both heat generation and heat loss are impaired; the child becomes hypothermic in a cold environment and hyperthermic in a hot environment. • Sodium pump activity is reduced and cell membranes are more permeable than normal, which leads to an increase in intracellular sodium and a decrease in intracellular potassium and magnesium.	• Keep the child warm to prevent hypothermia; dry the child quickly and properly after washing, and cover with clothes and blankets; ensure that windows are kept closed at night and keep the temperature of the living environment at 25–30º C. • If a child has fever, cool the child by sponging with tepid (not cold) water (never alcohol rubs). • Give large doses of potassium and magnesium to all children. • Restrict sodium intake.
Skin, Muscles and Exocrine Glands	• The skin and subcutaneous fat are atrophied, which leads to loose folds of skin. • Many signs of dehydration are unreliable; eyes may be sunken because of loss of subcutaneous fat in the orbit. • Many glands, including the sweat, tear and salivary glands are atrophied; the child has dryness of the mouth, and eyes and sweat production is reduced. • Respiratory muscles are easily fatigued; the child is lacking in energy.	• Rehydrate the child with ReSoMal and continue feeding with F-75.

Annex D. F-75, F-100, Ready-to-Use Therapeutic Food, and Combined Mineral and Vitamin Mix Specifications

F-75 and F-100 Specifications

Constituent	F-75 Amount in 100 ml	F-100 Amount in 100 ml	F-100-Diluted Amount in 100 ml (approximation)
Energy	75 kcal	100 kcal	74 kcal
Protein	0.9 g	2.9 g	2.1 g
Lactose	1.3 g	4.2 g	3.1 g
Potassium	3.6 mmol	5.9 mmol	4.1 mmol
Sodium	0.6 mmol	1.9 mmol	1.4 mmol
Magnesium	0.43 mmol	0.73 mmol	0.54 mmol
Zinc	2.0 mg	2.3 mg	1.7 mg
Copper	0.25 mg	0.25 mg	0.1 mg
% of energy from protein	5%	12%	12%
% of energy from fat	32%	53%	53%
Osmolarity	333 mOsmol/L	419 mOsmol/L	310 mOsmol/L

Ready-to-Use Therapeutic Food Specification

RUTF is an integral part of outpatient programmes, as it allows children to be treated at home rather than at inpatient treatment centres. RUTF is an energy-dense, mineral- and vitamin-enriched food, which is equivalent to F-100 therapeutic milk.

There are several commercial types of RUTF, such as Plumpy'nut® and BP 100®. Several countries are producing their own RUTF using recipes that are adapted to locally available ingredients, and those products have nutritional quality similar to F-100. They have also been shown to be physiologically similar to both commercial forms of F-100 and RUTF.

Mean Nutrition Value of Plumpy'nut®

Nutrients	For 100 g	Per Packet of 92 g	Nutrients	For 100 g	Per Packet of 92 g
Energy	545 kcal	500 kcal	Vitamin A	910 µg	840 µg
Proteins	13.6 g	12.5 g	Vitamin D	16 µg	15 µg
Lipids	35.7 g	32.86 g	Vitamin E	20 mg	18.4 mg
Calcium	300 mg	276 mg	Vitamin C	53 mg	49 mg
Phosphorus	300 mg	276 mg	Vitamin B1	0.6 mg	0.55 mg
Potassium	1,111 mg	1,022 mg	Vitamin B2	1.8 mg	1.66 mg
Magnesium	92 mg	84.6 mg	Vitamin B6	0.6 mg	0.55 mg
Zinc	14 mg	12.9 mg	Vitamin B12	1.8 µg	1.7 µg

Nutrients	For 100 g	Per Packet of 92 g	Nutrients	For 100 g	Per Packet of 92 g
Copper	1.8 mg	1.6 mg	Vitamin K	21 µg	19.3 µg
Iron	11.5 mg	10.6 mg	Biotin	65 µg	60 µg
Iodine	100 µg	92 µg	Folic acid	210 µg	193 µg
Selenium	30 µg	27.6 µg	Pantothenic acid	3.1 mg	2.85 mg
Sodium	< 290 mg	< 267 mg	Niacin	5.3 mg	4.88 mg

RUTF is suitable for the treatment of severely malnourished children. RUTF should be soft or crushable, palatable, and easy for young children to eat without any preparation. At least half of the proteins contained in the product should come from milk products.

Nutrition Composition of RUTF

Moisture content	2.5% maximum
Energy	520–550 kcal/100 g
Proteins	10–12% total energy
Lipids	45–60% total energy
Sodium	290 mg/100 g maximum
Potassium	1,100–1,400 mg/100 g
Calcium	300–600 mg/100 g
Phosphorus (excluding phytate)	300–600 mg/100 g
Magnesium	80–140 mg/100 g
Iron	10–14 mg/100 g
Zinc	11–14 mg/100 g
Copper	1.4–1.8 mg/100 g
Selenium	20–40 µg
Iodine	70–140 µg/100 g
Vitamin A	0.8–1.1 mg/100 g
Vitamin D	15–20 µg/100 g
Vitamin E	20 mg/100 g minimum
Vitamin K	15–30 µg/100 g
Vitamin B1	0.5 mg/100 g minimum
Vitamin B2	1.6 mg/100 g minimum
Vitamin C	50 mg/100 g minimum
Vitamin B6	0.6 mg/100 g minimum
Vitamin B12	1.6 µg/100 g minimum
Folic acid	200 µg/100 g minimum
Niacin	5 mg/100 g minimum
Pantothenic acid	3 mg/100 g minimum
Biotin	60 µg/100 g minimum
n-6 fatty acids	3–10% of total energy
n-3 fatty acids	0.3–2.5% of total energy

Note: *Iron is already added to RUTF, but not to F-100.*

Combined Mineral and Vitamin Mix Composition

Nutritional Value of Commercial CMV (Per 6.35 g or 1 Level Scoop)

Vitamins	Minerals
Biotin: 0.2 mg	Vitamin D: 60 µg
Folic acid: 700 µg	Vitamin E: 44 mg
Niacin: 20 mg	Vitamin K: 80 µg
Pantothenic acid: 6 mg	
	Copper: 5.7 mg
Vitamin A: 3,000 µg	Iodine: 154 µg
Vitamin B1: 1.4 mg	Iron: 0 mg
Vitamin B12: 2 µg	Magnesium: 146 mg
Vitamin B2: 4 mg	Potassium: 2,340 mg
Vitamin B6: 1.4 mg	Selenium: 94 µg
Vitamin C: 200 mg	Zinc: 40 mg

Annex E. Composition of Mineral and Vitamin Mixes

Composition of Mineral Mix Solution

Substance	Amount
Potassium Chloride	89.5 g
Tripotassium citrate	32.4 g
Magnesium chloride ($MgCl_2.6H_2O$)	30.5 g
Zinc acetate	3.3 g
Copper sulphate	0.65 g
Sodium selenate*	10 mg
Potassium iodide*	5 mg
Potassium iodide	1,000 ml

*If it is not possible to weigh very small amounts accurately, this substance may be omitted.

The above solution can be stored at room temperature. It is added to ReSoMal or liquid feed at a concentration of 20 ml/L.

Composition of Vitamin Mix

Vitamin	Amount per L of Liquid Diet
Water-soluble	
Thaimine (vitamin B)	0.7 mg
Riboflavin (vitamin B2)	2.0 mg
Nicotinic acid	10 mg
Pyridoxine (vitamin B6)	0.7 mg
Cyanocobalamin (vitamin B12)	1 g
Folic Acid	0.35 mg
Ascobic acid (vitamin C)	100 mg
Pantothenic acid (vitamin B5)	3 mg
Biotin	0.1 mg
Fat-soluble	
Retinol (vitamin A)	1.5 mg
Calciferol (vitamin D)	30 g
α-Tocopherol (vitamin E)	22 mg
Vitamine K	40 g

Annex F. Guidance Table to Identify Target Weight for Discharge from the Management of SAM for Children 6–59 Months of Age

Weight on admission* (kg)	Target weight: 15% weight gain	Weight on admission* (kg)	Target weight: 15% weight gain
4.1	4.7	8.1	9.3
4.2	4.8	8.2	9.4
4.3	4.9	8.3	9.5
4.4	5.1	8.4	9.7
4.5	5.2	8.5	9.8
4.6	5.3	8.6	9.9
4.7	5.4	8.7	10.0
4.8	5.5	8.8	10.1
4.9	5.6	8.9	10.2
5.0	5.8	9.0	10.4
5.1	5.9	9.1	10.5
5.2	6.0	9.2	10.6
5.3	6.1	9.3	10.7
5.4	6.2	9.4	10.8
5.5	6.3	9.5	10.9
5.6	6.4	9.6	11.0
5.7	6.6	9.7	11.2
5.8	6.7	9.8	11.3
5.9	6.8	9.9	11.4
6.0	6.9	10.0	11.5
6.1	7.0	10.1	11.6
6.2	7.1	10.2	11.7
6.3	7.2	10.3	11.8
6.4	7.4	10.4	12.0
6.5	7.5	10.5	12.1
6.6	7.6	10.6	12.2
6.7	7.7	10.7	12.3
6.8	7.8	10.8	12.4
6.9	7.9	10.9	12.5
7.0	8.0	11.0	12.7
7.1	8.2	11.1	12.8
7.2	8.3	11.2	12.9
7.3	8.4	11.3	13.0
7.4	8.5	11.4	13.1
7.5	8.6	11.5	13.2
7.6	8.7	11.6	13.3
7.7	8.9	11.7	13.5
7.8	9.0	11.8	13.6
7.9	9.1	11.9	13.7
8.0	9.2	12.0	13.8

* Weight free of oedema

Answers to Short Answer Exercise

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1. The body's systems slow down ('reductive adaptation') and must gradually 'learn' to function fully again. Rapid changes (such as rapid feeding or fluids) would overwhelm the systems, so feeding must be conducted slowly and cautiously.

2. Nearly all children with SAM have bacterial infections. In addition, as a result of reductive adaptation, the usual signs of infection may not be apparent because the body does not use its limited energy to respond in the usual ways, such as inflammation or fever. So, assume that infection is present and treat all children with SAM with broad spectrum antibiotics.

3. Giving iron early in treatment will not cure anaemia, as the child already has a supply of stored iron. Giving iron early in treatment can also lead to 'free iron' in the body. Free iron can cause problems; it promotes the formation of free radicals and bacterial growth and causes some infections to get worse. In addition, the body tries to protect itself from free iron by converting it to ferritin, and this conversion requires energy and amino acids that are diverted from other critical activities.

4. ReSoMal has less sodium and more potassium than regular or low-osmolarity ORS, and children with SAM already have excess sodium in their cells, so sodium intake should be restricted.

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1. F-75 contains fewer calories than F-100 (and RUTF): 75 kcal per 100 ml instead of 100 kcal per 100 ml.

   F-75 contains less protein than F-100 (and RUTF): 0.9 g per 100 ml instead of 2.9 g per 100 ml.

2. Why is it important to have different formulas (F-75, F-100 and RUTF) for managing SAM?

   Children with SAM cannot tolerate usual amounts of protein and sodium, or high amounts of fat. F-75 is needed as a 'starter' formula so that the body will not be overwhelmed in the initial stage of treatment. When the child is stabilised, he or she can tolerate more protein and fat. F-100 or RUTF is then used to 'catch up' and rebuild wasted tissues.

3. CMV is included in F-75, F-100 and RUTF to correct electrolyte imbalance. What are two important minerals in this mix and why?

Two important minerals in CMV are potassium and magnesium. These are needed to correct electrolyte imbalance in the cells. More potassium is needed in the cells, and magnesium is essential for potassium to enter the cells and be retained.

4. If F-75 and F-100 are made with mineral mix instead of CMV, multivitamin drops, folic acid, and vitamin A (if the child has eye signs) must be given to children.

5. RUTF is an energy- and nutrient-dense ready-to-use food that has the same specifications as F-100, with iron added to it.

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1. Two conditions that are related and must be treated immediately in a severely malnourished child are ___*hypoglycaemia*___ and ___*hypothermia*___.

2. Cautious feeding with __*F-75*__ is necessary at first to stabilise the child. Later, __*F-100*__ or *RUTF* is given to rebuild wasted tissues and gain weight.

3. To correct electrolyte imbalance, it is important to give feeds prepared with a product called *combined mineral and vitamin mix (CMV).*

4. If a child with SAM has diarrhoea, a special rehydration solution called *ReSoMal* should be given. This solution has less __*sodium*__ and more __*potassium*__ than ORS.

   Note: *ReSoMal also has more sugar than ORS.*

5. True

6. True

7. True

8. False: Diuretics should never be given to reduce oedema. With correct feeding, the oedema will eventually go away.

9. True: CMV contains vitamins. If CMV is used, separate multivitamin drops are not needed. If mineral mix without vitamins is used, multivitamin drops are needed.