

MODULE

Micronutrient Deficiency

For the Ethiopian Health Center Team



**Ethiopia Public Health
Training Initiative**

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UNIT ONE

INTRODUCTION

1.1. PURPOSE OF THE MODULE

The lack of appropriate and relevant teaching materials is one of the bottlenecks that hinders training of effective, competent task oriented professionals who are well versed with the knowledge, skills, attitudes and that would enable them to solve community problems. Preparation of such a teaching material is an important milestone in an effort towards achieving these long-term goals.. Therefore, this module is prepared for equipping trainees with adequate knowledge, skills and attitudes through interactive teaching mainly focused on Micronutrient deficiency.

The preparation of this module has taken in to account the current guideline on the management of severe acute malnutrition, guideline on infant and young child feeding, the essential nutrition actions approach and guideline on micronutrient deficiency prevention and control of the Federal democratic Republic of Ethiopian Ministry of health.

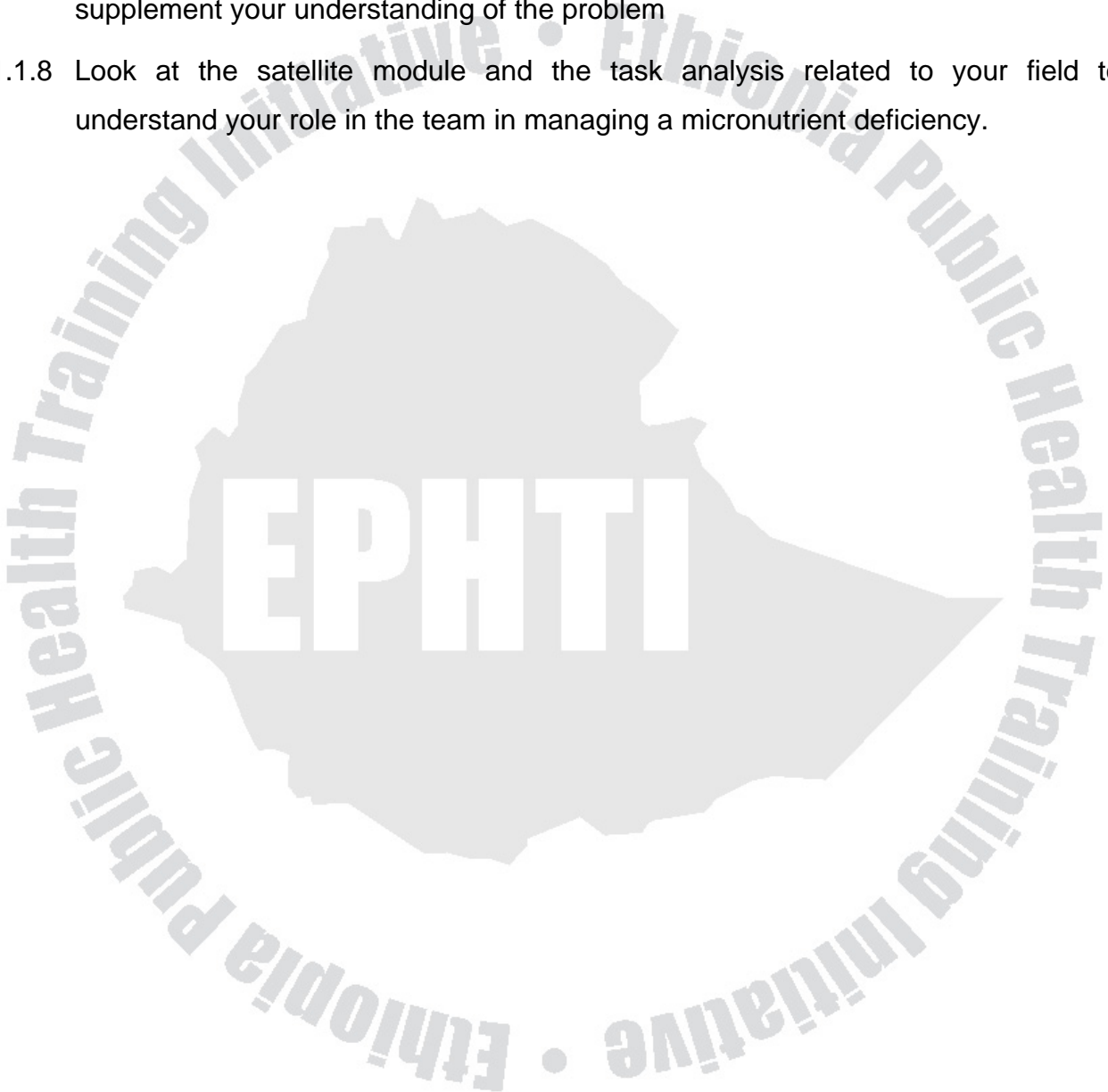
This module can be used for the basic training of health center teams at the training institutions and training of health center teams who are already in service sectors, and by health extension workers and care givers. However, it was not meant to replace standard textbooks or reference materials but can be used as a supplement to enhance the teaching and learning process.

1.2 DIRECTION FOR USING THE MODULE

In order to make maximum use of the module the user should follow these directions:

- 1.1.1 Check prerequisite knowledge required to use the module
- 1.1.2 Do the pretest pertaining to the core module in section 2.1.1
- 1.1.3 Read the core module thoroughly.

- 1.1.4 After going through the core module try to answer the pretest questions.
- 1.1.5 Evaluate yourself by referring to the key given in section 7.1 and 7.2
- 1.1.6 Read the case study and try to answer questions
- 1.1.7 Use the listed references and suggested reading materials to substantiate and supplement your understanding of the problem
- 1.1.8 Look at the satellite module and the task analysis related to your field to understand your role in the team in managing a micronutrient deficiency.



UNIT TWO

CORE MODULES

2.1. PRE-AND POST TEST

2.1.1 PRE-AND POST TEST FOR THE HEALTH CENTER TEAM (FROM THE CORE MODULE)

Directions: Choose the letter of the choice with the right answer.

1. Which segment of the population is more predisposed to Iodine deficiency disorders?
 - a. Under two years
 - b. Pregnant women
 - c. Adults
 - d. Adolescents
 - e. A and B

2. What are the different risk factors involved for the development of IDD?
 - a. Ignorance about the importance of iodized salt
 - b. Poor consumption of seafood like fish
 - c. Increased consumption of food that contains thiocyanate or cyanogenic glycoside
 - d. All of the above
 - e. A and C

3. Which of the following is not true about IDD?
 - a. Total goiter rate is 26% in Ethiopia
 - b. IDD is more common in mountainous areas
 - c. IDD affects also other mammals
 - d. Can be prevented by fortification of foods and drinks
 - e. None

4. List 4 consequences of IDD?

- a.
- b.
- c.
- d.

5. What are the basic causes of anemia?

- a. Inadequate dietary intake
- b. Excessive RBC destruction
- c. Inadequate RBC production
- d. All of the above
- e. None

6. Which of the following is a false statement?

- a. IDD is associated with the use of food like cassava
- b. Immunization can prevent IDD
- c. Xerophthalmia is more prevalent among children below 6 years
- d. IDD is non-preventable communicable disease
- e. b and d

7. What preventive measures should be taken to prevent VIT A deficiency?

- a. Diarrhea control using ORS
- b. Fortification of food with vitamin A
- c. Immunization program to control measles
- d. All of the above
- e. None of the above

8. In the clinical work up of anemia what laboratory investigations can be done in a routine laboratory setup?

- a. Hemoglobin determination
- b. Stained red blood cell morphology assessment
- c. Stool examination for ova of parasites

- d. Reticulocyte count
 - e. All of the above
9. What is the importance of reticulocyte count in the assessment of Anemia?
- a. to diagnose anemia
 - b. to diagnose polycythemia
 - c. to assess the presence of abnormal red blood cell morphology
 - d. to assess the status to RBC production with in the bone marrow
 - e. None of the above
10. What is the importance of studying stained red cell morphology in the assessment of anemia?
- a. To assess nutritional anemia
 - b. It enables the classification of anemia
 - c. To diagnose iron deficiency anemia
 - d. All of the above
 - e. None
11. What are the causes of rickets?
- a. Poor dietary intake of calcium
 - b. Poor dietary intake of vitamin D
 - c. Poor exposure to sunlight during childhood
 - d. Fat malabsorption syndrome
 - e. All
12. What are the consequences of vitamin D deficiency?
- a. Repeated chest infections
 - b. Poor bone growth and increased fragility after trivial trauma
 - c. Cephalopelvic disproportion in females
 - d. Tetany in infants and toddlers
 - e. All
13. The level of calcium in the serum is maintained by

- a. Calcitonin
- b. Parathyroid hormone
- c. 1,25 dihydroxycholecalciferol
- d. All
- e. None

14. Which of the following is not the function of zinc?

- a. Promotes growth
- b. Enhances resistance to infection
- c. Acts as antioxidant
- d. Forms part of insulin
- e. None

15. Which of the following is not a consequence of a zinc deficient diet during pregnancy?

- a. Delivery of low birth weight baby
- b. Pre-term labor
- c. Precipitated labor
- d. Post partum hemorrhage
- e. None

16. Which of the following foods are **excellent** sources of zinc?

- a. Dairy products
- b. Dark red beef
- c. Green leafy vegetables
- d. Cereals
- e. Legumes

17. One of the following is not the consequence of folate deficiency?

- a. Megaloblastic anemia
- b. Spinal cord and peripheral neural disease
- c. Aggravates immunity in HIV infected patients
- d. Neural tube defect during fetal period

e. None

18. Vitamin A is useful for the following body functions?

- a. Epithelial tissue replication
- b. Bone growth
- c. Vision
- d. Reproduction
- e. All

19. Which of the following vitamins cause hypervitaminosis?

- a. Vitamin B-9 (folate)
- b. Vitamin A
- c. Ascorbic acid (vitamin C)
- d. Vitamin D
- e. b and d

20. One of the following is not true about folic acid?

- a. Found in good amount in liver, kidney, and fish
- b. Important for the synthesis of hemoglobin during RBC synthesis
- c. Needed most during growth and pregnancy
- d. Important for myelin sheath synthesis
- e. Its' deficiency causes pernicious anemia

21. Which one of the following is the clinical manifestations of rickets?

- a. Frontal bossing
- b. Double malleoli
- c. Delayed fontanelle closure
- d. Bow legs
- e. All

22. One the following deficiencies causes megaloblastic anemia: -

- a. Vit D deficiency

- b. Iron deficiency anemia
- c. Folic acid deficiency
- d. Vit B-12 deficiency
- e. c and d

23. Which of the following is the correct order of vitamin A deficiency clinical manifestations?

- a. Night blindness, Bitot's spot, corneal xerosis, corneal ulceration, corneal scar
- b. Bitot's spot, corneal xerosis, night blindness, corneal scar, corneal ulceration
- c. Night blindness, corneal xerosis, corneal ulceration, Bitot's spot, corneal scar
- d. Bitot's spot, night blindness, corneal xerosis, corneal ulceration, corneal scar
- e. Corneal xerosis, night blindness, Bitot's spot, corneal ulceration, corneal scar

24. Osteoporosis is not caused by:

- a. Vit B 1 deficiency
- b. Vit D deficiency
- c. Steroid treatment
- d. Calcium deficiency
- e. Menopause

25. Which of the following nutrients are not anti-oxidants?

- a. Vitamin A
- b. Vitamin E
- c. Vitamin C
- d. Zinc
- e. Iron

26. Which of the following nutrients are suitable for fortification?

- a. Vitamin A

- b. Vitamin D
- c. Vitamin B2 (Riboflavin)
- d. Iodine
- e. All

27. Which of the following nutrients affects bone integrity?

- a. Vitamin A
- b. Vitamin C
- c. Vitamin D
- d. Calcium
- e. All

28. One of the following causes of anemia does not match the type anemia listed?

- a. Microcytic hypochromic anemia – iron deficiency
- b. Microcytic hypochromic anemia – Hookworm infection
- c. Macrocytic anemia – Folate deficiency
- d. Normocytic normochromic anemia – Bone marrow failure
- e. Pernicious anemia – *Diphyllobotrium latum* infection

2.1.2. PRE AND POSTTEST FOR SPECIFIC CATEGORIES OF THE HEALTH CENTER TEAM (FROM THE SATELLITE MODULES)

2.1.2.1. PRE AND POST TEST FOR HEALTH OFFICERS

Directions: - Circle on any of the following choices that you think is correct answers.

1. One of the following is a nutritional problem of public health importance in developing countries,
 - a. Protein energy malnutrition
 - b. Iron deficiency anemia (IDA)
 - c. Iodine deficiency disease (IDD)
 - d. Vitamin A deficiency (VAD)

e. Vitamin D deficiency

2. Which groups of the population are more predisposed to IDD?

- a. Under two years of age
- b. Pregnant ladies
- c. Adults
- d. Adolescents
- e. A and B

3. What are the different risk factors involved in the development Iodine deficiency disorder?

- a. Low socioeconomic conditions
- b. Ignorance of about the importance of iodized salt
- c. Infections like measles, Pertussis, diarrhea
- d. Use of some drugs
- e. All of the above

4. How prevalent is IDD in Ethiopia?

5. List 3 different types of health problems encountered because of IDD?

- a.
- b.
- c.

6. What are the basic causes of anemia?

- a. Inadequate dietary intake
- b. Excessive RBC destruction
- c. Inadequate RBC production
- d. All of the above
- e. None

7. Which of the following is a false statement?

- a. IDD is associated with the use of food like cassava
 - b. Immunization can prevent IDD
 - c. Exophthalmia is more prevalent among children below 6 years
 - d. IDD is a non-preventable communicable disease
 - e. B and D
8. What preventive measures should be taken to prevent VIT A Deficiency
- a. Diarrhea control using ORS
 - b. Fortification of food with vitamin A.
 - c. Immunization program to control measles
 - d. All of the above
 - e. None of the above
9. In the clinical work up of anemia, what laboratory investigations can be done in a routine laboratory setup?
- a. Hemoglobin determination
 - b. Stool RBC Count
 - c. Serum albumin determination
 - d. Differential leukocyte count
 - e. All of the above
10. What is the importance of hemoglobin determination in the assessment of iron deficiency anemia?
- a. To diagnose anemia
 - b. To diagnose polycythemia
 - c. To assess the presence of abnormal red blood cell morphology
 - d. None of the above
11. What is the importance of studying stained red cell morphology in the assessment of pro Anemia?
- a. To assess nutritional anemia

- b. It enables the classification of anemia
- c. To diagnose iron deficiency anemia
- d. All of the above

12. What pathogens contribute indirectly to the development of anemia?

- a. Viruses
- b. Bacteria
- c. Parasites
- d. All of the above

13. The basic objective of managing a child with Vit A deficiency: -

- a. Treating superimposed infections
- b. Supplying therapeutic dose of Vit A
- c. Managing complications
- d. Provision of immunization (Vit A)

14. The commonest type of malnutrition in Ethiopia

- a. Iodine deficiency disorders
- b. Vitamin A deficiency
- c. Iron deficiency anemia
- d. Rickets
- e. None

15. Indication for atherapeutic dose of vitamin A is a case of

- a. Xerophthalmia
- b. Measles
- c. Severe PEM
- d. Severe ARI

e. A and B

16. Which of the following diseases have a very close relationship with protein energy malnutrition

- a. Tuberculosis
- b. Measles
- c. Diarrhea
- d. Pertusis (whooping cough)
- e. Common cold

Abebech brought her 3 years old male child called Temtime to the pediatric OPD of Jimma Hospital. She told you that the child has intermittent diarrhea, loss of appetite. Besides she stated that the child is not interested in his surrounding and sits miserably. On physical examination you found out that the child is apathetic, hypotensive, has gray easily pluckable hair, edema, weighs 9kg when he is expected to weigh 14kg. He also has bowed legs and bead like swellings on the costochondral junctions. The child is also pale and has difficulty of vision during dim light and had whitish triangular patches on the lateral lower quadrant of the bulbar conjunctiva. Answer questions 5 to 10 based on the above scenario.

17. How would you manage this child?

- a. Give him cod liver oil and advise the mother to expose him to sunlight
- b. Start him with low protein 1-1.5g/kg/d and low energy 100 kcal/kg/d in the stabilization phase and later increase to 5 gm of protein/kg/d and 180kcal/kg/d in the rehabilitation phase
- c. Give iron after 7 days (after control of infection)
- d. 200,000 IU of vitamin A is required at the 1st, 2nd and 14th days
- e. All are correct

18. What will be your approach to the mother to prevent a recurrence of the situation?

- a. Nutrition education on child feeding and meal planning
- b. Counseling her on the importance of mixing different foods cereals, legumes, animal products, sea foods; fruits and vegetables in child feeding to prevent micronutrient deficiency
- c. Tell her the importance of gardening in her yard-garden if she has land
- d. Work with her how to improve the nutritional status of her child and appoint her for follow up (growth monitoring)
- e. All are correct

19. Other micronutrient deficiencies that co-exist with PEM include:

- a) Vitamin A deficiency
- b) Vitamin D deficiency
- c) Riboflavin deficiency
- d) Iron deficiency

1.2.1.2. PRE AND POST TEST TO PUBLIC HEALTH NURSES

Direction: Respond to the following questions accordingly.

Pre and Post Test for Public Health Nurse

1. List down the critical contact point in the health care settings to address Vitamin A deficiency disorders?

A. _____

B. _____

C. _____

- D. _____
- E. _____
- F. _____

2. Who are at the risk of developing Vitamin A Deficiency?

- A. Children at the age of six months and six years.
- B. Pregnant women
- C. Lactating mother
- D. All of the above.

3. List down the three methods used to control vitamin A deficiency?

- A. _____
- B. _____
- C. _____

4. Who are at the risk of developing Iodine deficiency diseases?

- A. School age children
- B. women of reproductive age
- C. Pregnant and lactating mothers
- D. All of the above.

5. Who are at the risk of developing Iron deficiency Anemia?

- A. Non Lactating mother.
- B. Exclusively breast fed infant.
- C. Pregnant women and children.
- D. The answer is not given.

6. Which one of the following is the public health measure to control iron deficiency anemia?

- A. Iron Supplementation
- B. Fortifications of food.
- C. De-worming

D. All of the above.

7. What is the recommended daily requirement for iodine per person to prevent IDD (Iodine Deficiency Disease)?

8. Which one of the following vitamin enhances the absorption of Iron?

- A..Vitamin A
- B. Vitamin B
- C. Vitamin D
- D. Vitamin C

9. List some of food items that are of animal origin and that improves iron availability in the body?

10. List at least five causes of iron deficiency anemia?

- A.
- B.
- C.
- D.
- E.

11. What does the term "Xeophtalmia`mean"?

2.1.2.3. PRE AND POST TEST FOR MEDICAL LABORATORY TECHNICIANS

1.2.1.4. PRE AND POST TEST ON PEM FOR THE SANITARIANS

Direction. Circle on any of the following choices which you think is the best answer.

1. Asebech always wraps her eight months old child with cloths and the child had no a chance to be exposed to sunlight for fear of cold and evil eyes. As a result the child's legs were weak and not straight. What will be the possible cause(s) of the problem?
 - A. Lack of fish intake
 - B. Evil eyes
 - C. Cold
 - D. Inadequate sun light resulting in vitamin D deficiency
2. What type of environmental health intervention shall be implemented in areas where iron deficiency anemia is highly prevalent?
 - A. Proper human waste management
 - B. Food hygiene
 - C. Provision of safe water supply
 - D. All
3. Animut, a fisherman who is living in Gorgora at the edge of Lake Tana, was visiting Gorgora clinic with a complaint of body weakness. The physical examination and laboratory test revealed that Animut's problem was anemia. What will be the possible cause(s) of anemia based on the explanation given above?
 - A. Lack of fish intake
 - B. High fish intake
 - C. Schistosomiasis
 - D. Lack of *Teff*
4. Inhabitants of Kitimbile Pesant association in Jimma zone lead a subsistence life where it is to buy vegetables and animal products. Which deficiency disease is likely to occur?
 - A. Anemia
 - B. Night blindness
 - C. Rickets
 - D. Marasmus

2.1.2.5. PRETEST FOR HEALTH EXTENSION WORKERS (HEWS)

1. The causes of micronutrient deficiency is (are)
 - a. Germs
 - b. Evil eye
 - c. Not proper child feeding practices
 - d. Tooth extractions
 - e. None of the above

2. One of the following is not a method of preventing iron deficiency anemia: -
 - a. Maintaining personal hygiene and proper waste disposal
 - b. Giving anti-helminthes periodically
 - c. Increase iron intake from diet
 - d. Avoiding blood loss
 - e. Avoiding sunlight exposure

3. Which of the following is not a sign for zinc deficiency?
 - a. Losing of taste, smell and vision
 - b. Stopping or ceasing of growth
 - c. Poor resistance to infection
 - d. Pregnancy complications
 - e. Swelling of the body

4. Which of the following is a risk factor for the occurrence of rickets?
 - a. Poor feeding both in quality and quantity
 - b. Neglect of children in the household by parents or care givers
 - c. Harmful traditional practices that decreases sunlight exposure
 - d. Economic problems
 - e. All are correct

5. Which of the following is not a manifestation of vitamin A deficiency?
 - a. Night blindness

- b. Corneal scar
 - c. Growth retardation
 - d. Poor school performance
 - e. Susceptibility to Infection
6. Folic acid deficiency causes all of the following except,
- a. Night blindness
 - b. Neural tube defect during pregnancy
 - c. Neuropathy in adults
 - d. Anemia (Megaloblastic)
 - e. None

2.2. SIGNIFICANCE AND BRIEF DESCRIPTION OF THE PROBLEM

2.2.1. IODINE DEFICIENCY DISORDER

Iodine deficiency disorder refers to medical conditions ranging from simple goiter to deafness, mutism, squint and profound mental retardation called cretinism. Iodine is part of the hormone thyroxin, which controls energy metabolism. The deficiency diseases are goiter and cretinism. Iodine occurs in seafood and in foods grown on land that was once covered by oceans. The daily requirement for a normal person is 150 micrograms. The term iodine deficiency disorders' (IDD) has been adopted to describe the spectrum of effects of iodine deficiency that include goiter, endemic cretinism psychomotor delays, and subsequent increased pre-and post-natal mortality.

Universal salt iodization (USI) is the most widely practiced intervention in eliminating iodine deficiency disorders (IDDs). Salt iodine testing is an important process indicator for monitoring progress towards USI. Although considerable success in eliminating or reducing endemic goiter has been achieved through national salt iodization programs and mandatory iodization programs of household salt, IDD remains a problem.

Consistent monitoring of iodine fortification in salt at production, storage, sale and consumption levels: and prevention of sale of non-iodated salt are vital components of

salt iodization programs that should be adjusted to meet local conditions and requirements. The information generated by a monitoring mechanism should directly be linked to decision-making, and there should be a feed back system allowing necessary changes to be made. Therefore, monitoring salt iodization is a useful first step in tracking progress towards meeting the goal of IDD elimination. Further extension of the IDD control program is likely and preparations are underway in many countries.

In order to prevent IDD, universal salt iodization (USI) program launched in Ethiopia. In Ethiopia supply of iodized salt to the population was the strategy adopted to prevent IDD. The Quality and Standards Authority of Ethiopia, has set the iodine level to be 60-80 PPM as potassium iodate, after making allowance for losses of iodine during storage and distribution. In Ethiopia, the average consumption of salt per capita per day is 10grams and salt with iodine content of 60-80 PPM would therefore satisfy the recommended daily requirement of 150µg of iodine per a person to prevent IDD.

2.2.2. IRON

Iron is probably the most widely known of all essential minerals. Most of the iron in the body is a component of the proteins hemoglobin and myoglobin. These compounds carry oxygen in association with the iron they contain. Hemoglobin is the oxygen carrier in the red blood cells, and myoglobin in the oxygen reservoir in the muscle. At least 350 million people- mostly women of childbearing age – suffer from anemia, making it one of the world's most common diseases. Iron deficiency anemia is common in children of the developing countries. Evidence from studies show that infants, young children and women are predisposed to different risk factors for the development of anemia. In iron deficiency anemia (which is only one of several types of anemia's), the red blood cells contain less hemoglobin and lose their ability to carry oxygen. Nutritional iron deficiency develops when the diet does not provide the physiological iron requirement either as a result of poor dietary intake or poor absorption.

2.2.3. VITAMIN D DEFICIENCY (RICKETS)

Vitamin D deficiency leads a disorder known as rickets in children and osteomalacia in adults. The situation is common in children because it is primarily a disease of growing

bone. However, its clinical significance is mainly due to the effect the disease has on general child health. Developmental delay is a commonly observed finding in rickets. Moreover, rickets is associated with increased morbidity and mortality. There is ample evidence demonstrating increased rates of diarrhoeal diseases and acute respiratory infections, in rickets. An increased susceptibility to infection associated with rickets may be multi-factorial: the chest wall deformity of late rickets alters immune status and the association of rickets with Protein-energy malnutrition (PEM) are some of the factors involved.

Vitamin D deficiency is the commonest cause of rickets in children and vitamin D supplementation has brought down the incidence of rickets to a virtually non-existent level in the developed world. The infant with rickets in the United States, for instance, is typically a black breast-fed infant who does not receive supplemental vitamin D and usually lives in northern areas of United States with lower levels of sunlight. In developing countries where there is a high proportion of sunny weather, the occurrence of rickets in a significant proportion of children is largely attributed to social and cultural factors. Keeping children indoors because of the fear that they will catch cold, fear of evil eyes, and the tradition of wrapping children in swaddling clothes contribute to lack of adequate sunlight exposure. Calcium administration is appropriate in all cases of rickets. The preventive measures for rickets may also need to be modified. Calcium supplementation along with sunlight exposure is a more effective strategy.

2.2.4. VITAMIN A DEFICIENCY AND XEROPHTHALMIA

Vitamin A deficiency is one of the major nutritional problems in Ethiopia as well as many developing countries. In spite of the potential to produce a wide variety of fruits and vegetables containing beta-carotene, most people do not consume them due to the reason that they tend to sell them (E.g. Carrots, mangos, Papayas) on the one hand and the traditional belief that these foods are low class foods (Kale, Cabbage). As a result mostly children under the age of 59 months are affected by the tolls of morbidity, disability and mortality due vitamin A deficiency. Severe vitamin A deficiency (VAD) has been known to cause xerophthalmia (X). Xerophthalmia (X) literally means “dry eye” in Greek.

Vitamin A deficiency is considered to be a problem of public health importance if one of the following is observed in children under five of that area (Table1)

Table 1. Threshold for making VAD a problem of public health Importance

INDICATOR	LEVEL	PREVALENCE OF VAD IN UNDER FIVE CHILDREN THRESHOLD (%)
Xerophthalmia	Night blindness (XN)	1.0
	Bitot's spot (XIB)	0.5
	Corneal xerosis(X2) or corneal ulceration/ Keratomalacia < 1/3 of corneal surface(x3A), or corneal ulceration/ Keratomalacia >=1/3 of corneal surface(X3B)	0.01
	Corneal scars (XS)	0.05
Biochemical deficiency (serum retinol)	< 0.70 $\mu\text{mol/L}$	5.0

The association between vitamin A deficiency and mortality and morbidity in older infants and young children.

Corneal xerophthalmia:

In 1981, anecdotal reports and small studies led the international vitamin A consultative group to estimate that approximately 60% of all children under 5 years that develop corneal xerophthalmia die over the next 6 months.

Non-corneal xerophthalmia:

Short study of children with/without non-corneal xerophthalmia in Indonesia (Sommer et al 1983)

Type of Xerophthalmia	Relative Risk of dying in next 3 months
XN night blindness only	2.4
XIB (Bitot's spot only)*	6.6
Both Night blindness and bitot's spots (XN and XIB)	8.6

* See glossary

Risk in children with xerophthalmia divided by risk in children without xerophthalmia. Clinical vitamin A deficiency is strongly associated with subsequent mortality in young children. Vitamin A supplementation increases child survival by decreasing the severity of diseases like measles, acute respiratory infections, diarrheal disease and acute malnutrition. It decreases mortality from measles by 40%, mortality from all the above common infections by 23-35%. Vertical transmission of HIV from mother to child is also lower in mothers with normal vitamin A status.

2.2.5. ZINC

Zinc is found in every cell of the body and is a part of over 200 enzymes. Essential for the maintenance of vision, taste and smell, this mineral is also necessary for immune function, protein synthesis, and cell growth. It is required for the activity of the antioxidant enzyme super oxide dismutase. Zinc has been used successfully in the treatment of rheumatoid arthritis, acne, and macular eye degeneration.

While severe deficiencies of zinc are uncommon, marginal deficiencies are frequent in the elderly, those suffering from abnormal eating behavior, and AIDS patients. Deficiencies may be responsible for many of the secondary conditions in AIDS patients, including gastrointestinal malfunction, diarrhea, anorexia, impaired immunity, central nervous system malfunction, and hypoalbuminemia.

Zinc plays an important role in immune function, helping increase resistance to infection. When combined with Vitamin A supplements, zinc helps the suppressed immune system recover. Low levels of zinc result in a decrease in helper T-cells and thymic hormone, which may adversely effect immune functioning. Low doses of zinc have been shown to improve immunity without causing the side effects associated with high doses of the element. It has shown antiviral properties and is used in lozenge form to shorten the duration of the common cold. In stark contrast, high doses of zinc may also impair immunity. Zinc is found from red meet, the darker the meat the more its zinc content is.

Optimal level of zinc is 15-30 mg.

2.2.6. FOLIC ACID

B9)

Vitamin B-9, more commonly known as folic acid, functions together with a group of related water-soluble compounds, collectively called folacin, in many body processes. It is critical to cellular division because it is necessary in DNA synthesis.

Folic acid, also known as folacin or folate, maintains the cell's genetic code and transfer inherited traits from one cell to another. It is vitally important for the foetal development of nerve cells, and a folic acid deficiency during pregnancy has been linked to several birth defects. Supplements of folic acid should be considered by all women of childbearing age. Studies carried out by the World Health Organization indicate that up to a third of all pregnant women in the world have folate deficiencies.

Folic acid is a common vitamin deficiency. Vitamin B-12 should always be included in a folacin supplement program because the folacin supplementation can mask an underlying Vitamin B-12 deficiency. Also, Vitamin B-12 reactivates folic acid in the body and a Vitamin B-12 deficiency can cause a folic acid deficiency.

At greatest risk for a folate deficiency are the elderly, women taking birth control pills, long-term antibiotic patients, and alcoholics.

Due to the overwhelming evidence of folacin's impact on preventing neural tube defects, the FDA is now recommending food fortification of this vitamin. It found in green leafy vegetables cereals and legumes.

2.3. LEARNING OBJECTIVES: -

For effective prevention and management of a case with micronutrient deficiencies the students at the end of the training will have the following knowledge, attitudes and behavioral outcomes: -

1. Define and identify the types of micronutrient deficiencies
2. Enumerate the causes and factors contributing to micronutrient deficiencies
3. Describe the magnitude and contribution of micronutrient deficiencies to the overall child health problems in the country and locally.
4. Identify and describe the clinical manifestations of various micronutrient deficiencies and its complications.
5. Demonstrate the process of assessing a child with micronutrient deficiencies
6. Identify the degree of micronutrient deficiencies
7. List the diagnostic methods and procedures for a case with micronutrient deficiencies.
8. Describe the principles and methods of treating micronutrient deficiencies
9. Select the appropriate treatment for a case of micronutrient deficiencies
10. Describe methods of preparing dietary treatment for a case of micronutrient deficiencies.
11. Identify and manage or refer timely when needed, a case of severe micronutrient deficiencies
12. Demonstrate the appropriate management of a case with micronutrient deficiencies
13. Learn how to monitor their growth (growth monitoring) and take action

14. Promote hygienic preparation and storage of weaning foods.
15. Identify methods and targets for health education in the prevention of micronutrient deficiencies
16. Describe proper growth monitoring activities and their importance in the prevention of micronutrient deficiencies
17. Promote breast feeding and proper weaning practice
18. Promote immunization of children



2.4. CASE STUDY: A LEARNING ACTIVITY

Case study 1. Micronutrients can be plenty out there but inhibitory prices make them Unavailable to the consumers!



On the edge of a large city was a poor neighborhood called Village X. There was no space for gardens so people bought all their food in markets and stores but food prices were so high the families were never able to buy enough. The main cause of the high prices was middlemen. The middlemen were people between the farmers in the country who raised the food and the families in Village X who ate it.

Here is how maize and *teff* meal go to the families of Village X. Out in the country, women grew maize and *teff* in their fields. After the maize and *teff* was harvested they put it into sacks. A young man bought the sacks of maize and *teff* and took them to a small market. The owner of the store bought the sacks and kept them in his grain store. A truck came, and the truck driver picked up the sacks and took them to a mill. The mill owner ground the maize and *teff* into flour and put it back into sacks. Another truck driver took the sacks to the big markets. A young man bought a sack of maize and *teff* flour and took it on a bus to Village X. There he opened the sack and sold the meal to six market women. The market women took the maize and *teff* to the Village X market for selling.

All these people between the farmwomen and the Village X mothers were middlemen. Every time, the maize and *teff* passed from one person to another the price went up where the price of *teff* was roughly four times that of maize. The Village X people were

too poor to pay for *teff* meal or meat products, they resorted to buying maize every time because it was relatively cheaper. An Epidemiological survey in Village X revealed many residents with symptoms of loss of appetite, pallor, lassitude, weakness and children in that area were poorly attentive at schools and scored lower grades. **The problem was that mothers could afford to buy only maize which is deficient in iron leading to the development of a deficiency disease known as anemia.** This problem could be easily corrected by reducing the price of *teff* to an affordable level, which may involve controlling the middlemen by concerned authorities.

Case study 2: Night blindness



Everyday the night falls Adanech experienced an inability to see clearly. Her uneducated father and mother were anxious about her situation and were trying to improve her sight and took her to almost all religious settings, including an exorcism in the area. However, her sight was getting worse day by day and reached a point where she needed help to walk every time after a sunset. Village girls now labeled her as “*daphintam*”- meaning unable to see at night. As the youngest girl in a family of 10, what went wrong to her sight?

Adanech was born in a rural village located 30 km North of Addis Ababa. All her brothers and sisters before her grew up in a time where there was huge expanse of farm and grazing land and hence fruits, and dairy products were plentiful. There was always a surplus of fruits and animal products for sale to city dwellers and in return to buy salt, oil, and gasoline and other household items that are not found in a rural setting. Surplus cattle and sheep were also taken to the market for sale so as to buy clothes for the family and to pay for land taxation.

By the time Adanech was 4 years old, the number of inhabitants in that village more than tripled; yet, agricultural practices remained essentially the same as her ancestors used to do three thousand years ago. Land was redistributed several times to accommodate the young couples and hence the plot of land allotted to each family was shrinking. Thus the amounts of fruits, vegetables diary products harvested was shrinking also. Because of the tight economic situation in the household not enough milk was drunk, not enough fruit was eaten and not enough sheep were slaughtered, except in the holidays. Food insecurity has become the norm in the village. At good times a great proportion of the farm products end up in the market; at bad times even the families themselves starved. As a result Adanech grew up at a time of food scarcity where the staple diet did not contain sufficient vitamin A to protect her eyes from night blindness. Many people in the village erroneously believed the underlying cause of her sight problem was bad spirit. For Adanech, this was not the case. **As a student of grade five she knew her sight could be restored if she could afford to eat vegetables and fruits rich in Vitamin A.**



Case study 3. Iodine deficiency

In a remote village called Kolla Diba in Gondar, a girl named Zertihun was born in the 1980s. Until the age of five she was one of the most beautiful children. She was from a poor family but that did not disturb her for she new poverty is neither in her genes nor in her stars. However, she was worried by her stunted growth and poor academic performance, Her head has been growing out of proportion. After the age of five the front part of her neck bulged out into an ugly mass that governed her destiny-a goiter. Although borne as beautiful girl, bright and full of stamina, her charm had faded over time and her confidence completely eroded. Eventually, she refused to go to school for her classmates nicknamed her as “*enkirtam*”, an insult that she couldn’t tolerate at her age.

Zertihun’s frustration became a self-fulfilling prophecy. Unlike the traditional practice of the region, no gentleman was proposing to her parents for marriage because her goiter

placed her in the ugly and undesirable categories. As a result, by the age of 18 she decided to rebuild her life by removing her goiter. She did not think much about who would do the operation.

Now the time had arrived. Zertihun arranged an appointment with the traditional practitioner on Friday, 1999 and was operated through an aggressive traditional procedure which punctured her swollen neck taking no provision of aseptic techniques. Although she was not anaesthetized during the operation she bore the pain dreaming of a better future. Unfortunately, luck was not on her side and things turn out for the worst: The traditional practitioner used un-sterilized equipment and the unlucky Zertihun contracted the deadly HIV. **Her condition of goiter could have been easily prevented by using iodized salt or by daily intake of iodine rich foods such as fish and meat.** Zertihun traveled back in time to her childhood and recited the chain of events initiated that led to her present conditions. Her soul aches with pain for goiter has shattered her past, and HIV destroyed her future.

2.5. DEFINITION

Micronutrient deficiency refers to the deficiency of micronutrients that are essential for the vital function including growth, development, immunity, fertility and other lively processes. Although there are various micronutrients essential to our body in this regard, this module focuses mainly on a few micronutrients that are of public health importance in the Ethiopia due to the tolls of morbidity, disability and mortality they are causing in the population. Therefore, this module focuses mainly on the following micronutrients: Iodine Deficiency disorder, Vitamin A deficiency, Iron Deficiency anemia, vitamin D deficiency (rickets), Folic acid deficiency and zinc deficiency.

2.6. EPIDEMIOLOGY

2.6.1. IODINE DEFICIENCY DISORDERS

IDD remains a significant public health problem in many countries. Recent studies have shown that over 200 million people in the world are affected by the most visible symptom of iodine deficiency disorders. Globally, 30 % of the world's population is affected by IDD

and more than 150 million people are affected in Africa alone. In Ethiopia, one out of every 1000 is a **cretin** (severely mentally retarded dwarf), and about 50,000 peri-natal deaths are occurring annually due to IDD. Twenty two percent of the total population have goiter and 62 % of the population is at risk for IDD according to national survey conducted by the previous Ethiopian Nutrition Institute. In some pocket areas of the country the prevalence of goiter is found to be 50-95 % (WHO considers that if the goiter rate is above 5 % in the population it is a public health problem). From the various surveys conducted in many parts of Ethiopia, IDD has become one of the biggest nutritional public health concerns. Various surveys of goiter prevalence showed a particular predilection to the highlands and inland areas with the prevalence ranging from 0.4% to 63%.

2.6.2. IRON DEFICIENCY ANEMIA

Nutritional problems are common to all less industrialized societies. Dietary deficiencies account for the majority of the cases of iron deficiency anemia. Microcytic anemia is associated with deficient diet among low socio-economic African- American children aged 15-60 months. It is well known that there are two forms of dietary iron: heme and non-heme. Bioavailability of iron varies depending upon whether it is heme or nonheme iron. In the heme case of non heme iron which usually is of plant origin, the absorption rate is determined by both the level of stored iron and factors in the intestine that influence the body's ability to extract iron from the luminal nonheme iron pool. Several dietary factors may act as either enhancers or inhibitors of absorption from the stomach and upper small intestine. The balance between these factors determines the bioavailability of nonheme iron in the meal. A diet containing high amounts of inhibitors and low amounts of enhancers will lead to decreased availability of dietary iron which in turn results in iron deficiency anemia.

It has been demonstrated by different studies that non-heme iron absorption is enhanced by the presence of other dietary components like ascorbic acid and foods of animal origin in the diet. The main form of dietary iron available to most developing countries is non-heme iron.

Ascorbic acid (Vitamin C) is one of the factors in the diet that enhances absorption of non-heme iron. The influence of ascorbic acid is most substantial in inhibitory food, which means food that contains the main inhibitors of nonheme iron absorption, phytate and polyphenoles. It is effective in promoting iron absorption if eaten together with the iron. There could be a decrease in the consumption of sources of this vitamin either due to seasonally availability, economical problems or lack knowledge.

Organic acids also have similar role in promoting iron absorption. It was shown that the addition of citric, malic or tartaric acids to rice-based meal highly improved iron absorption. These organic acids are obtained from vegetables. Fermentation of foods also improves the bioavailability of non-heme iron. Demant et al 1980-noted increased absorption of iron from South-African beer made from maize and sorghum than gruel made from the same ingredients. It has been suggested that this may be due to production of lactic acid, which is probably the promoter of absorption.

Animal tissues including beef, chicken fish lamb and liver are enhancers. They improve iron availability by both supplying highly available heme iron and improving absorption from non-heme iron pool. Socio-economically poor communities do not consume animal tissues as such frequently. Decreased intake of dietary sources of these enhancers like fruits and animal tissues especially in the case of diet that has inhibitors leads to iron deficiency anemia.

A diet which is cereal based and monotonous as in the case in most third world countries will have a very small amount of its' iron content available to the body. A recent study in Venezuela by Peter et al. On bioavailability of iron from a diet consumed by different socio-economic strata indicated that iron replete people from upper class (I-III) absorbed dietary iron much better than lower social classes (IV and V), the diets of social classes I-III contained more enhancers of iron absorption (vitamin c and meat protein) and less inhibitors phytate than the social classes IV and V.

Low socio-economic status could operate through a number of ways like increased chance of getting infection because of poor hygiene, health service availability, having diet poor in quality and quantity which will have low amount of its iron available, etc.

It has also been observed that prolonged exclusive breast-feeding beyond 6 months of life could be one of the risk factors for iron deficiency anemia. A recent hospital based study on children between 6 to 24 months of age who were admitted for acute infection or inflammatory diseases indicated that those children who were exclusively breast fed after 6 months of age are at risk of developing iron deficiency anemia as compared to those children who has been given iron fortified formula milk from birth and those who had been given breast milk for five to six months and then switched to iron fortified formula. This study suggested appropriate iron fortified weaning food or routine iron supplementation should be given starting at 6 months for exclusively breast-fed children.

Another cause of iron deficiency anemia is infection: either parasitic or other. Evidence from different studies have revealed that children in developing countries are predisposed to different infectious diseases which are risk factors for the development of iron deficiency anemia. A Study-conducted school children in Zanzibar indicated that the most anemic cases had hookworm infection. Another study in the same country using a different method indicated that the prevalence of iron deficiency anemia increased steadily as hookworm infection intensity and blood loss increased. A similar study in Nepal by Curtale F. et al revealed that presence of eggs of hookworm and *Ascaris lumbricoides* was significantly associated with low hemoglobin levels in children aged 6 to 120 months.

Wiegel et al showed that children who had current or past infection of Cutaneous Leishmaniasis during their study had statistically significant risk of developing iron deficiency anemia as compared to non-infected children.

A study in Jamaica about the relationship between *Trichuris trichuria* infection and iron status showed that the prevalence of anemia among heavily infected children was 33% which is significantly higher as compared to the rest of the sample 11%, and the

difference remained significant after controlling for the confounding variables including socio-economic status, age, gender, area of residence and presence of Ascaris infection (sole effect of Trichuris infection).

Though many authors reported that malaria is one of the causes of anemia in the tropics, malaria may not result in iron deficiency, but because of hemolysis there is increased storage of iron as hemosiderin which is unavailable form of iron storage. Infection of children with human immunodeficiency virus (HIV) is also one risk factor for iron deficiency. Castaldo et al have observed that iron deficiency was significantly associated malabsorption in HIV positive children, and parenteral iron administration was required for raising hemoglobin level in the infected children as opposed to those children with normal iron absorption who responded to oral iron intake.

2.6.3. VITAMIN A DEFICIENCY

Vitamin A has the distinction of being the first fat-soluble vitamin to be recognized. It is certainly one of the most versatile, with parts to play in such diverse functions as vision, maintenance of body lining and skin, bone growth, anti oxidant activity and reproduction. Vitamin A deficiency can increase the risk of mother to child transmission of HIV.

The prevalence of vitamin A deficiency ranges from 0.3% to 28.3%.

In Ethiopia, blinding malnutrition was reported from 17 villages in Arsi among children six months to six years of age. In this area vitamin A deficiency of as high as **28.3% was found, but** the overall prevalence of xerophthalmia was 10.9% (Bitot's spots prevalence of 8.8%). Reports of eye clinics showed that among new out-patients under six years old, the rate of xerophthalmia for Bale was 11.9%, Wollega 0.8%, and Shewa 0.3%, with an average of 4.5% . A 5.9% rate of xerophthalmia in Gamu Gofa (Gardula) was reported. DeSole reported hyperendemic Vitamin A deficiency in wheat farming areas of Bale and Arsi, i.e. average prevalence of 5.0% for Bitot's spots. 0.8% for corneal xerosis and ulceration and 0.5% for corneal scar. In Tigray and Gondar, vitamin A intake was less than 40% of the required level and in young children of Arsi pastoralists less than 30%.

2.6.4. VITAMIN D DEFICIENCY (RICKETS)

Rickets also contributes to increased morbidity, disability and mortality. In a case-control study done in Addis Ababa the odds of dying in rachitic patients was five times higher than that of controls.

Paradoxically, rickets is widely prevalent in many tropical and subtropical regions despite abundant sunshine. Reports from health institutions suggest that rickets is an important child health problem in Ethiopia. In a review of pediatric admissions in Jimma hospital about 7% of under 5 children were diagnosed with rickets. A more recent community based study in Jimma town showed rickets prevalence of 4% in randomly selected children between 6-59 months of age.

The incidence of rickets is particularly high in slum children who live in crowded houses almost devoid of sunlight. Vitamin D deficiency is the most common cause of rickets in Ethiopia. All the rachitic children were said to be exposed to sunlight, the majority daily, and with no clothes on. From clinical experience too some children present with rickets despite history of adequate sunlight exposure (unpublished observation. The deficiency of calcium may increase the requirement for vitamin D, and therefore calcium deficiency may aggravate a borderline vitamin D status. In rats the rate of inactivation of 25-hydroxy-cholecalciferol in the liver is increased by calcium deprivation (or increased phytic acid). The effect is mediated by 1,25 dihydroxy-cholecalciferol produced in response to secondary hyperpara-thyroidism. Studies conducted in Nigeria suggest that rickets is largely the result of lack of calcium. Calcium deficiency as a cause of rickets is also reported from rural South Africa. The evidence for the role of calcium deficiency in the causation of rickets comes from dietary surveys, biochemical studies, and the response to calcium therapy alone.

2.6.5. FOLATE DEFICIENCY

It is one of the major causes of nutritional anemia especially among pregnant women in the developing countries. Elderly, women taking birth control pills, long-term usage of antibiotic by patients, and alcoholics are at greatest risk for a folate deficiency. However, studies of adolescents found that 85% of boys, 90% of girls from families of low income status and 100% of girls from upper income families took in less than half the adult

recommended daily allowance of 400 micrograms (for pregnant women) and 180 mcg for non pregnant women 15 years and above.

Evidence indicates that the problem of folate deficiency is common in the developed countries though we don't have studies in Ethiopia. In 1989, the U.S. National Research Council, which oversees the recommended daily allowances, reduced the recommended level for folate from the 1980 level of 400mcg to 180mcg because they found few people achieved higher levels. Due to the overwhelming evidence of folate impact on preventing neural tube defects, the Federal Drug Administration (FDA) is now recommending food fortification of this vitamin. The U.S. Public Health Service recommends 400mcg for all women, especially those in their childbearing years.

Folic acid may be a factor in warding off heart attacks, strokes and some common cancers. Furthermore, a less than optimal intake of folic acid can double or triple the risk of developing one or more of these deadly diseases, even for those not considered deficient by today's nutritional standards of 200 micrograms (mcg) for men and 180 mcg for women. Low folate consumption has been linked to cancers of the lung, esophagus, breast and cervix as well as to precancerous colon and rectal tumors called adenomas.

2.6.6. ZINC DEFICIENCY

Zinc occurs in a very small quantity but works with proteins in every corner of the body as a helper for some seventy enzymes. A deficiency of zinc was first observed in 1960's in the Middle East, where a high cereal, low animal protein diet was common.

Researchers speculate that depressed zinc levels might be a sustaining factor in abnormal eating behavior and recommend that patients receive supplements in addition to a well-balanced diet. A study from 1992 states that zinc supplementation contributes to successful treatment of anorexia, one of the secondary conditions of AIDS.

Zinc deficiency in the elderly is suspected as a possible factor in Alzheimer's disease that causes memory loss. Zinc is involved with enzymes, which govern DNA function. Dementia, the hallmark symptom of Alzheimer's disease, is thought to result from disturbances in these enzymes and DNA cells. Alzheimer's patients have been shown to

have low levels of zinc in brain and cerebrospinal fluid. Supplements have led to improvements in memory, comprehension, communication, and social interaction in these patients.

Zinc is central to male sex hormone and prostate function. Deficiencies may lead to prostate enlargement and decreased testosterone and sperm count. Studies from the 1980s indicate zinc is a good treatment for oligospermia and for some, infertility. For women, low zinc levels during pregnancy may lead to premature birth, low birth weight, growth retardation, and preeclampsia (in the mother). Research from 1995 supports the use of supplements to improve pregnancy outcomes, suggesting zinc should be incorporated into prenatal care.

Alcohol, even in moderate amounts, can increase the excretion of zinc in urine and can impair body's ability to combine zinc into its proper enzyme combinations in the liver. Coffee should not be consumed at the same time as zinc because it may decrease absorption of zinc. Other inhibitors of Zinc absorption include; heavy metals, phytates in cereals and legumes.

2.7. PREDISPOSING FACTORS/ CAUSES, ETIOLOGY AND PATHOGENESIS

2.7.1. Predisposing factors/causes

At the level of an individual one or more of the following factors may operate: -

- ❖ **Lack of knowledge** -People do not understand the nutritional nature of the their Child's health problem
- ❖ **Poverty** - lack of means to obtain and provide food to their child as in the case of war.
- ❖ **Famine and vulnerability**- destitution, being an orphan (Example HIV taking away parents Lives)
- ❖ **Infections** - there is a reciprocal relationship between malnutrition and infection. During infection, the requirement for nutrients increases and there may be an increased loss of nutrients due to diarrhea, genesis of fever and other acute phase reactants is at the expense of nutrients.

- ❖ **Emotional deprivation-** In orphan children and in children whose parents are negligent in giving care to their children for different reasons, children will lose their appetite and hence end up in state of malnutrition
- ❖ **The Cultural factors-** Different biases as to who should take the lion's share of the family 's food (Example, age bias—older children are given more food than the smaller ones,
- ❖ **Gender bias**—male children are more favored in getting nutritious food than female children in some families, etc.)
- ❖ **Mal-distribution of food stuffs** - within the family, it occurs between the different ages and sexes due to biases, food prejudices and taboos. It also occurs between the different regions of any country because of inappropriate food and nutrition policy, poor marketing and distribution system due to different reasons like embargo, country under-siege, etc.

2.7.2. ETIOLOGY OF MICRONUTRIENT DEFICENCIES

2.7.2.1. IDD

- Living in the mountainous areas where plant foods have inadequate in iodine
- Taking cassava tuber as a food without detoxifying it and other chelating substances
- Not taking sea foods

2.7.2.2. Rickets and osteomalacia

- Lack of exposure to sunlight
- Inadequate intake of foods rich in vitamin D such as Milk and milk products
- Fat malabsorption
- Inadequate intake of calcium

2.7.2.3. Vitamin – A deficiency

- Inadequate intake of the vitamin
- Infections like measles

2.7.2.4. Iron deficiency anemia

- Hookworm infection and other parasites including Schistosomiasis, ascariasis, Trichuriasis
- Blood loss
- Diet deficient in iron
- Severe and chronic malaria
- Taking foods that chelate/combine iron in the intestine, like phytates, milk, tannic acid (in tea), fiber, phosphorus (in egg yolk), and antacid syrup.
- Chronic infections like tuberculosis
- Achlorhydria (decreased secretion of HCl due to surgical resection of the stomach)

2.7.2.5. Zinc deficiency

- Conditions that decrease absorption of zinc, like phytates and dietary fibers
- Conditions that increase the excretion of zinc
- Diet poor in zinc content

2.8. CLINICAL FEATURES

Refer to the satellite module for health officer's section 2.8.

2.9. PREVENTION OF SELECTED MICRONUTRIENT DEFICIENCIES (OPTIONS FOR INTERVENTION)

2.9.1 Dietary diversification and Nutrition education

This approach focuses on educating mothers/care givers on the importance of having a balanced diet through diversification of food. It also aims at the production of foodstuffs at the backyard garden and intensification of horticultural activities. The nutrition education should focus on: -

- Cultural malpractice and beliefs in child feeding and weaning process, weaning foods, exposure of children to sun light, time of weaning and food prejudices
- Intra household mal-distribution of food (age and sex bias)
- Effects of emotional deprivation and neglect on nutritional status of children and proper child treatment practices
- Importance of breast feeding
- Hygiene (personal hygiene, food hygiene, environmental hygiene)
- Importance of immunization
- Importance of growing fruits and vegetables in the backyard garden and consumption by the household members regardless of their age and sex.
- Importance taking their children to health institutions for **growth monitoring**
 - Monitoring of the growth of children is very important for the following reasons:
 - Steady growth is the best indicator of child's health.
 - Weight gain is the most sensitive measure of growth.
 - Serial measurement of weight is simple, universally applicable tool for assessing growth.
 - Weight gain monitoring is the best method for early detection of health problems whether from malnutrition or infection.
 - Improving maternal nutrition during pregnancy and lactation.

A balanced diet can be prepared by mixing different locally available foods. For example the nutritional requirements of children for different micronutrients can be met by preparing the following diets: -

1. **Quadri mix**---staple+ animal protein + plant protein + leafy vegetable
2. **Triple Mix**---Staple +animal protein + plant protein or leafy vegetables
3. **Double mix**--- staple + Animal protein or plant protein or leafy vegetable

Parents / caregivers need to be instructed how to modify the nutrient contents of the locally available foods used in weaning and child feeding.

2.9.2. Dietary modification: -

This approach focuses on modifying the micronutrient y, protein and energy content of the complementary foods.

- Making iodized accsssible to the whole family especially women in child bearing age.
- Iron and folic acid supplementation to mother during pregnancy and lactation
- vitamin A supplementation to the mother during lactation during the first 6 weeks of delivery
- Iron and vitamin A supplementation to children
- Periodic deworming(giving antihelmithic) of mothers(except in the first trimester of pregnancy) and children every 6 months

2.9.3 Economic approach:

This approach aims at improving the incomes of the target community as a solution to their nutritional problems. It is considered usually in areas where there are many poor people and if their purchasing power is low as in the case of urban slums and people displaced because of war and other natural calamities. There are different methods in this approach: -

- **Food for work**— This involves offering of some work for the poor people and paying them off in terms of food. It is good in that it offsets seasonality in the dietary intake, but it is donor dependent
- **Food subsidy** --- This involves subsidizing of either producers or consumers of food by the government. Structural adjustment policies interfere with the materialization of this approach
- **Income generating projects**---This method operates in some regions of Ethiopia and involves development of income generating projects in the community to make them

generate fund for buying food. It includes organizing the community and using their potentials in the running of the project. The projects could be weaving, pottery, Bee keeping, etc. This approach needs a good feasibility study on how the income generated is used, the sustainability of the programme, etc.

The above approaches could be used either simultaneously where it applies or independently. This should be determined by doing a thorough strength, weakness, opportunities and constraints (SWOC) analysis.

2.9.4. Nutritional Surveillance

Targets for surveillance:- Infant & child growth monitoring and promotion(GMP) activities need to be carried out in an integrated manner with other PHC services. Missed opportunities for GM should be fully utilized in such a way that children coming to the health institutions for other purposes are covered in the growth monitoring and promotion (GMP) activities. Besides every child should be regularly monitored for growth performance (growth take up) every month. **Triple A cycle** (assessment, analysis and action) be employed in effecting GM activities.

- ❖ *Assessment includes regular measurement of weight and heights of < 5 children and comparing their growth performance with the standard(determining the direction of growth of the child)*
- ❖ *Analysis includes assessment of the different causes of growth faltering and options for intervention with the mother/care giver.*
- ❖ *Action involves nutritional intervention to curb the problems, which include counseling of the care taker on child feeding practices.*

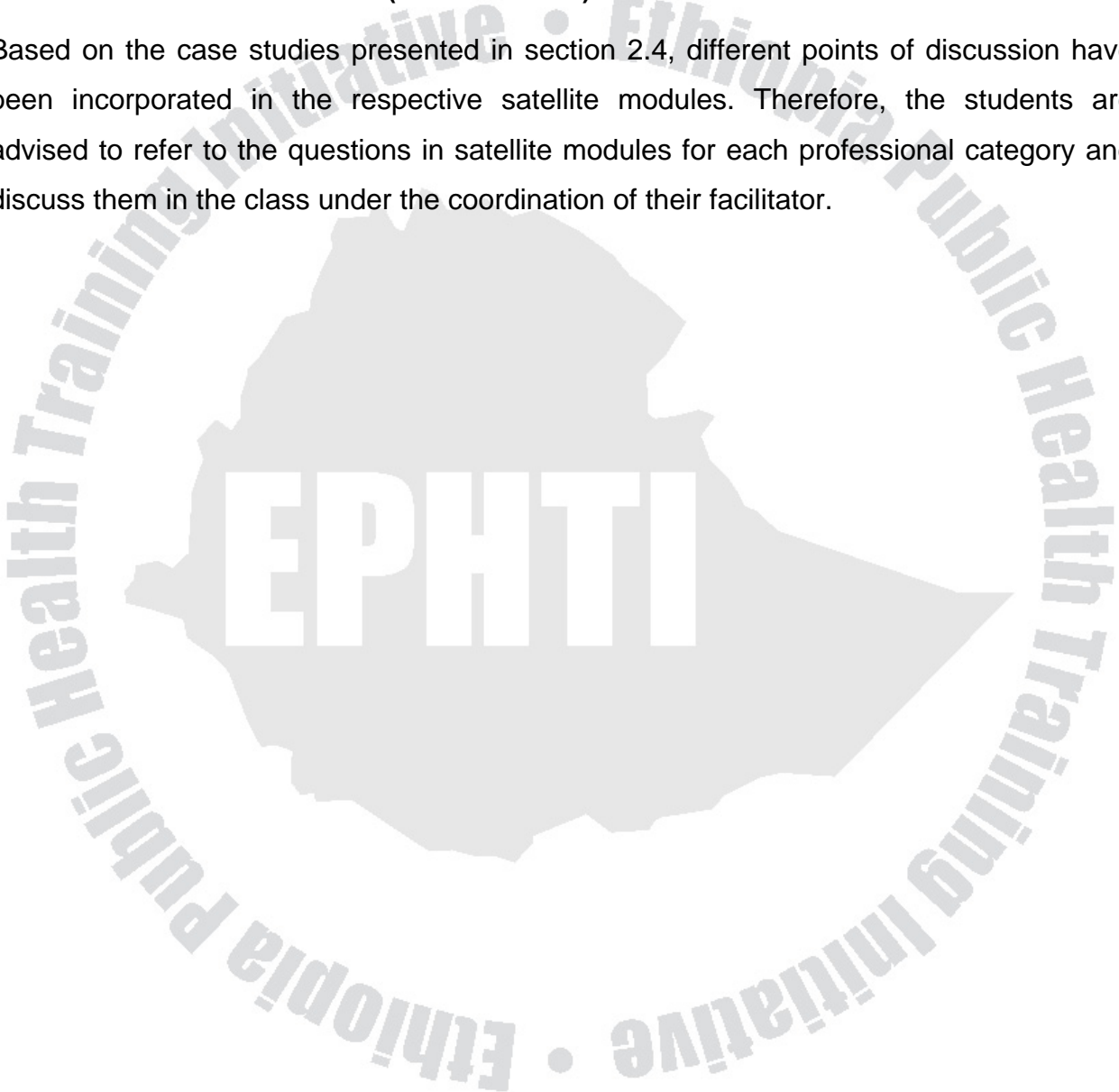
The action may include rehabilitation of severely malnourished children and following them up and micronutrient supplementation, Nutrition education on importance of backyard gardening & horticultural activities, dietary diversification, breast feeding and proper child feeding practices.

2.9.5. Nutritional surveys

Community based nutritional surveys including anthropocentric measurements and dietary consumption surveys need to be carried out among under five children in order to early detect the occurrence of nutritional problems in the community.

2.10. LEARNING ACTIVITIES (CASE STUDY) CONTINUED

Based on the case studies presented in section 2.4, different points of discussion have been incorporated in the respective satellite modules. Therefore, the students are advised to refer to the questions in satellite modules for each professional category and discuss them in the class under the coordination of their facilitator.



UNIT THREE

SATELLITE MODULES



UNIT ONE

SATELLITE MODULE FOR HEALTH OFFICERS

INTRODUCTION

1.1. Purpose and use of the module

The ultimate purpose of this training module is to produce competent Health Officers who can effectively manage and provide care for cases of micronutrient deficiency both in clinical and community settings.

1.2. Direction for using the satellite module

This satellite module can be used in the basic training of Health Center team particularly health officers who are either already in the service or in training Programs. In order to make maximum use of the satellite module, the health officer should follow these directions

- ❖ Evaluate yourself by doing the pre-test pertinent to your category under section 2.1.2.1 before going through the satellite module and evaluate your self by referring to the answer keys given in the unit 7 section 7.1.1
- ❖ Read the core module very thoroughly
- ❖ Read the case study and try to answer questions pertinent to it
- ❖ Use listed references and suggested reading materials to supplement your understanding of the problem.
- ❖ For total and comprehensive understanding of the causes, etiology, pathogenesis, epidemiology and prevention of micronutrient deficiencies, the health officer students are advised to refer to the core module.
- ❖ After going through this module evaluate yourself by doing post-test and comparing your score with the key given in unit 7 section 7.2.1

UNIT TWO

SATELLITE MODULE FOR HEALTH OFFICER

2.1. Pre and Post Test For The Satellite Module Of Health Officers

See the pre and posttests for the health officers in the core module under unit 2, section 2.1.2.1

2.2. Significance and Brief Description Of The Problem

See the part under unit 2 section 2.2 in the core module

2.3. Learning Objectives

For effective case management of Micronutrient deficiencies the health officer student will be able to do the following at the end of the training

1. Demonstrate the process of assessing a child with micronutrient deficiencies
2. Identify and describe the clinical manifestations/complications in a child with micronutrient deficiencies
3. List the diagnostic methods and procedures for a case with micronutrient deficiencies
4. Describe the principles and methods of treatment of micronutrient deficiencies
5. Enumerate the 6 contact points for implementing essential nutrition action in order to prevent micronutrient deficiencies
6. Identify and manage or refer timely when needed, a case of micronutrient deficiencies
7. Demonstrate the appropriate management of case of micronutrient deficiencies
8. Describe proper follow up of a case of micronutrient deficiencies

Case study: Learning Activity

Read the case studies 1,2 and 3 in the core module very thoroughly so that you will be able to answer questions pertaining to it in section 2.12 of this module.

2.5. Definition

Refer to the core module unit 2 sections 2.5

2.6. Epidemiology

Refer to the core module unit 2 sections 2.6

2.7. Cause, Etiology and pathogenesis

Refer to unit 2 section 2.7 of the core module

2.7.2. ETIOLOGY OF MICRONUTRIENT DEFICENCIES

Refer to the core module section 2.7

- poor in zinc content

2.8. Clinical Features

2.8.1. Iodine deficiency

- **Fetus**
 - Abortion
 - Still birth
 - Congenital anomalies
 - Increased infant mortality
 - Neurologic cretinism (including mental deficiency, deaf mutism, spastic diplegia, squint)
 - myxedematous cretinism (dwarfism, mental deficiency)
 - Psychomotor defects

- **Neonate**
 - Neonatal goiter
 - Neonatal hypothyroidism
- **Child and adolocsent**
 - Goiter
 - Juvenile hypothyroidism
 - Impaired mental function
 - Retarded physical development
- **Adult**
 - Goiter with its complications
 - Hypothyroidism
 - Impaired mental function
 - Poor physical work out put
 - Iodine induced hyperthyroidism
- **Beasts of burden (animals used for production like oxen, horses, donkeys are also affected)**
 - Weakness

Diagnosis

Three components to diagnosing IDD:

1. Determination of thyroid size/goiter
2. Determination of urine iodine excretion
3. Determination of blood T4 +TSH levels

Usually the diagnosis must depend upon clinical assessment only using WHO criteria

Measuring Thyroid Size /WHO/

STAGE O No goiter

STAGE IA Goiter detectable by palpation and not visible when neck is in the normal position or distended

STAGE IB Goiter palpable and visible when neck is extended

STAGE IIGoiter visible with the neck in normal position

STAGE III Goiter visible at a distance

STAGE IV Huge goiter

At the community level determination of the endemicity of IDD is very important to institute appropriate intervention measures. The following are classification and techniques of survey to detect IDD at the community level.

Table 1. Classification of Endemia of Iodine deficiency disorders by Severity

Grades of severity of iodine deficiency disorders			
	Mild IDD	Moderate IDD	Severe IDD
1. Prevalence of goiter (total)	5-19%	20-29%	$\geq 30\%$
2. Cretinism	0	0	0-5
3. Daily urine urinary iodine ug/d	50-100	25-49	< 25
Median Urine iodine ug/d	3.5-5	2-3.4	0-1.9
4. Prevalence of neonatal TSH > 50 ug/d	$< 1\%$	1-5%	$> 5\%$

Source: WHO/ICCIDD Report

Survey Techniques for endemic Goiter and Cretinism

1. Survey Organization
 - i. Examine school children
 - ii. If goiter prevalence is $> 10\%$ in school children, sample population for survey
2. If goiter prevalence is $> 10\%$ in school children, assess 24 hours urine iodine
3. Check for Goitrogenic factors (e.g. soy products, drugs, cabbage, cassava, etc)

TREATMENT AND PREVENTION OF IODINE DEFICIENCY

Universal salt iodization is one of the most cost effective strategies in preventing Iodine deficiency disorders. The Quality and Standards Authority of Ethiopia, has set the iodine level to be 60-80 PPM as potassium iodate, after making allowance for losses of iodine during storage and distribution. In Ethiopia, the average considering the current average consumption of salt per capita per day of 10grams, salt with iodine content of 60 mg/kg would therefore satisfy the recommended daily requirement of 150 μ g of iodine per a person to prevent IDD. Consumption of iodized salt by the family can be communicated through the seven contacts of women and children with the health services, namely: antenatal care, delivery, postnatal and family planning visit, immunization visits, well baby and growth monitoring and promotion visits and sick child visits. For selected segments of population who are at risk of developing IDD (pregnant mothers and children, under 2 years living in severely endemic areas, administration of iodized oil capsule is recommended, this intervention is expensive. In general the control measures can be individualized based on the severity of IDD that can be summarized as follows:

Table2. Possible interventions

Severity of IDD	Choice of intervention methods
Mild IDD	Iodized salt at the concentration of 10-25 mg/kg. It may disappear with socioeconomic development
Moderate IDD	Can be controlled with iodinated salt at the concentration of 25 to 40mg/kg if the salt can be produced and effectively distributed. Otherwise iodized oil ether orally or by injection should be used through the primary health care system contacts
Severe IDD	Iodized oil either by injection or orally for the prevention and control of central nervous system defects

Source: Shils OS, Modern nutrition in Health and Diseases Vol II:261.

2.8.2. IRON

Symptoms and Sign of the deficiency

Symptoms

- Weakness
- Fatigue
- Dyspnea on exertion
- Coldness and parasthesia of the hands and feet
- Vague GI complaints such as
 - Capricious appetite
 - Flatulence
 - Epigastric distress
 - Belching
 - Constipation or diarrhea
- Glossitis (varying degree of papillary atrophy and soreness) which is
 - More common over 40 years of age
 - More in women than men
- Angular stomatitis in 10-15%
- Plummer Vinson syndrome in middle age women

Signs

- Pallor
- Pica (geophagia, clay eating and ice eating)
- Finger nails and toe nails –lusterless, thin, brittle, flattened and spoon-shaped (koilonychias)
- “Hemic” murmur, splenomegally, dependent edema, and lastly congestive heart failure.

Diagnosis

Difficult to diagnose in mild cases

I. Clinical signs and symptoms

II. Biochemical Method

- Hemoglobin determination or hematocrit
- Peripheral morphology shows hypochromic microcytic
- Serum Iron and serum ferritin decreases
- Total Iron binding capacity increases usually greater than 84%
- Bone marrow aspiration shows low iron storage in macrophages, decrease in number of sideroblasts

III. Dietary

- Dietary history
- 24 hours dietary recall
- Food frequency questionnaire,

Differential diagnosis

- Thalassemia minor (target RBC)
- Sideroblastosis (Perl's prussian blue stain)
- Chronic illnesses

TREATMENT

In treating iron deficiency anemia we should also consider administration of folic acid (see Table 1 below).

Table 1. Treatment protocol for nutritional anemia

Age group	Dose	Duration of Treatment
< 2 years	25 mg iron + 100 - 400µg folic acid daily	3 months
2 – 12 years	60 mg iron +400µg folic acid daily	3 months
Adolescents and adults including pregnant women	120 mg of iron + 800µg folic acid Daily	3 months

Source: WHO, BASICS,, UNICEF. Nutrition Essentials: A guide for health managers

Oral or parenteral administration of iron in the form of gluconate, succinate, sulphate . Iron dextran should be administered parentally for patients with:

- Ulcerative colitis, regional enteritis, intestinal shunts, colostomy or ileostomy
- Malabsorption syndromes
- Uncooperating patient or severe intolerance of oral dose

Complications of parenteral administration

Anaphylactic shock particularly during i.V administration

Skin staining at the injection sites

2.8.3. SIGNS AND SYMPTOMS OF VITAMIN A DEFICIENCY DISORDER (VADD)

- Night blindness
- Lack of tear secretions (due to destruction of goblet cell)
- Changes in eyes with eventual blindness if deficiency is severe and untreated
- Susceptibility to respiratory infections
- Dry, rough skin
- Changes in mucous membranes
- Weight loss
- Poor bone growth
- Weak tooth enamel
- Diarrhea
- Corneal Xerosis(Dryness)
- Corneal Ulceration/ Keratomalacia
- Bitot's spots
- Conjunctival Xerosis
- Corneal scar
- Slow growth

It is characterized clinically by Xerosis (dryness) of the eyes and night blindness, which are classified by the WHO as follows:

Night blindness (XN) is the first symptom of VAD, which is the inability to see in low levels of light. In low levels of light (eg. dusk, moonlight, darkened room) it is the rods within the retina, which are primarily responsible for vision, as they are more sensitive to light than the cones. Retinal is an essential component of rhodopsin, the main visual pigment in the rods. Due to the high prevalence in Ethiopia, local names in have developed to describe the condition including “Dafint” in Amharic and “berberti” in Oromiffa indicating the commonness of the problem.

Bitot's spots (XIB): are signs of VAD that are frothy or “cheesy” white or off-white lesions on conjunctiva of the eye. They are made up of clumps of squamous cells, and are most often seen in the lower lateral quadrant of the bulbar conjunctiva Vitamin A deficiency leads to squamous metaplasia of all the mucus membranes of the body.

(Respiratory, gastro intestinal, genito-urinary tracts, as well as the conjunctivae are also affected).

Corneal xerosis (X2A) : is seen as a wrinkling of the cornea.

A Corneal ulcer/ Keratomalacia (X3A) is ulceration and softening of the cornea where less than 1/3 of the corneal surface involved and

Corneal ulcer/ Keratomalacia (X3B) is ulceration and softening of the cornea where greater than 1/3 of the corneal surface involved

A corneal scar (XS) is seen as a white spot on the cornea and is due to a healed corneal ulcer.

In Kerato Malacia: **which is** the fifth stage of vitamin A deficiency, the eyeballs become opaque and soft, jelly like substance, her after, there will be rapid destruction of the eyeballs and no hope of recovery after the condition reached this stage. Active corneal xerophthalmia (i.e. corneal xerosis and/or ulcers) are extremely rare below 6 months and above 5 years of age. However, corneal scars (inactive corneal xerophthalmia) are permanent sequelae among survivors of full-thickness corneal ulcers, and Bitot's spots can sometimes persist even if the VAD is reversed. Non-corneal xerophthalmia (night blindness and/or Bitot's spot) can occur in older children and adults, and transient night blindness can be common among pregnant and lactating women in deficient populations. Clinical forms of xerophthalmia, and WHO classification thresholds (among children aged 2-5 years inclusive) of xerophthalmia and biochemical vitamin A deficiency to consider it a problem of public health importance:

DIGNOSIS

Many months of deficiency are required before lab studies reflect deficiency. The following methods can be used to assess the deficiency.

I. Clinical

- Clinical signs and symptoms
 - Dark-adaptation test
 - Electro-nystagmogram
 - Electro-retinogram
- } may not be applicable in Ethiopian HC setup

II. Biochemical

- Serum level and
- Plasma Vitamin A and plasma carotene

III. Dietary

- Dietary history
- 24 hours dietary recall
- Food frequency questionnaire,

Treatment:

Doses of oral vitamin A (as retinal palmitate in oil). One dose immediately, the second dose the next day, and the third dose 2 weeks later.

- 0-5 months 50, 000 IU per dose
- 6-11 months 100,000 IU per dose
- 12⁺ months 200,000 IU per dose.

Prevention:

Vitamin A supplementation

- I. **Universal Supplementation:** A single dose of vitamin A every 6 months in population where vitamin A deficiency is a problem of public health importance (see criteria above).

Target groups: Children 6-59 months and lactating mothers within 6 weeks of delivery. The supplementation could be done through the six critical contacts of women and children with the health service unit:

- Antenatal care
- Delivery
- Postnatal care and family planning
- Immunizations
- Well baby and
- Growth monitoring/ promotion visits and
- Sick child visit

Other outlets such as EPI+ programs, Community IMCI and clinical IMCI contacts can also be used for supplementing vitamin A.

II. Disease targeted supplementation: Give a single dose vitamin A to children under five years at the first contact with the health professional as follows:

A case of Protein energy malnutrition on the : 1st, 2nd and 14th days (Therapeutic dose)

A case of measles: 1st, 2nd and 14th days (Therapeutic dose)

Cases of acute respiratory illness and diarrheal diseases: a single dose on the 1st day of contact

III. Food Diversification: Give nutrition education on the importance of consuming diversified dietary sources of vitamin A such as green leafy vegetable (Kale, Cabbage) and Yellow fruits and vegetable (Mango, Papaya, Carrot, etc.)

C. Food Fortification: Different food vehicles like sugar can be fortified with vitamin A.

2.8.4. VITAMIN D DEFICIENCY SYMPTOMS

- Rickets (a childhood deficiency disease): malformations of joints or bones, late tooth development, weak muscles, listlessness, double malleolus, Rachitic Rosary, Bowed legs and knocked knees, delayed Fontanel closure, craniotabes
- Osteomalacia (adult rickets): pain in ribs, lower spine, pelvis and legs, muscle weakness and spasm, brittle, easily broken bones.

Diagnosis

I. Clinical: signs and symptoms

II. Biochemical

- Reduced levels of Vitamin D forms in blood.
- Decreased serum phosphate, decreased calcium, increased alkaline phosphatase, urinary hydroxyproline, PTH levels.

III. Biophysical: Bone X-ray

IV. **Dietary Method:** Dietary history, 24 hour dietary recall method, food frequency questionnaire

2.8.5. FOLIC ACID DEFICIENCY

DEFICIENCY SYMPTOMS

- Irritability
- Neural tube defects if deficient during pregnancy
- Weakness
- Lack of energy
- Sleeping difficulties
- Paleness
- Sore red tongue
- Mild mental symptoms, such as forgetfulness and confusion
- Diarrhea

DIAGNOSIS

- Serum folic acid (unreliable unless levels are abnormally low)
- Blood cells showing macrocytic anemia coupled with normal levels of B-12 in blood
- Neutrophilic segmentation index

TREATMENT

- For adults and adolescents 800microgram/for 3 months in conditions complicated by pregnancy, hyper metabolic states, alcoholism, hemolytic anemia and conditions that reduce folate absorption
- Supplementation of 400 microgram/day for 6 months should be done for all pregnant women to prevent folic acid deficiency (see table 1 below)

Table 1. Treatment protocol for nutritional anemia

Age group	Dose	Duration of Treatment
< 2 years	25 mg iron + 100 - 400µg folic acid daily	3 months
2 – 12 years	60 mg iron +400µg folic acid daily	3 months
Adolescents and adults including pregnant women	120 mg of iron + 800µg folic acid Daily	3 months

Source: WHO, BASICS,, UNICEF. Nutrition Essentials: A guide for health managers

2.8.6. ZINC DEFICIENCY

Moderate deficiency:

- Impaired taste and smell (hypogeusia)
- Growth retardation in children and in fetuses (results in low birth weight)
- Delayed sexual maturation and impotence
- Alopecia
- Rashes
- Multiple skin lesions (Acrodermatitis enteropathica)
- Glossitis
- Stomatitis
- Impaired immunity
- Abnormalities of labor including preterm labor or precipitated labor
- Post partum hemorrhage due to uterine atony
- Blepharitis
- Paronychia
- Sterility
- Low sperm count and hypogonadism
- Delayed wound healing
- Night blindness and eye lesions including photophobia
- Impaired appetite and food intake

Severe deficiency:

- Delayed bone maturation
- Enlarged spleen or liver
- Decreased size of testicles
- Testicular function less than normal
- Decreased growth or dwarfism

DIAGNOSIS

It is not practical to do the static and functional biochemical tests in our setup but the diagnosis could be made based up on clinical manifestations and dietary history.

TREATMENT

- Zinc supplementation
- Counseling on the importance of increased consumption of zinc friendly foods

2.11 Prevention of Micronutrient deficiencies (options for intervention)

Parental education on child feeding practices, importance of bringing their under five children to the nearby health institutions every month in the first 3 years and every 3 months then after for **growth monitoring and follow up**, the importance of immunizations and personal, food and environmental hygiene are critically important in averting the occurrence micronutrient mal nutrition. Nutritional status of children less than 2 years and mothers should be promoted at 6 **essential contacts** with the health care unit which includes:

- Antenatal care visits
- Delivery
- Postnatal care and Family planning visits
- Immunizations

- Growth monitoring and well baby clinic visits
- Sick baby clinic visits

During all these contacts **Essential Nutrition Actions (ENA)** that need to be promoted are the following:

- I. Exclusive breast-feeding up to 6 months of age
- II. Complementary feeding at the age of 6 months with continued breast feeding up to 2 years and beyond
- III. Continued feeding of the sick child
- IV. Maternal nutrition
- V. Vitamin A supplementation for children 6-59 months and for lactating mothers within 8 weeks after delivery.
- VI. Iron and folic acid supplementation to the mother during pregnancy and in the postnatal period
- VII. Ensure the consumption of iodized salt by the family

2.12 Learning activities (case study) continued

Refer to case studies 1,2 and 3 in the core module and discuss on the following questions in the class. The instructor can assist you.

1. *What pertinent history do you ask parents of children in cases 1.2 and 3?*
2. *What pertinent physical signs would you look for?*
3. *What laboratory investigations would you order in order to substantiate your diagnosis?*
4. *What other assessments do you carry out in order to determine the type of malnutrition?*
5. *What is your diagnosis from the story?*
6. *What other causes do you consider for the differential diagnosis?*

7. *What complications do you expect from nutritional problems of such kind?*
8. *What are the risk factors for the development of cases 1,2 and 3?*
9. *How would you manage the 3 cases?*
10. *What are the preventive measures for the 3 cases?*

2.13. Post test

See the pre and posttest in the core module pertaining to health officers unit 2 section 2.1.2.1

2.14. Role and Task Analysis

Refer to unit 4 of the core module for the tasks expected of you.

2.15. Glossary and abbreviations

Refer to unit 5 of the core module

2.16. References

Refer to unit 6 of the core module

2.17. Annexes

Refer to unit 7 of the core module for answer keys and other materials

UNIT ONE

SATELLITE MODULE FOR PUBLIC HEALTH NURSES

Introduction

Adequate nutrition is the intake and utilization of enough energy and nutrients, together with disease control, to maintain well-being, health and productivity. “Malnutrition” includes generalized malnutrition (which manifests itself as stunting, underweight and wasting in individuals) and deficiencies of micronutrients such as vitamin A, Iron, Zinc, and Iodine. The magnitude of the problem relating with micronutrients in Ethiopia are so intense and majority of children, adults, pregnant and lactating women are affected. Therefore, health workers particularly the public health nurses are critical to the design and implementation of nutrition program. Collaboration with the other professionals and implementing the essential nutrition action can reduce infant and child mortality; improve physical and mental growth, development, and productivity.

1.1. Purpose and Use of the Satellite Module

The purpose of this satellite module is to equip learners (trainees) with knowledge and skills required to identify and manage effectively cases of micronutrient deficiency. The public health nurses can use this satellite module in their-services or in-services training programs.

1.2. Direction for using the Satellite Module

For a better understanding of this module, the public health nurses are advised to follow the following directions.

- Do the pretest prepared to all categories and pertinent to your field.
- Read or refer to the core module
- Read the case history
- Evaluate yourself by doing post tests and comparing the score by referring to the key answers given.

UNIT TWO

SATELLITE MODULE FOR PUBLIC HEALTH NURSES

2.1 Pre and Post test

See the core module unit 2

2.2 Significance and Brief Description of the Problem

See the core module unit 2.

2.3 Learning Objectives

To be able to prioritize the key nutrition behaviors which met the health and nutrition needs of vulnerable groups of population in the communities and integrate these in to ongoing intervention programs in health facilities and communities at large.

2.4 Case Study: Learning Activities.

Read cases 1, 2 and 3 so that you will be able to discuss questions in section 2.12 of this module.

2.5 Micronutrient Deficiencies:

Micronutrient deficiency refers to the deficiency (decrease in the level) of micronutrients that are essential for the vital function including growth, development, immunity, fertility

and other lively processes. Although there are various micronutrients essential to our body, in this regard, this module focuses mainly on few micronutrients that are of public health importance in the Ethiopian context due to the tolls of morbidity, disability and mortality they are causing in the population. Therefore, this module focuses mainly on the following micronutrients: Vitamin A deficiency, Iron Deficiency anemia, Iodine Deficiency disorder and vitamin D deficiency (rickets),

2.5.1. VITAMIN A DEFICIENCY

Vitamin A has the distinction of being the first fat-soluble vitamin to be recognized. It is certainly one of the most versatile, with parts to play in such diverse functions as vision, maintenance of body lining and skin, bone growth, anti oxidant activity and reproduction. A deficiency may be as many as hundred thousand a year world wide, placing a heavy burden on society.

Until recently vitamin A deficiency was thought to be a problem only for the eye health and vision. It is now clear that it is also essential for the proper functioning of the immune system of the children, which occurs, long before damage to the eye is apparent.

It is also worth to mention that the vitamin A status of the infant is closely correlated with that of the mother. Vitamin A deficient mother transfers less vitamin A to their fetuses. After birth the concentration of vitamin A in the breast milk depends on the vitamin A status of lactating woman. Breast milk with sufficient vitamin A will provide infant with enough vitamin A for at least the first 6 months of life and possibly the first year.

In Ethiopia 27 % of children less than five years of age suffer from sub clinical vitamin A deficiency. This means that between now and the year 2005 over 298, 000 children lives will be lost as a result of vitamin A deficiency if action is not taken.

Vitamin A:

- Important component for seeing in dim light.
- Has to come from food or supplements
- Is stored in the liver
- Builds the epithelial cells
- Is important for immune system.

Who is at the greatest risk?

- Children 6 to 59 months
- Women during pregnancy and lactation

Objectives:

- Eliminate vitamin A deficiency
- Decrease child morbidity and mortality.

Solution to vitamin A deficiency

Strategies

- Breast milk
- Food diversification
- Supplementations
- Food fortification

1. Breast feeding

Breast milk is a hygienic source of energy, essential nutrients, water, immune factors, and many other components that are beneficial for infant and young children. Breast milk protects against vitamin A deficiency. Breast milk is the ideal food for the children in the first six months of age. This is because:

- Breast milk is rich in vitamin A
- Exclusive breastfeeding reduces infection and vitamin A losses.
- Postpartum vitamin A supplementation of lactating women will raise breast milk vitamin A content.

- Promotion of exclusive breastfeeding is a strategy for preventing Vitamin A deficiency.
- Vitamin A intervention increases the benefits of breast feeding promotion for maternal and child health and survival.

The Public Health Nurses should always utilize the following important key message at each contact with the mother in order to promote breast feeding.

- Early initiation of breast feeding
- Exclusive breast feeding until six months
- Breast feeding day and night at least ten times.
- Correct positioning and attachment
- Empty one breast and switch to the other.

2. Food diversification: Encouraging more frequent intake of foods that are naturally rich in vitamin A using communication activities and counseling by the health workers.

- Access` and availability to adequate foods
- Especially children after six months of age and pregnant and lactating women.

3. Treatment supplementation for different diseases in children

Provide the Vitamin A capsule for children 6 to 59 months using the following dose

- < 12 months 100 000 IU capsule
- >12 months 200 000 IU capsule

Using an IMCI modality and depending on the diagnosis, the public health nurse should follow::

- Children 6 to 59 months: 2 times a year.
- < 12 months 100 000 IU Capsule
- >12 months 200 000 IU Capsule.
- Advice to take Vitamin A rich foods (liver, kidney, fish oils, cheese carrots....etc)

Treatment supplementation for different diseases

- Pneumonia, severe malnutrition, severe anemia and persistent diarrhea Capsule on day 1.
- Measles: capsule on day 1, day 2, day 30.
- Treatment of eye problems due to Vitamin A deficiency: capsule on Day 1, Day 2. Day 30.

4. Food Fortification: Adding vitamin A to foods that are commonly consumed by the high risk groups, such as: Vitamin A enriched sugar, Iron enriched flour, fish liver oil ... etc..

Key contact points for control of Vitamin A deficiency.

- Pregnancy
- Delivery
- Postnatal and family planning
- Well child/ GM/P
- Immunization
- Sick child

Pregnancy (antenatal contact)

- Increased food and vitamin A intake. In the areas where vitamin A deficiency is common and vitamin A rich foods are scarce, low dose of vitamin A supplements (< 10 000 IU/ day or 25 000 IU/week) or multiple micronutrient supplements with appropriate levels of vitamin A may be recommended.)
- Counsel on early initiation of breast feeding, feeding of colostrum, and frequent exclusive breast feeding
- Assess nutritional status and encourage increased energy intake, a varied diet, including vitamin A-rich food, and reduced workloads during pregnancy
- Discuss family planning options that protect lactation, including Lactational Amenorrhea Method (LAM)
- Educate on parasite prevention and treat parasite infection.

Immediate postpartum Contact

- Facilitate early initiation of breast feeding, counsel on frequent and exclusive breast feeding, and help establish good breast feeding skills (Proper positioning and attachment).
- Administer a single high dose vitamin A supplement to mother immediately after delivery.
- Assess nutritional status and counsel mother on increasing energy intake, consuming a varied vitamin A rich diet, and reducing work load through out lactation.
- Discuss family planning options that protect lactation, including LAM.

Postnatal contact

- Vitamin A deficiency will result in low vitamin A concentration in breast milk.
- In areas where vitamin A deficiency is common, give a single high dose [200,000 IU] vitamin A capsule as soon after delivery as possible, but no later than eight weeks postpartum. This will help to build up vitamin A stores, improve the vitamin A content of breast milk, and reduce the risk of infection in mother and infants.
- The Public Health Nurse should be aware that a single high dose of Vitamin A supplement (More than 10,000 IU per day or 25, 000 IU per week) should not be taken during pregnancy because it will harm the developing fetus. Since the risk of pregnancy for lactating women is very low during the first 8 weeks of post partum, this is the only time that they should take the high dose capsule.
- Assess breast feeding practices and encourage and support exclusive breast feeding for six months
- Provide maternal nutrition counseling, reinforcing the need for increased energy intake, a varied and vitamin A rich diet and reduce work load.
- Administer a single high –dose vitamin A supplement to lactating women, if she is still within the eight weeks post partum period and has not yet received it.
- Discuss family planning options that protects lactation including LAM
- Treat parasite infection and educate on parasite prevention.

Well baby contact (Growth monitoring and immunizations)

- Provide nutritional assessment and counseling, reinforcing the mother's need for increased energy intake, a varied vitamin A diet, and reduced work load.
- Counsel on exclusive breast feeding, timing for the introduction of appropriate complementary food, the importance of vitamin A rich foods in the child's diet, and practical ways of enriching the child's diet using locally available foods.
- Check and complete vitamin A supplementation protocol for older infants and young children.
- Check and complete mother vitamin A supplementations (if within 8 weeks postpartum)
- Discuss family planning options that protect lactation, including LAM, IUCD...etc.
- Administer 50,000 IU Vitamin A supplement to non breast fed infant under six months at first contact

The sick baby clinic/ Sick child:

- Assess and counsel on breast feeding and adequate and complimentary feeding during and after illness.
- Check and complete vitamin A supplementation protocol: Follow national policies therapeutic dosing with high dose of vitamin A capsule for measles, xerophthalmia, chronic diarrhea and severe malnutrition.

Action to support breast-feeding and improve vitamin A status:

1. Community level

- The public health nurse should work with local NGOs, community outreach programs, and extension agents in all sectors to incorporate information and support the optimal infant feeding and maternal nutrition into their activities.
- Establish and /or provide training to mother support groups and plan and conduct home visits to share information and experience on breast feeding and complementary feeding.

- Use local communication channels (mass media, schools, religious institutions, community events, market place, community based distributions systems etc.) to disseminate information on optimal infant feeding practices, maternal nutrition, and vitamin A.
- Increases availability of vitamin A-rich foods through schools and community gardens, fruit trees and animal husbandry (raising hens, chickens, and other small animals).

2. Household level

- The public health nurse should advise the mother at home setting level that sun dried seasonal fruits and vegetables or air dried out of direct sunlight would provide a source of vitamin A through out the year.
- Recommend the mother in a way that she may be capable of serving vitamin A-rich foods with a little fat (oil, butter, peanuts) to increases utilization by the body.
- Recommend communities to plant gardens with a variety of vitamin A-rich vegetables such as Mango, Sweet potatoes, Pumpkin, Carrot

Basic Facts: Consequences of Vitamin A deficiency in Pregnancy

Increases the risk of:

- Night blindness
- Maternal mortality
- Miscarriage
- Still birth
- Low birth weight
- Reduced transfer of Vitamin A to fetus

2.5.2 Iron Deficiency Anemia

Anemia is low level hemoglobin in the blood, as evidenced by reduced quality or quantity of red blood cells that affects oxygen carrying capacity of blood. It has massive consequences for maternal and child health, child development and productivity. Iron is essential to periods of growth, such as infancy, adolescence, pregnancy and lactation.

Iron deficiency is the most common nutrient deficiency worldwide. The groups at highest risk are infant, teenage girls, pregnant women, and the elderly. Studies indicated that iron deficiency is 30 to 50 % of the people in these groups.

It has also been observed that prolonged exclusive breast-feeding could be one of the risk factors for iron deficiency anemia. A recent hospital based study on children between 6 to 24 months of age who were admitted for acute infection or inflammatory diseases indicated that those children who were exclusively breast fed after 6 months of age are at risk of developing iron deficiency anemia as compared to those children who has been given iron fortified formula milk from birth and those who had been given breast milk for five to six months and then switched to iron fortified formula. This study suggested appropriate iron fortified weaning food or routine iron supplementation should be given starting at 6 months for exclusively breast-fed children.

Another cause of iron deficiency anemia is infection: either parasitic or other. Evidence from different studies has revealed that children in developing countries are predisposed to different infectious diseases which are risk factors for the development of iron deficiency anemia.

Who is at the risk?

- Children 6-24 months
- Special risk infants: low birth weight, premature, and/or from anemic mothers.
- Women of reproductive age, especially pregnant women.
- Adolescents (especially females)
- People living with HIV/Aids / PLWHA

Consequences of Anemia in pregnant Women:

Increased risk of:

- Premature birth
- Intrauterine growth retardation
- Low birth weight
- Increased risk of maternal mortality
- Reduced ability to survive bleeding during and after birth
- Decreased productivity due to fatigue and tachypnia.

Consequences of Anemia in Children:

- Increased infant mortality(due to low birth weight)
- Learning deficits (Iron Deficiency anemia lowers IQ by 10 points)
- Fatigue and poor growth
- Iron deficiency affects iodine up take thus increasing risk of Iodine Deficiency Disorders

Critical Contact Points

Essential nutrition action needs to be taken by all health and extension workers.

Those critical contact points are:

- During pregnancy
- During delivery
- During postnatal period
- Well baby clinic
- Immunization
- Sick child clinic

1. Antenatal contact

- Give Iron /folic acid supplementation
- De-worm pregnant women
- Give anti malarial to pregnant women
- Promote mosquitoes-nets for mothers and baby
- Promote improved diet for women
- Prepare for optimal breast feeding once the baby is born

- Promote consumption of iodized salt during antenatal Visits.

2. Delivery Contact

- Put the baby to breast immediately
- Give Vitamin A to mother
- Continue` Iron/folic acid for the mother
- Promote improved diet for mother during lactation

Post-natal and/ or family planning contact

- Promote exclusive breast feeding for 0-6 months
- Check appropriate position and attachment during breastfeeding
- Promote improved diet for mother
- Continue iron/folic acid for mother
- Promote mosquito-nets for mothers and baby
- Promote consumption of iodized salt and FP, STI prevention and child's vaccination.

3. Immunization Contact

- Complete Vitamin A for the baby
- De-worm older infants
- Assess and treat infants anemia
- Promote optimal breast feeding exclusive for 0-6 months
- Promote adequate complementary feeding
- Promote use of mosquito-net mother and child` Vaccinations (child and women) and FP, STI and timely referral.

4. Well child visit and GM/P Contact

- Monitor infant/child's growth
- Assess and counsel on feeding BF and CF (breast feeding and complementary feeding)
- Assess and treat infant anemia

- Promote consumption of iodized salt
- Complete vitamin A
- De-worm for parasites
- Check and complete vaccinations.

5. Sick child visit (IMCI) contact

- Monitor infant /child growth
- Counsel on feeding breast feeding and complementary feeding
- Assess and treat anemia
- De-worm
- Complete vitamin A and vaccinations
- Assess and treat as IMCI

6. Contact in other sectors

6.1. In school Programs

- Assess and treat child and adolescent anemia
- Promote consumption of iodized `salt
- Complete vitamin A
- De-worm
- School lunch if possible
- Promotion of better nutrition

6.2 In out reach sites

- Promote adequate breast feeding and complementary feeding
- Promote control of anemia
- Promote consumption of iron rich foods
- Promote consumption of Vitamin A rich food
- Promote consumption of iodized salt
- Promote vitamin A supplementations
- Treat iron deficiency anemia
- Promote increased food intake during pregnancy and lactation.

6.3 In existing community based organization meetings.

- Promote adequate breast feeding and complementary feeding
- Promote control of anemia
- Promote consumption of iron rich foods
- Promote consumption of Vitamin A rich food
- Promote consumption of iodized salt
- Promote vitamin A supplementations
- Promote increased food intake during pregnancy and lactation
- ◆ National immunization days for polio and measles can be used to give Vitamin A.

6.4 In Micro-credit groups targeting women:

- Promote adequate breast feeding and complementary feeding
- Promote control of anemia
- Promote consumption of iron rich foods
- Promote consumption of Vitamin A rich food
- Promote consumption of iodized salt
- Promote vitamin A supplementations
- Promote increased food intake during pregnancy and lactation

6.5 In Emergency situation: In addition to therapeutic feedings and food distributions.

- Promote adequate breast feeding and complementary feeding
- Complete vitamin A
- De-worm
- Promote control of anemia
- Increased food distribution/ food intake during pregnancy and lactations.
- Provide vaccination (measles) and assess and treat the child as IMCI protocol.
- Provide family planning method based on informed choice.

- Promote environmental sanitation and clean water.

2.5.3 Iodine Deficiency Disorders (IDD)

Proper nutrition is essential for mental and physical development and school performance. Evidence from different countries shows that malnutrition considerably reduces children's learning ability, school performance and retention rates. Iodine deficiency lowers the ability of children to think and become creative and productive adults. Iodine is also necessary for the normal development of the brain of fetus during pregnancy. Pregnant women living in iodine deficiency regions are more likely to give birth to mentally retarded children.

IDD remains a significant public health problem in many countries. According the 1990 nutritional survey in Ethiopia, the total rate of goiter, the most visible sign of iodine deficiency is 22 %. Globally, 30 % of the world's population is affected by IDD and more than 150 million people are affected in Africa alone. In Ethiopia, one out of every 1000 is **a cretin** (severely mentally retarded and dwarf), and about 50,000 peri-natal deaths are occurring annually due to iodine deficiency disorders.

Iodine is essential for the production of Thyroxin hormone used for:

- Brain development and function
- Growth
- Reproduction
- Body temperature

Consequences of iodine deficiency on education

- Educability diminished (reduce intelligence)
- Drop-out rates increased
- Under utilization of school facilities
- Reduce productivity

Who is at high risk?

- In school age children
- Women in the reproductive age
- Men and females of all ages
- Young children and growing fetus are particularly vulnerable to the damage caused by IDD.
- Infants who are not exclusively breast fed
- Lactating women

Strategies used to control IDD

1. Distribute iodized oil capsule
2. Increase access and consumption by all families of iodized salt

Distribution of Iodized oil capsule

The public health nurse should distribute to all potential clients if available.

For High endemic areas only the following regime should be utilized

1. capsule for pregnant women and children less than 5 years
2. Capsule for women and children for 5 to 14 years of age.

Key contact points for control of IDD

- Pregnancy
- Delivery
- Postnatal and family planning
- Immunization
- Well child/ GM/P
- Sick child Clinic

-(Refer the essential activities on the key contact points for Vitamin A and Iron deficiency as applied to IDD)

-The public nurse should know the following important element of a successful IDD program.

Elements of a successful IDD program

- Supplement supply
- Delivery system
- Demand and compliance
- Monitoring and evaluation

2.5.4 Vitamin 'D' Deficiency (Rickets):

Rickets is a disease caused due to Vitamin D deficiency. It is characterized by weakness and deformity of bones. Deficiency states occur due to lack of calcium ion in the body which in turn is mainly due to defective absorption because of vitamin D deficiency.

The two most important vitamins 'D's are vitamin D-2 and D-3. Vitamin D-2 (ergocalciferol) exists in fungi and yeast and is generally added to milk, food and vitamin supplements. It is used to combat hypocalcaemia (low blood calcium). Vitamin D-3 (cholecalciferol), is found in fish oils, egg yolks and milk. The body produces vitamin D-3 in the presence of ultraviolet light.

Unhealthy child care practices such as non exposure of infants to sunshine and complete covering while outdoors for fear of evil eyes contribute to the occurrence of rickets in Ethiopian children.

Since sunshine is adequately available in Africa, rickets is uncommon. But in countries like Ethiopia, traditional and cultural practice of child-care has contributed to the occurrence of rickets. Rickets is more commonly associated with protein energy malnutrition and improper weaning practice.

Functions of Vitamin D

- Regulates growth, hardening and repairing of bone by controlling absorption of calcium and phosphorus from small intestine.
- Prevent rickets
- Prevent hypocalcaemia (low blood calcium)
- Prevent post-operative muscle contraction

- Work with calcium to control bone formation, promotes normal growth and development of infants and children particularly bones and teeth.
- Absorbs and uses calcium and phosphorous to make bone

Deficiency:

- Rickets (Childhood deficiency disease) malformation of joints or bones, lack of tooth development, weak muscle, bowed legs, knocked knees and delayed fontanel closure
- Osteomalacia (adult rickets) pain in ribs, lower spine, pelvis and legs, muscles weakness and spasm and easily broken bone
- Muscle disease (Myopathies)

Investigation to detect deficiency

- Reduced level of vitamin D forms in blood
- Decrease serum phosphate, decreased calcium and increased alkaline phosphate
- Bone X-rays

The role of public health nurse in the prevention of rickets:

Nutrition education focusing on the:

- ◆ Importance of exposing child to the sun light (direct exposure with no filtration of the sunlight by the fog or window glass).
- ◆ Be aware and inform caregivers that many factors including smoke, fog, clothes and glass interfere with production of vitamin 'D'
- ◆ A daily exposure for ten minutes
- ◆ Importance of exclusive breast feeding and complementary feeding.

Sources of Vitamin D

- Butter
- Cod-liver oil
- Egg yolks
- Salmon

- Sardines
- Sunlight plus subcutaneous fat
- Vitamin D fortified milk.

How to take available capsule or tablets

- Take with or immediately after food to increase absorption
- Take oral solutions with meals or 1-1: 30 hours after meal.
- High dose of vitamin D have been generally discouraged as it has side-effects including: calcification of soft tissue, kidney failure which is manifested by high blood pressure, irregular heart beat, nausea, weight loss, seizure, mental and physical growth retardation, kidney damage ...etc

2.6 Practical Nursing for Improving Nutrition

Guidelines for appropriate complementary feeding of infants and young children 6- 24 months.

- ***Appropriate complementary feeding promotes growth and prevents stunting among children 6-24 months.***

The period of complementary feeding is when others foods or liquids are provided along with breast milk. Rates of malnutrition's usually peak at this time with consequences of persist throughout life. Stunting is seldom reversed in later childhood and adolescents. Inadequate feeding of female children also affects nutrients stores, subsequent reproductive health, and the risk of maternal mortality.

- ***Appropriate complementary feeding involves` the combination of practices` to maintain breast milk intake and, as the same time, improve the quantity and quality of foods children consume.***

The 6-11 months period is especially vulnerable time because infants are just learning to eat and must be fed soft foods frequently and patiently. Care must be taken to ensure that these foods complement rather than replace breast milk. For older infants and toddlers, breast milk continues to be important sources of energy, protein,

micronutrients. Therefore, breast feeding should continue through 24 months and beyond.

- ***Improving complementary feeding requires a combination of strategies***

Energy intake can be increased by increasing breast feeding frequency, increasing food portion sizes, frequency, and/or providing more energy-dense foods. Micronutrient intake can be increased by diversifying the diet to include fruits, vegetables, and animal products, sea foods; using fortified foods; and/or giving supplements. Choosing food combinations that enhance micronutrient absorption is also important.

The public nurse should promote infant and child optimal feeding using the following facts

- Continue frequent, on demand breastfeeding, including night feeding for infants.
- Introduce complementary foods beginning at six months of age.
- Increases food quantity as the child ages, while maintaining frequent breast feeding.
 - Provide 6-8 month old infants approximately 280 Kcl /day from complementary foods.
 - Provide 9-11 month old infants approximately 450Kcl/day from supplementary foods.
 - Provide 12-24 month old children approximately 750Kcl/day from supplementary foods.
- ***Increases feeding frequency as the child age, using a combination of meals and snacks.***
 - Feed 6-8 month old infants complementary foods 2-3 per day.
 - Feed 9-11 month old infants complementary foods 3-4 times per day.
 - Feed 12-24 month old children complementary foods 4-5 times per day.
- ***Gradually increase food consistency and variety as the child ages, adapting the diet to the infant's requirements and abilities.***
 - Feed mashed and semi-solid foods, softened with breast milk, if possible, and beginning at 6 months of age.

- Feed energy-dense combination of foods to 6-11 months olds.
- Introduce “finger foods”(snacks that can be eaten by children alone) beginning around 8 months of age in the mean time, try to avoid risk of chocking
- Make the transition to the family diet at about 12 months of age.

Diversify the diet to improve quality and micronutrient intake.

- Feed Vitamin A-rich fruits and vegetables daily.
- Feed meat, poultry, or fish daily or as often as possible, if feasible and acceptable.
- Use fortified foods, such as iodized salt, Vitamin A-enriched sugar, iron enriched sugar, Iron enriched flour or other staples, when available.

Practice active feeding

- Feed infants directly and assist older children when they fed themselves.
- Offer favorite foods and encourage children to eat when they lose interest or have depressed appetites.
- If children refuse many foods, experiment with different food combination, tastes, texture, and methods for encouragement
- Talk to children while feeding.
- Feed slowly and patiently and minimize distractions during meals.
- Do not force children to eat.

Practice frequent and active feeding during and after illness.

- During illness, increases fluid intake by more frequent breastfeeding, and patiently encourage children to eat favorite foods.
- After illness, breastfeed and give foods more often than usual, and encourage children to eat more food at each sitting.

Practice good hygiene and proper food handling

- Wash caregivers’ and children’s hands with soap before and after food preparation and eating.
- Serve foods immediately after preparation

- Use clean utensil to prepare and serve food.
- Serve children using clean cups and bowls, and never use feeding bottles.

i. Responsibility of the public health nurse to improve the intake of micronutrients:

The nurse should know that both the quantity and quality of complementary food are important to ensure good health and development. Infants should eat a variety of nutrient-rich foods, including animal products, fruits, and vegetables. The followings are important behaviors that have to transfer to the care givers and mothers with regard to optimal complementary feeding behaviors. The public health nurse should advise the mother the following behaviors to be adopted.

1. At 6 months, mother or care giver introduces soft, appropriate foods and continues breastfeeding on demand.
 - When the child is 6 month old, the mother gives the infant complementary foods in addition to breast milk-to help the infant grow strong and healthy. After six months exclusive breast milk cannot meet all the nutritional needs for growth and development.
 - Mother continues to give breast milk as the main food through the infant's first year. Breast milk will continue to protect the child against illnesses.
2. The mother or care giver increases the amount of food and the number of feedings as the child` gets older. The mother or care giver uses a separate bowl for the child. She should be strongly encouraged to continue frequent breast-feeding.
3. The mother or care giver increases food thickness and variety as the child gets older, adapting to the child's nutritional requirements and physical abilities.
4. The mother or care giver interacts with child during feeding (responsive feeding)
5. The mother or care giver practices good hygiene and safe food preparation.
6. The mother or care giver breastfeeds until child is at least 2 years old.
7. The mother or care giver continues to breast feed when child is ill and encourages the child to eat during and after illness.

2.6.2 Prevention and Intervention.

This involves teaching all sections of the community, especially fathers and mothers, to make the best use of the foods available (including breast feeding), to make use of available primary health care services, and to grow local foods in their own garden.

There are seven rules, which, if kept, can largely improve nutritional status in the community.

1. Identify the local sources of food stuffs.
2. Recognize the causes of improper feeding in the community.
3. Explain the effects of improper feeding on different age and sex groups.
4. Teach nutritional food values of local food stuffs.
5. Demonstrate how to cook balanced meals using locally available foods.
6. Teach personal and food hygiene at home
7. Evaluate what the community members have learned about improved nutrition in order to prevent micronutrient deficiency
8. Make the required food stuff available.

2.6.3 Nursing Advice and help for optimal Breast feeding Behaviors.

Exclusive breastfeeding from 0-6 months

1. Mother gives infant only breast milk for the first 6 months.
2. Mother positions and attaches infant correctly at the breast
 - a. Mother positions and attaches correctly to help prevent sore or cracked nipples, stimulate her milk supply, make it easier for her infant to breastfeed, and make breastfeeding more comfortable for her and for infant.
 - b. Mother does not breastfeed from breast with cracked nipples mastitis but instead expresses milk from that breast and discards the milk frequently from the infected breast until it is healed.

Signs of properly positioned infant:

- a. Mother's back supported whether sitting or lying down
- b. Infant's whole body is facing the mother and is close to her.
- c. Mother holds infant's entire body, not just the neck and the shoulders.

Signs of properly attached infant:

- a. Mother brings infant toward her breast, not the breast toward her infant
- b. Infant's mouth is open wide.
- c. Infant's lower lip turns outwards
- d. Infant's chin touches mother's breast
- e. Mother entire nipple and a good portion of the areola (dark skin around the nipple) are in infant's mouth.

Mother initiates breastfeeding within 1 hour of birth.

- Takes advantages of the newborn's intense suckling reflex and alertness
- Stimulates breast milk production
- Protects infants from diseases by providing the thick yellowish milk (colostrums),
- Helps to expel placenta more rapidly and reduce blood loss.
- Helps expel meconium the infant's first stool.
- Keeps newborn warm through skin-to skin contact
- Fosters bonding between mother and infant
- Mother breast feeds frequently, day and night.
- Mother offers second breast after infant empties the first.
- Mother continues breastfeeding when either she or the infant is sick.
- Mother who will be away from her infant for an extended period expresses her breast milk. Care givers feeds expressed breast milk from a cup.
- Mother expresses breast milk following these steps.

washes hands

- Prepares a clean container
- Gently massages breasts in a circular motion
- Positions her thumb on the upper edge of the areola and the first two fingers on the underside of the breast behind the areola.
- Pushes straight into the chest wall.
- Avoids spreading the fingers apart.
- For large breasts, first lifts and then pushes in to the chest wall

- Rolls thumb and fingers forward as if making thumb and fingerprints.
- Repeats rhythmically: position, roll; position; push, roll
- Rotates the thumb and finger positions.

Learning Activities (Case Study) Continued

Refer to the story of cases 1,2 and 3 in the core module and discuss on the following questions among the team.

1. What type of major health problem did the health center team identify in that particular community?
2. What fundamental intervention programmes need to be planned by the health workers in general? (Consider all the given case scenario)
3. Who should be involved in identifying and prioritizing the health problems for better intervention and good outcome?
4. What is expected from the health workers as far as the given case scenario is concerned?
5. What type of feeding behavior and practices would bring change and improve the health of the community?
6. What basic things were thought by the nurse in order help children to grow healthier and to prevent micronutrient deficiency?
7. What will happen to children if they do not get the necessary nutrients?
8. What will be the role of the public health nurse in the promotion of health and prevention of diseases in the community?

UNIT ONE

SATELLITE MODULE FOR LABORATORY TECHNICIANS

Introduction

1.1 Purpose of the module

This module helps laboratory technicians to participate in the team in the diagnosis and management of micronutrient deficiencies, with a particular emphasis on the laboratory investigations of selected micronutrients such as iron, iodine, zinc, folate, vitamins A and D. Additionally useful laboratory tests associated with these micronutrient deficiencies are discussed.

1.2 Direction for using the satellite module

For a better understanding of this module the laboratory technicians are advised to follow the following directions.

- Do the pretest in your profession in unit 2, section 2.1.2.3 of the core module
- Read the core module thoroughly
- Use listed references and suggested reading materials to substantiate your understanding of the problem
- Evaluate yourself by doing the post test and referring to the keys given in unit 7 section 7.1.2.3

UNIT TWO

SATELLITE MODULE

2.1. Pretest

Refer to the pre and post test in the core module unit 2 section 2.1.2.3

2.2. Significance and brief description of the problem

See the core module unit 2 section 2.2.

2.3. Learning Objectives

After completion of this module students will able to:

- Describe how to collect, handle and label blood specimens
- List the different specimens that are used for the diagnosis of micronutrient deficiencies.
- Describe the concept of laboratory diagnosis of micronutrient deficiencies.
- List biochemical tests used in the diagnosis of iron deficiency anemias
- Describe the micro method of packed cell volume determination.

- Describe and demonstrate how to prepare and stain thin blood film for red blood cell morphology
- Demonstrate how to assess stained thin blood films including elements of the blood films other than red cell morphology (e.g. hemoparasites)
- Classify anemia based on red blood cell morphology and measured hemoglobin
- Indicate the biochemical profiles of microcytic hypochromic anemia due to iron deficiency

2.4 Learning activities: Case study

2.5 Definition

Refer to the core module unit 2 sections 2.5.

2.6 Epidemiology

Refer to the core module unit 2 sections 2.6.

2.7 Cause, Etiology and pathogenesis

Refer to the core module unit 2 sections 2.7.

2.8 Clinical features

Refer to the core module unit 2 sections 2.8.

2.9. Diagnosis

2.9.1 Introduction

Medical laboratory professionals are mainly involved in the diagnosis of micronutrient deficiencies. Depending on the level of the laboratory, various hematological and biochemical tests most of which specific and some non-specific for the specific types of micronutrient are performed. Some of these tests detect free micronutrients and others detect the micronutrient or the metabolites in bound forms by making use of simple to very complex biochemical and immunological tests such as RIA and ELISA.

Specific laboratory tests are available for the diagnosis of the above mentioned micronutrient deficiency. These are: -

Folate: - Folate deficiency is usually detected by hematological abnormalities (e.g. macrocytic megaloblastic anemia and often milder signs such as hypersegmented neutrophils). Measurement of serum folate levels and confirmation by measurement of homocysteine levels also establishes the diagnosis.

Iodine: -The diagnosis of iodine deficiency is based on blood tests indicating low levels of iodine and thyroid hormones or a high level of thyroid stimulating hormone (TSH). T₄ and

T₃ in dried blood spots exposed to natural environment are less stable, lasting only a few days. One major advantage of TSH monitoring is that these specimens are stable and may be shipped long distances over a period of a month or more. The use of this technology has now been applied to field conditions in developing countries. Rapid development in the technology for the measurement of T₄, T₃ and TSH by immunoassay has occurred with improved sensitivity, precision, greater convenience and reduced costs.

The measurement of urine iodine excretion also provides the best single measurement of iodine intake of the population. It can be used for both initial and follow up assessment.

Vitamin A: measuring serum retinal and serum retinal binding protein makes -laboratory diagnosis of vitamin A deficiency.

Vitamin D: - Measurement of blood plasma 25-OH-D, blood plasma calcium, and blood plasma parathyroid hormone enables the diagnosis of vitamin D deficiency.

Zinc: -Zinc status in human subjects is assessed by measurement of zinc in plasma, erythrocytes, neutrophils, lymphocytes, and hair. Available data indicate that zinc in neutrophils and the assay of activity of alkaline phosphatase in neutrophils may be the best tools for the diagnosis of zinc deficiency.

Iron: - Examination of the full blood count and blood film will suggest the diagnosis of iron deficiency anemia. Tests that are useful for laboratory assessment of iron status are: hemoglobin measurement, packed cell volume (PCV) or hematocrit (HCT), red blood cell count, mean cell volume (MCV), red cell distribution width (RDW), erythrocyte protoporphyrine, serum iron, transferrin, transferrin saturation, bone marrow biopsy, serum ferritin, erythrocyte ferritin, transferrin receptor and body iron stores.

Typical Patterns of Serum iron studies in hypochromic microcytic anemias				
	Serum Iron	TIBC	Saturation	Ferritin

Iron deficiency	Low	High	Low	Low
Chronic disease	Low	Low	Low	Normal or Low
Thalassemia	Normal	Normal	Normal	High

Even though all the above-mentioned tests and techniques are available to aid the diagnosis of these selected micronutrient deficiencies, conditions in the third world countries including Ethiopia greatly limit the practical application. Limitations include cost, the greater difficulty in securing venous blood from young children, unavailability of electricity in peripheral health institutions also interruption when available, and the limitation of laboratory facilities including skilled technicians. Therefore emphasis is given only to those tests that could be easily performed at primary health care centers.

2.9.2. Blood Collection

The proper collection and reliable processing of blood specimens is a vital part of the laboratory diagnostic process. This helps to assess the morphology of red blood cells in thin blood film and to know the level and type of anemia in relation to selected micronutrient deficiency. Unless an appropriately designed procedure is observed and strictly followed, reliability cannot be ensured on subsequent laboratory results even if the test itself is performed carefully.

Blood sources for hematological and biochemical tests are:

- Capillary/peripheral blood
- Venous blood

2.9.2.1 Capillary/Peripheral Blood or Micro blood Samples

This is frequently used when only small quantities of blood are required, (e.g., for hemoglobin quantification, and for blood smear preparation). It can be collected from palmar surface of the tip of the ring or middle finger or the free margin of the ear lobe in adults and plantar surface of the big toe or the heel in infants and small children.

Notes: -

- Edematous, congested and cyanotic sites should not be punctured.

- Cold sites should not be punctured as samples collected from cold sites give falsely high results of hemoglobin and cell counts. Site should be massaged until it is warm and pink.

2.9.2.2. Venous blood collection

It is used when larger quantity (greater than 0.5ml) of blood is required. E.g. serum iron. It can be collected from forearm, wrist or ankle veins that are not in i.v. infusion. In infants and children, venipuncture presents special problems because of the small size of the veins and difficulty controlling the patient. Puncture of the external jugular vein in the neck region and the femoral vein in the inguinal area is the procedure of choice for obtaining blood. However, experienced doctor or specially trained health professionals should do this technique of blood collection.

Blood collection procedures, both capillary and venous, should be done aseptically and according to the standard procedure to prevent the patient from any risk of acquiring infection. All collected samples and materials used in the collection procedure should be treated as potentially infectious. Materials used in the collection and processing of the specimen should be disposed properly, if disposable, or treated with appropriate disinfectant before cleaned and reused. Labeling specimens at any stage, starting from collection is very mandatory.

2.9.3. Estimation of hemoglobin by the Acid Hematin Method of Sahli-Hellige

Principle: -

Hemoglobin in a sample of blood is converted to a brown colored acid hematin by treatment with 0.1 N HCl and after allowing the diluted sample to stand for 5 minute to ensure complete conversion to acid hematin it is diluted with distilled water or 0.1 N HCl until its color match as with the color of an artificial standard (tinted glass).

Depending on the type of hemoglobinometer, this gives the hemoglobin concentration either in g/dl or as a percentage of normal where 100% is equal to 14.6 g/dl. To convert the percentage to g/l, multiply by 1.46 or to g/dl by 0.146. Other standardized haemoglobin estimation methods could be used whenever available. Though, expensive the haemo-cue method is more reliable and dependable than the Sahli's method. As some other colorimetric methods it is not technically demanding, standardization is simple and operation with out direct electric supply option is offered.

Normal range of hemoglobin at different age groups

Hemoglobin in mg/dl	
Children at birth	13.6-19.6
Children at 1 year	11.3-13.0
Children, 10-12 years	11.5-14.8
Women	11.5-16.5
Men	13.0-18.0

Source: Harriet Lane handbook

2.9.4. PREPARATION, STAINING AND EXAMINATION OF PERIPHERAL BLOOD FILM

2.9.4.1 Preparation of Thin Blood Film

Examination of the blood film is an important part of the hematological evaluation and the validity or reliability of the information obtained from blood film evaluation, the differential leukocyte count in particular depends heavily on well-made and well-stained films. If not made from skin puncture, films should be prepared within 1 hour of blood collection into EDTA. Adequate mixing is necessary prior to film preparation if the blood has been standing for any appreciable period of time. A thin blood films can be prepared on glass slides or cover glasses. The latter has the single most important advantage of more even distribution of leucocytes. Preparation of blood films on glass slides has the following advantages:

- Slides are not easily broken
- Slides are easier to label
- When large numbers of films are to be dealt with, slides will be found much easier to handle.

Generally it is advisable to make a smear that covers about 2/3 or 3/4 the size of the slid. Cells should evenly spread in monolayer, especially at the examination area near the tail of the smear. Preferably blood slides should be labeled before they are made. The commonest practice is, once the smear is dry, it should be labeled appropriately with the name of the patient and date or a reference number on the head of the film using a lead pencil or graphite. If these are not available, labeling can be made by scratching the above information on dried smear with the edge of a slide. A paper label should be affixed to the slide after staining.

2.9.4.2 Staining of thin blood film with Romanowsky dyes

Modern Romanowsky stains in common use (e.g., Wright's, Leishman's) containing an acidic component (eosin B) and a basic component (methylene blue) are commonly used. Also panoptic stains like MayGrunwalds- Giemsa could be used to stain blood films for differential leukocyte count and red cell morphology study. Wright's or Leishman's methods are simpler to be practiced at peripheral laboratories. These stains could be purchased as a ready to use solution or as powder and prepared in the laboratory in a solution form. Their staining reactions are also similar.

Appearance of cells and cell components in Romanowsky-stained blood films

Films stained with Wright's stain are pinkish in color when viewed with the naked eye. Microscopically,

- . Red cells - pink with a central pale area
- . Nuclei of leukocytes - blue to purple
- . Cytoplasmic neutrophilic granules - tan
- . Eosinophilic granules - red orange each distinctly discernible
- . Basophilic granules - dark blue
- . Cytoplasm of monocytes - faint blue gray
- . Platelets - violet granules
- . Malaria parasites - sky blue cytoplasm and red purple chromatin

Note: Before staining patient blood films, it is always advisable to stain one or two well-prepared blood films according to the procedure by making use of filtered staining solutions to check for the quality of the stain using the above-mentioned characteristics. If deviation, necessary adjustments should be made and rechecked.

2.9.4.3 Examination of stained thin blood films

Examination of stained thin blood film helps for Morphologic classification of anemia and is considered to be the most appropriate and practical way for the correct appraisal of red cell morphology. If performed properly and related with the values of other hematological parameters, they provide clue as to the type of anemia at peripheral level.

1. Normocytic normochromic anemia

There is normal sized RBC with normal hemoglobinization. Mean cell volume (MCV), Mean cell hemoglobin (MCH) and Mean cell hemoglobin concentration (MCHC) are normal. This is caused by increased red cell loss, blood loss, blood loss anemia, and hemolytic anemia

2. Microcytic Hypochromic Anemia

These are small, incompletely hemoglobinized red cells. MCV, MCH and MCHC are decreased. It is caused by iron deficiency anemia, thalassemia and anemia of chronic diseases. Differentiation is possible by measuring biochemicals like serum iron, TIBC etc. see table

3. Macrocytic Normochromic Anemia

There are large red cells with MCV, MCH increased. It is caused by folic acid and/or vitamin B₁₂ deficiency.

2.9.5. The Differential Leukocyte Count

It is the enumeration of the relative proportions (percentages) of the various types of white cells as seen on stained films of peripheral blood. The count is usually performed by visual examination of blood films, which are prepared on slides by the wedge technique. For a reliable differential count the film must not be too thin and the tail of the film should be smooth. To achieve this, the film should be made using a smooth glass spreader. This should result in a film in which there is some overlap of the red cells diminishing to separation near the tail and in which the white cells on the body of the film are not too badly shrunken. If the film is too thin or if a rough-edged spreader is used, 50% of the white cells accumulate at the edges and in the tail and gross qualitative irregularity in distribution will be the rule. The polymorphonuclear leucocytes and monocytes predominate at the edges while much of smaller lymphocytes are found in the middle.

2.9.5.1 Methods of counting

Various systems of performing the differential count have been advocated. The problem is to overcome the differences in distribution of the various classes of white cells, which are probably always present to a small extent even in well-made films.

The lateral strip (“crenellation”) pattern of differential counting is the most routinely used pattern and in this method the field of view is moved from side to side across the width of the slide in the counting area just behind the feathered edge where the cells are separated from one another and are free from artifacts. Multiple manual registers or electronic counters are used for the count.

N.B. The following elements of the blood film must be observed while performing the differential count.

- Erythrocytes: size, shape, degree of hemoglobinization, presence of inclusion bodies
- The presence of atypical lymphocytes
- Haemoparasites: malaria, borrelia, babesia, microfilariae, trypanosoma, etc.

2.9.5.2 Reporting the differential leukocyte count

The differential leukocyte count could be expressed as the percentage of each type of cell or it could be related to the total leukocyte count and the results reported in absolute numbers.

2.9.5.3 Normal differential ranges:

	1-4 years	10 years	Adults
Neutrophils	36-48%	45-55%	55-65%
Eosinophils	2-5%	2-5%	2-4%
Basophils	0-1%	0-1%	0-1%
Lymphocytes	44-54%	38-45%	25-35%
Monocytes	3-6%	3-6%	3-6%

2.9.7.4 Interpretation: -

Observation of more than 5% hypersegmented neutrophils (neutrophils with 5 or more segments) is a good indicator of folate deficiency.

2.9.6. Measurement of Packed red-cell volume

The packed cell volume (PCV) is the proportion of whole blood occupied by the red cells expressed as liter per liter or in percentage. Determination of PCV by centrifugation is a reproducible procedure. The measurement assesses red-cell status in that the PCV depends essentially up on the number and volume of the red cells. It is the basis for the determination of the absolute values of red cell volume and hemoglobin content. The PCV became established as a reliable indication of anemia when the reliability of hemoglobinometry was questionable as that of the Sahli method.

Method

Well mixed oxygenated capillary or EDTA anticoagulated venous blood is drawn in to a standard capillary tube with or with out anticoagulant by capillary flow about 2/3 to ¾ its volume is carefully sealed in a fine flame or plugged with Plasticine or similar material.

The tube is centrifuged for 5 minutes in a purpose-designed centrifuge. The length of the red cell column is expressed as the ratio of the total column by making use of specially designed PCV -readers. Care must be taken not to include the leucocytes or platelets (the Buffy layer) when measuring the red cell column. Results are expressed as the ratio

of red cells to whole blood in liters or in percentage. By microchaematocrit it is only possible to measure results to two decimal places.

The major role of the primary health care laboratory professional in the diagnosis of micronutrient deficiency is to perform tests used in presumptive diagnosis. Additionally for specific diagnosis using biochemical tests involved in proper collection, preparation, storage and transportation of the appropriate samples to the central or specialized laboratories. The type of specimen, storage and transportation requirement may vary according to the test protocol used, hence following the instructions is mandatory. However, limited hematological investigations such as mentioned above could be performed to aid in the diagnosis of iron deficiency anemia.

2.10 Case management

Refer to the core module unit 2 sections 2.10.

2.11. Prevention and intervention

Refer to the core module unit 2 sections 2.11.

2.12. Learning activities (case study) continued

Refer to story of health professionals in the core module and discuss on the following questions in the class. The instructor can assist you.

- *How is blood specimen collected, stained and examined for blood morphology examination?*
- *What could be the etiology of micronutrient deficiencies?*
- *What laboratory investigations could be done at the health station or health center level?*
- *What should be reported in the laboratory request form in the determination of hematological tests for the assessment of iron and folate deficiency?*
- *What is the prime role of laboratory professionals at primary health care level in the diagnosis and management of micronutrient deficiencies?*

2.13 Roles and Task Analysis

Refer to the core module unit 4.

2.14 Glossary and abbreviations

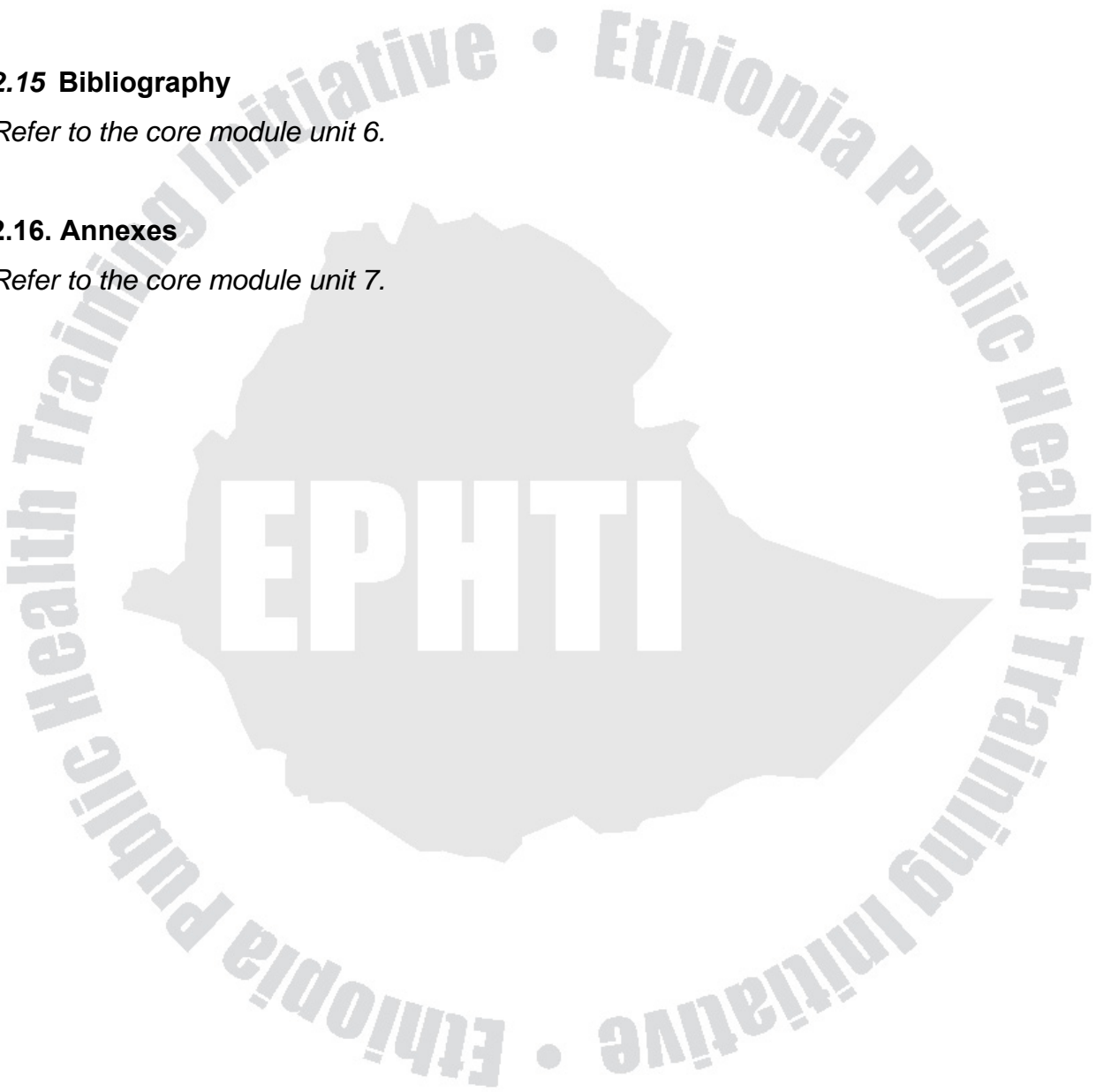
Refer to the core module unit 5.

2.15 Bibliography

Refer to the core module unit 6.

2.16. Annexes

Refer to the core module unit 7.



UNIT ONE

SATELLITE MODULE FOR SANITARIAN

Introduction

The role of the sanitarian in the prevention of micronutrient deficiencies is mostly in awareness creation, environmental sanitation improvement and behavioral changes in nutritional improvement and hygiene practices.

1.1 Purpose and use of the module

The main purpose of this module is to equip the sanitarians with adequate knowledge and skills for the prevention of micronutrient deficiencies together with other team members.

1.2 Directions for using the module

For a better understanding of this module, the sanitarian is advised to follow the following directions

- Do the pre test pertinent to your field in unit 2 of the core module (The sanitarian should also read the core module thoroughly at first and when referred in this module)
- The sanitarian could be successful in using this module if he works with other team members and intersectorally with other development workers (agriculture extension workers, development workers, home economists, etc)
- Evaluate your self by doing posttests and comparing your score with the pre tests.

UNIT TWO

SATELLITE MODULE

2.1 Pre test and posttest:

Please refer to the core module

2.2 significance and brief description of the problem:

Please refer to the core module

2.3 Learning objectives

At the end of reading this module the sanitarians will be able to:

- Describe the prevention methods of micro nutrient deficiencies
- Identify appropriate methods and the primary targets for nutrition and health education program in the prevention of micro nutrient deficiencies
- Describe why personal hygiene, environmental sanitation and nutrition education prevent those risk factors which are associated with micro nutrient deficiencies
- Describe the whole mechanism of different factors that are associated with the problem of micro nutrient deficiencies

2.4 Learning activities:

Read the case study in the core module

2.5 Definitions

Refer the core module

2.6 Epidemiology

Refer the core module

2.7 Etiology and pathogenesis

Please refer to the core module

2.8 Prevention and intervention

2.8.1 Prevention of iron deficiency anemia

There are important areas for the sanitarian to concentrate on in order to prevent iron deficiency anemia. These are:

1. *Dietary diversification*: Dietary diversification involves promotion of a diet with a wider variety of iron containing foods especially meat or fish. This intervention is often not possible among the poor populations of the developing world due to the

high cost of foods rich in iron (refer to case study 1). Dietary diversification can be addressed by:

- i. *Economic approach* (promotion of agriculture). This approach aims at improving the incomes of the target community as a solution to their nutritional problems.
 - ii. *Income generation scheme*: Income generation schemes enable the target community to buy food. It includes organizing the community and using their potentials in the running of the project. The target communities according to their needs or resources available could identify the project. The project may be weaving, bee keeping, pottery, etc.
2. *Fortification*: The fortification of staple foods such as wheat or other grains is likely to increase iron intake for those population that have access to them. However, infants and children who have a limited capacity to eat large quantities of fortified food are not likely to benefit significantly from this strategy. Targeted fortification as is practiced by the developed world is an excellent way to increase the intake of iron in children. Nevertheless, fortified commercially prepared infant foods are relatively expensive and may not be affordable for many families with children at highest risk of iron deficiency.
3. *Supplementation*: The final approach is through supplementation of individuals or communities at risk. For infants and children, this approach is the most likely to succeed. Supplementation may be the best way to reach infants and young children in families that can't afford expensive iron containing or fortified foods. Challenges from supplementation, however, includes compliance and adequate distribution of the supplement.
4. *Environmental sanitation*: Many studies have shown that iron deficiency anemia is associated with malaria and other parasitic infections. Therefore, to prevent these problems the following are major interventions that has to be conducted by the sanitarian together with other team members in the community.

- *Helminth control:* In communities where hookworm is endemic, anthelmintic medicines should be given to all anemic persons to eliminate the intestinal worms.
- *Malaria control:* Where *P. falciparum* malaria is endemic, detecting and treating malaria must be an essential part of controlling anemia. Malaria prevention with treated bed-nets can be highly effective. Environmental measures include eliminating standing pools of water, and mosquito breeding areas near dwellings, mosquito spraying, etc.

5. Reproductive health

Iron deficiency anemia can be controlled in women by preventing early pregnancies through family planning, reducing the total number of pregnancies, increasing the time between pregnancies, and increasing breast feeding. Managing complications, such as excessive bleeding during delivery and postpartum periods, protects iron status.

6. Health and hygiene education: one of the problems for the high prevalence of micronutrient deficiencies is lack of knowledge or information on simple preventive measures such as storage and cleanness of food and proper food preparation.

Hygiene or health education programs should, therefore, be planned to help community members understand the importance of hygiene practices in food preparation, in the prevention of parasitic infections. In general health promotion to be successful in hygiene or health education program we should focus on the following facts.

1. Health or hygiene education should be targeted.
2. Health or hygiene education should be simple (short, and to the point). Facts have to be given to the target group.
3. Health or hygiene education program should be convincing and (target group should be able to get the point and demonstrate it).
4. Health or hygiene education programs should be given at appropriate time, place and condition.

As preparation for health or hygiene educations a behavioral and environmental analysis should be done. Behavior is culture bound and hence each culture will have to be analyzed critically so that proper strategy could be formulated to change or modify

existing behavior. Each culture lives in a unique environment requiring evaluation to understand the interaction contributing to micronutrient deficiencies.

- Behavioral analysis. This means understanding what the current or existing behaviors of people in the communities are with regard to:
- The care or practices of food hygiene during preparation and storage
- Having latrine or latrine use
- Water hygiene
- Select target behavior

There are many ideal or feasible behaviors that health professionals want to see people practicing, but it may not be practical to achieve all. It is therefore, necessary to select target behaviors from among many ideals to act upon:

What target behavior do you want to change?

For example, in the case of iron deficiency anemia prevention, the ideal behaviors among many which the sanitarian may have to concentrate on the prevention of helmenthic infection.

Is there approximation that you want to build on?

Building on local knowledge and practices is much better and than to introduce behaviors or practices from others cultures. People wash hands with soap after eating not before eating.

- Other people wash hands before eating but not after latrine use, understanding culture may result in a positive behavior change in hand washing.
- Types of communication: in the arts of communication, messages are transmitted in different ways. Examples are
 - Interpersonal communication
 - Group communication
 - Mass communication

Channels of communication

Channels are tools and means by which a message is communicated to the target audience. The hygiene educator should prepare not only the message but also the channels so that messages will be effectively delivered and understood by the target audience. Channels are different for each method of communication. For example for mass communication, we may have to use radio, television, newspaper but for person to person we should use posters or flip charts.

2.8.2 Public health interventions to reduce IDD

Adequate iodine intake

Iodine is essential for the production of thyroxin-a hormone produced by the thyroid gland-and used for a number of vital body functions such as maintaining body temperature, brain function, growth, and reproduction. Deficiency of iodine during early fetal life can adversely affect fetal neurological development, causing impaired cognitive functions of varying degrees in children.

Causes of iodine deficiency disorders

IDD occurs where the soil is iodine deficient, resulting in low levels of iodine in locally grown foods and water supplies. Where iodine levels in the environment are adequate, foods can provide enough iodine, including vegetables, milk products, eggs, poultry, and meat. Adding iodine to salt is a simple, low-cost procedure that can replace the shortfall in iodine intake.

Who is at risk?

Populations living in areas with iodine deficient soils are particularly vulnerable to IDD and its effects. Goiter-the most easily seen form of IDD-is common in school-age children and women of reproductive age.

Infants who are not exclusively breastfed are at risk of IDD. Where goiter is endemic, lactating women are at high risk of iodine deficiency because the iodine is preferentially used for breast milk, and these women should receive iodine supplements if adequately iodized salt is not available.

What needs to be done?

The technology for adding potassium iodate to salt during processing and refinement is one of the lowest-cost health and nutrition interventions available.

In summary, an array of nutrition interventions is available to address nutrition problems in different settings. Based on experiences in the past two decades, the most cost-effective, widely applicable, and manageable nutrition interventions for primary health care services consist of promoting, protecting, and supporting-

- Exclusive breastfeeding for at least four, and if possible, for six months;
- Appropriate complementary feeding and continued breastfeeding to two years
- Adequate nutritional care of sick and malnourished children;
- Adequate vitamin A intake;
- Adequate iron intake;
- Adequate iodine intake

To assess the existence of micronutrient deficiency in a given community the sanitarian should assess the nutritional situation of the community using different indicators. Use the following table as a guideline in collecting data.

Examples of household survey questions for priority nutrition interventions (WHO, 1999).

Priority behavior	Indicator	Questions
Exclusive breast feeding	% of infants 0-6 months of age who are exclusively breastfed	What did the child eat yesterday? (Note if anything other than breast milk was given except vitamin drops.
Complementary feeding and continued breastfeeding to two years	% of infants 6-9 months of age given breast milk and semi-solid complementary foods. % of children 6-23 months who are actively encouraged to eat. % of infants 12-18 months of age given semi-solid or solid	What did the child eat yesterday? Was this food liquid, semi-solid, or solid? (Record the number of times the child was fed). What ingredients were in the child's food? (Use a checklist of locally available foods rich in vitamin A and C,

	<p>complementary foods at least 4 times/day, in addition to breast milk.</p> <p>% of children 20-23 months of age who are breast feeding</p>	<p>local sources of animal products, and energy-dense foods.)</p> <p>Did you actively encourage the child to eat yesterday? If yes, what did you do? (Correct answers: Give foods liked by the child, sat with the child, and others.)</p>
Care of sick children	<p>% of children 0-23 months of age who were sick in the past 2 weeks, and increased breast feeding.</p> <p>% of children 0-23 months of age, who were sick in the past 2 weeks, & didn't reduce feeding other foods.</p> <p>% of children 6-23 months of age sick in the past 2 weeks and were encouraged to eat.</p>	<p>Was the child ill in the past 2 weeks?</p> <p>If yes, did the child breastfeed more, less or the same?</p> <p>If yes, did the child eat more, less or the same amount of other foods?</p> <p>If yes, did you actively encourage the child to eat during or after the illness? (Correct answers: Gave special foods liked by the child, sat with the child, and others).</p>

Priority behavior	Indicator	Questions
Vitamin A	<p>Percentage of children 12-59 months who received a vitamin A capsule in the past six months.</p> <p>Percentage of mothers who received a postpartum dose of vitamin A</p>	<p>In the past six months, did the child (12-59 months of age) receive a vitamin A capsule?</p> <p>When the last child was born, did the mother take a vitamin A capsule?</p> <p>Note: Respondent should be able to identify iron/folic acid from a sample of various tablets. If yes, how many did you consume?</p>

Iodized salt	Percentage of households using iodized salt	<p>What salt did you use yesterday for preparing your meals? Check to see if the logo or brand name is known to have iodine in the salt.</p> <p>Test the sample of salt for the presence of iodine (using UNICEF salt testing kits).</p> <p>If possible, take urine samples to estimate urinary iodine levels.</p>
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2.8.3 What needs to be done to curb problem of vitamin A deficiency?

Possible intervention measures:

The root cause of vitamin A deficiency is the continued inadequate dietary intake of vitamin A-rich foods. The preferred solution is to add more vitamin A-rich foods to the diet. Important sources of vitamin A are: foods from animal sources, like liver and other organ meats, milk, poultry, and eggs; and plant sources, such as red palm oil, dark green leafy vegetables and orange or yellow fruits. Vitamin A from plant sources is widely available and generally inexpensive. However, these plants are often not fed to preschool aged children because of cultural influence on food intake.

2.8.4. Prevention of vitamin D deficiency

To eliminate or at least reduce micronutrient deficiency diseases, the following measures are suggested:

- *Dietary diversification:* Changes in agricultural policy programs to encourage crop varieties and associated dietary changes must be introduced in Ethiopia. Therefore, agricultural policies that favor small animal husbandry and poultry production and the growing of fruits and vegetables, processing techniques to preserve fruits and vegetables, the promotion of home and community gardens and increasing family incomes-all are actions that can help the intake of vitamin A. Encouraging more frequent intake of foods that are naturally rich in vitamin A using communication activities and counseling by health worker coupled with appropriate

public education can solve vitamin A deficiency problem that is common throughout the nation.

- *Fortification*: For people who can afford to pay adding vitamin A to foods that are commonly consumed by the high-risk groups.
- *Supplementation*: In vitamin A deficiency risk areas, giving age-appropriate doses of oral supplements of vitamin A to children and to women (within the first 6-8 weeks) after delivery is an option if available.
- *Preventing illnesses*: Preventing illness and treating them early also protects against reduced vitamin A stores and contributes to reducing VADD.
- *Nutrition Education on Harmful Traditional Practices*: In developed countries such as USA, fortified milk, which is now available in most cities, contains 400 IU of vitamin D per quart, is one of the most useful forms of mass medication. In the context of developed nations, it offers a simple practical and economic method of ensuring a regular intake of vitamin D. However, this approach may be of limited application for developing countries such as Ethiopia. In developing countries where there is a high proportion of sunny weather the occurrence of rickets in a significant proportion of children is largely attributed to social and cultural factors. Keeping children indoors because of the fear that they will catch cold, fear of evil eyes, and the tradition of wrapping children in swaddling clothes contribute to lack of adequate sunlight exposure. As a result the incidence of rickets is particularly high in slum children who live in crowded houses almost devoid of sunlight. Therefore, proper housing with good illumination, teaching parents the importance of exposure of infants to sufficient sunshine could considerably reduce the incidence of vitamin D deficiency (For details see the core module section 2.6.4)

UNIT ONE

SATELLITE MODULE FOR HEALTH EXTENSION WORKERS (HEW)

Introductions

1.1. Purpose & Use of the Module

Materialization of the Community based management of micronutrient deficiencies is made possible through training of HEW that are well equipped with the basic knowledge attitude and skill of diagnosing, treating, timely referring, preventing and controlling Micronutrient deficiency. Therefore, this satellite module will be utilized in the training of HEW to fulfill the aforementioned purposes. The satellite module can be used in the training or refreshment of HEWs by the health center team, NGOS and other like organizations.

1.2. Direction

- Administer the pretest before starting the actual training
- Read the core module thoroughly before using this satellite module for the training of PHWs/CHWS
- Read the stories in the core module to pose practical questions to the PHW/CHWS
- Use more participatory and simple methods of training for this group.
- Administer the post-test at the end of the training and compare their results by referring to the keys given in unit 7, section 7.5.

UNIT TWO

SATELLITE MODULE FOR PRIMARY HEALTH WORKERS (HEW)/COMMUNITY HEALTH WORKERS

(HEW)

2.1. Pre and posttest

See the pre and post test for primary health workers (HEW)/Community health workers (HEW) in the core module section 2.1.2.5

2.2. Significance and brief descriptions of the problem

The user of this module for training HEWs is highly advised to refer to the core module sections 2.2.



- **Learning Objectives**

- At the end of completing this module the HEWs will be able to:
 - Define and identify types of micronutrient deficiencies
 - Identify symptoms and signs of common micronutrient deficiencies
 - Demonstrate preparation of nutritious food that contain the essential micronutrients to the mothers and care givers
 - Refer children with micronutrient deficiencies to the to the appropriate health institution
 - Give health education on the preventive methods of micronutrient deficiencies and importance of child nutrition for proper growth and development
 - Advise mothers/care givers on the importance of exclusive feeding during the first 6 months and complementary feeding with breast milk there after
 - Educate mothers/care givers/or other members of the family about the importance of horticulture and backyard gardening, immunization, importance of continued feeding during diarrhea



2.4. Learning activities (case study)

Read the different stories in the core module for the class or make them read it thoroughly so that they will be able discuss the questions related to the story in unit 2, section 2.12

2.5. Definition

Micronutrient mal nutrition is the manifestation of deficient dietary intake of micronutrients that provide the body with the function of growth, development, immunity, fertility, and other essential bodily activities that are dependent on the supply of the particular nutrient.

2.6. Epidemiology

Micronutrient deficiency is called a hidden hunger because it is unnoticeable and has far-reaching consequences. Besides there are simple solutions to it. In Ethiopia, about 40% of all mothers and 50% of pregnant mothers are anemic. Vitamin A deficiency affects about 27% of the population. Total goiter rate is 22%. As the diet of over 85% of the society is based on cereal foods, there the deficiency of other micronutrients like zinc and iron.

2.7. Causes

Different factors contribute to the occurrence of micronutrient deficiencies. These include:

- Lack of knowledge about child feeding and child handling
- Infection with parasites like hookworm, schistosomiasis, trichuris, ascaris and malaria and other viral (like measles, HIV), bacterial (tuberculosis and others)
- Cultural malpractices (poor exposure to sun light, omission from family diet, sex and age biases in feeding)
- Poverty, human made and natural calamities,
- Social unrest (war)
- Poor food production
- Uncontrolled population growth
- poor marketing, storage and distribution systems.

Clinical features

Children with micronutrient deficiencies are shorter and lighter than their counterparts of the same age and sex. The specific nutrients will have the following signs and symptoms:-

IODINE DEFICIENCY

Fetus: Abortion, still birth, increased infant mortality, mental retardation (poor school performance)

Neonate: Neonatal goiter

Child and adolescent: Goiter, impaired mental function, retarded physical development (short stature)

Adult: Goiter with its complications

IRON DEFICIENCY

- Weakness
- Fatigue
- Pallor
- Shortness of breath on exertion
- A sense of being overly tired
- Pica (soil eating, clay eating and ice eating)
- Finger nails and toe nails –lusterless, thin, brittle, flattened and spoon-shaped (koilonychia)
- In severe cases heart failure
- Shortness of breath, tachycardia

VITAMIN A DEFICIENCY

- Night blindness

- Bitot's spots (white spots on the lateral lower side of the bulbar conjunctiva)
- Xerosis (dryness) of the eyes
- Corneal ulceration and corneal scar

VITAMIN D DEFICIENCY

In children: Rickets- Characterized by: delayed dentition, delayed closure of fontanelle, bowed legs, beads on the chest (rachitic rosary),

FOLIC ACID DEFICIENCY

- Anemia characterized by weakness, fatigue and pallor
- Neural tube defect during pregnancy

ZINC DEFICIENCY

- Loss of taste and smell acuity
- Poor physical growth in children
- Abnormalities of labor
- Postpartum hemorrhage
- Increased susceptibility to infection

For detail information refer to core module, unit 2, and section 2.8

2.9. Diagnosis

In diagnosing micronutrient deficiencies proper history and physical examination are essential. For some micronutrients like iron laboratory examination may help in the evaluation (hemoglobin, hematocrit)

History- the following information needs to be asked by the CHW/PHW in order to identify malnutrition in children and specific risk factors pertaining to the index child.

- Dietary history
- Weaning practices
- Food taboos
- History of diarrhea or other infection

- History of immunization
- Birth interval in the family
- Child care practices

Physical Examination

- Vital signs –Pulse rate, Respiratory rate, Weight and height
- Check for specific signs of micronutrient deficiency
- Check for the underlying causes of the anemia (infection, malabsorption, hemorrhage, etc.)

2.10. Case management

Upon regular **growth monitoring** care givers of those children with micronutrient deficiencies should be educated to improve their child feeding practices by preparing a balanced diet from locally available foodstuffs. Children who fail to improve in their nutritional status in the subsequent measurements (follow up) be referred to the next health institution for better management. For further details *refer to the core module unit 2, section 2.10*

2.11. Prevention & Intervention

Give nutrition education to mothers or caregivers on **essential Nutrition Actions (ENA)** that need to be promoted are the following:

- Exclusive breast-feeding up to 6 months of age
- Complementary feeding at the age of 6 months with continued breast feeding up to 2 years and beyond
- Continued feeding of the sick child(Importance of continued feeding during diarrheal attack or other illness)
- Maternal nutrition: Increased consumption of balanced diet during pregnancy and lactation by mothers
- Vitamin A supplementation for children 6-59 months and for lactating mothers within 8 weeks after delivery.

- Iron and folic acid supplementation to the mother during pregnancy and in the postnatal period
- Ensure the consumption of iodized salt by the family

Proper child feeding practices like:

- Optimal complementary feeding of children gradually and step by step with liquid through semi-solid diet to solid diet
- Avoidance of bottle feeding and use of cup and spoon instead
- Avoidance of unhygienic practices that contribute to the development of micronutrient deficiency (food and water hygiene, personal hygiene, environment hygiene & proper waste and excreta disposal)
- Report to next level health facility (health center team) in the face of unusually increased number of cases of micronutrient deficiency in your village (e.g. Iodine deficiency)
- Measure the weights and heights of under five children in your village regularly every month in the first 3 years and every 3 months afterwards (**Growth monitoring/ Promotion**) and refer those who have weight for height < 60% to the next health institution.

Nutritional status of children less than 2 years and mothers should be promoted at 6 **essential points of contact with the community** and the health care unit include:

- Antenatal care
- Delivery
- Postnatal care and Family planning
- Immunization
- Growth monitoring and well baby clinic
- Sick baby clinic

2.12 Learning activities (Case study) continued

Read story of health workers cases 1, 2 and 3 to the class (make them read) and discuss the following questions.

- 1) *What should parents of children in cases 1,2 AND 3 do to prevent the prevalence of malnutrition?*
- 2) *If parents of these children come to see you first what do you do to address their problem?*
- 3) *What other factors contribute to development of the development of cases 1,2 and 3?*
- 4) *What do you think are the preventive measures of these cases?*

UNIT4: Role and task analysis

See unit four of the core module for the expected role and tasks of PHW/CHW

UNIT5: Glossary and abbreviations

See unit five of the core module

UNIT6: Bibliography

See unit six of the core module

UNIT 7: Annexes

See unit seven of the core module

TAKE HOME MESSAGE FOR THE MOTHER/ CAREGIVER

INTRODUCTION

Appropriate feeding practices are important for the survival, growth, development, health and nutrition of infants and children everywhere. Every pregnant and lactating women needs adequate nourishment as means of attaining and maintaining health and recognizing that infant malnutrition is part of a wider problem .The health of infants and young children cannot be isolated from the health and nutrition of women. Therefore, Advising, and counseling women's are an important elements in the health care intervention. The following are important points with regard to micronutrient deficiency disorders.

HOME TAKE MESSAGE WITH REGARD TO PRACTICE TO IMPROVE INFANT NUTRITION DURING THE FIRST SIX MONTHS.

1. Initiate breastfeeding within one hour of birth.

Early initiation will be important for :

- Take advantage of the newborns intense suckling reflex and alert state.
- Stimulating breast milk production.
- Serving as the baby's first immunizations. The infant will immediately benefit from the antibodies present in the colostrums (The first milk)
- Minimizing maternal postpartum hemorrhage.
- Fostering mother-child bonding.

2. Establish good breast feeding skills (proper positioning, attachment, and effective feeding)

3. Breast-feed exclusively for the first six months.

- Breast milk should be the baby's first taste. There should be no prelacteal feeds such as water, other liquids, or ritual foods.
- Breast milk completely satisfies an infant's nutritional and fluids needs for the first six-months.
- Exclusively breastfed infants are at much lower risk of dying than the other children whom are on different feeding scheme.

- Exclusive breast-feeding contributes to a delay in the return of fertility.

4. Practice frequent, on demand breastfeeding including night feeds.

- Babies should be fed 8-12 times per 24 hours, every 2-3 hours or more frequently if needed in the early months.

TAKE HOME MESSAGE WITH REGARD TO APPROPRIATE COMPLEMENTARY FEEDING OF BREAST FED CHILDREN 6-24 MONTHS` OF AGE.

1. Introduce complementary foods beginning at six months of age.

2. Increases food quantity as the child ages-while maintaining frequent breast-feeding.

3. Increase feeding frequencies as the child ages, using a combination of meals and snacks.

- Feed 6-8 month old infants complementary foods 2-3 times per day.
- Feed 9-11 month old infants complementary foods 3-4 times per day.
- Feed 12-24 month old children complementary foods 4-5 times per day.

4. Gradually increases food consistency and variety as the child ages, adapting the diet to the infant's requirement and abilities.

- Feed mashed and semi-solid foods, softened with breast milk, if possible beginning at six months of age.
- Feed energy –dense combinations of soft food to 6-11 months olds.
- Introduce finger foods.
- Make the transition to the family diet at about 12 months of age.

5. Diversify the diet to improve quality and micronutrient intake.

- Feed vitamin A-rich fruits and vegetables daily.
- Feed meat or fish as often as possible if feasible and acceptable.
- Use fortified foods, such as iodized salt, Vitamin A-enriched foods.

6. Practice active feeding.

7. Practice frequent and active feeding during and after illness.

- During illness, increases fluid intake by more frequent breastfeeding, and patiently encourage children to eat favorite foods.

- After illness, breastfeed and give foods more often than usual, and encourage children to eat more food at each sitting.

8. Practice good hygiene and proper food handling

- Wash hands before and after preparation and eating.
- Serve foods immediately after preparation.
- Use clean utensil to prepare and serve food.
- Serve children using clean cups and bowls, and never use feeding bottles.

SUPPORTING ADVICE FOR CARE GIVERS.

- Make sure children's immunization schedules are complete by one year of age.
- Use ORT to rehydrate children during diarrhea.
- Seek appropriate health care for, fever, diarrhea, respiratory infections, malaria, hookworm, and other infections.
- Practice family planning that does not interfere with breast-feeding to space children.

TAKE HOME MESSAGE DURING PREGANACY

- Increases food intake to permit adequate weight gain to support fetal growth and future lactation.
- Take iron/folic acid daily.

DURING LACTATION

- Eat at least two additional meals (650 Kcal) per day
- Use iodized salt for the household food preparation
- Eat vitamin A rich foods (mango, papaya, green leafy vegetables, carrots and animal foods)

UNIT FOUR

TASK AND ROLE ANALYSIS

Table 4.1. Knowledge objective and essential tasks of the health center team (health officer, Public health nurse, Medical laboratory technician and sanitarians)

	Learning objective (expected outcome)	HO	PHN	EH	MLT	Activity
Knowledge	Define and describe types of micronutrient deficiency	Define and describe types of micronutrient deficiency	Define and describe types of micronutrient deficiency.	Define and describe types of micronutrient deficiency.	Define and describe types of micronutrient deficiency.	Define and describe types of micronutrient deficiencies.
	List causes and risk factor of Micronutrient deficiencies.	List causes and risk factor of Micronutrient deficiencies.	List causes and risk factor of Micronutrient deficiencies.	List causes and risk factor of Micronutrient deficiencies.	List causes and risk factor of Micronutrient deficiencies	List causes and risk factor of Micronutrient deficiencies

	Describe the Magnitude and contribution of micronutrient deficiencies to over all childhood and adult health problems locally and nationally	Describe the Magnitude and contribution of micronutrient deficiencies to over all childhood and adult health problems locally and nationally	Describe the Magnitude and contribution of micronutrient deficiencies to over all childhood and adult health problems locally and nationally	Describe the Magnitude and contribution of micronutrient deficiencies to over all childhood and adult health problems locally and nationally	Describe the Magnitude and contribution of micronutrient deficiencies to over all childhood and adult health problems locally and nationally	Describe the Magnitude and contribution of micronutrient deficiencies to over all childhood and adult health problems locally and nationally
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Table 4.2. Knowledge objective and essential tasks of the health center team (health officer, Public health nurse, Medical laboratory technician and sanitarians)

	Learning Objective (Expected Outcome)	HO	PHN	EH	MLT	Activities
Knowl edge	Describe the assessment Of micronutrient deficiency.	Describe the assessment Of micronutrient deficiency.	Describe the assessment Of micronutrient deficiency	Describe the assessment Of micronutrien t deficiency	Describe the assessment Of micronutrient deficiency	. Describe the assessment Of micronutrient deficiency
	Describe the principle and Treatment of micronutrient Deficiency.	Describe the principle and Treatment of micronutrient Deficiency.	. Describe the principle and Treatment of micronutrient Deficiency.	-----	----	. Describe the principle and Treatment of micronutrient Deficiency.
	Describe the pathogenesis Of micronutrient deficiency	Describe the pathogenesis Of micronutrient deficiency	---	---	---	Describe the pathogenesis Of micronutrient deficiency

	Elaborate methods of preparing dietary treatment for the case of micronutrients deficiency	Elaborate methods of preparing dietary treatment for the case of micronutrients deficiency	Elaborate methods of preparing dietary treatment for the case of micronutrients deficiency	-----	-----	Describe the different ingredients in the preparation of micronutrients dietary therapy
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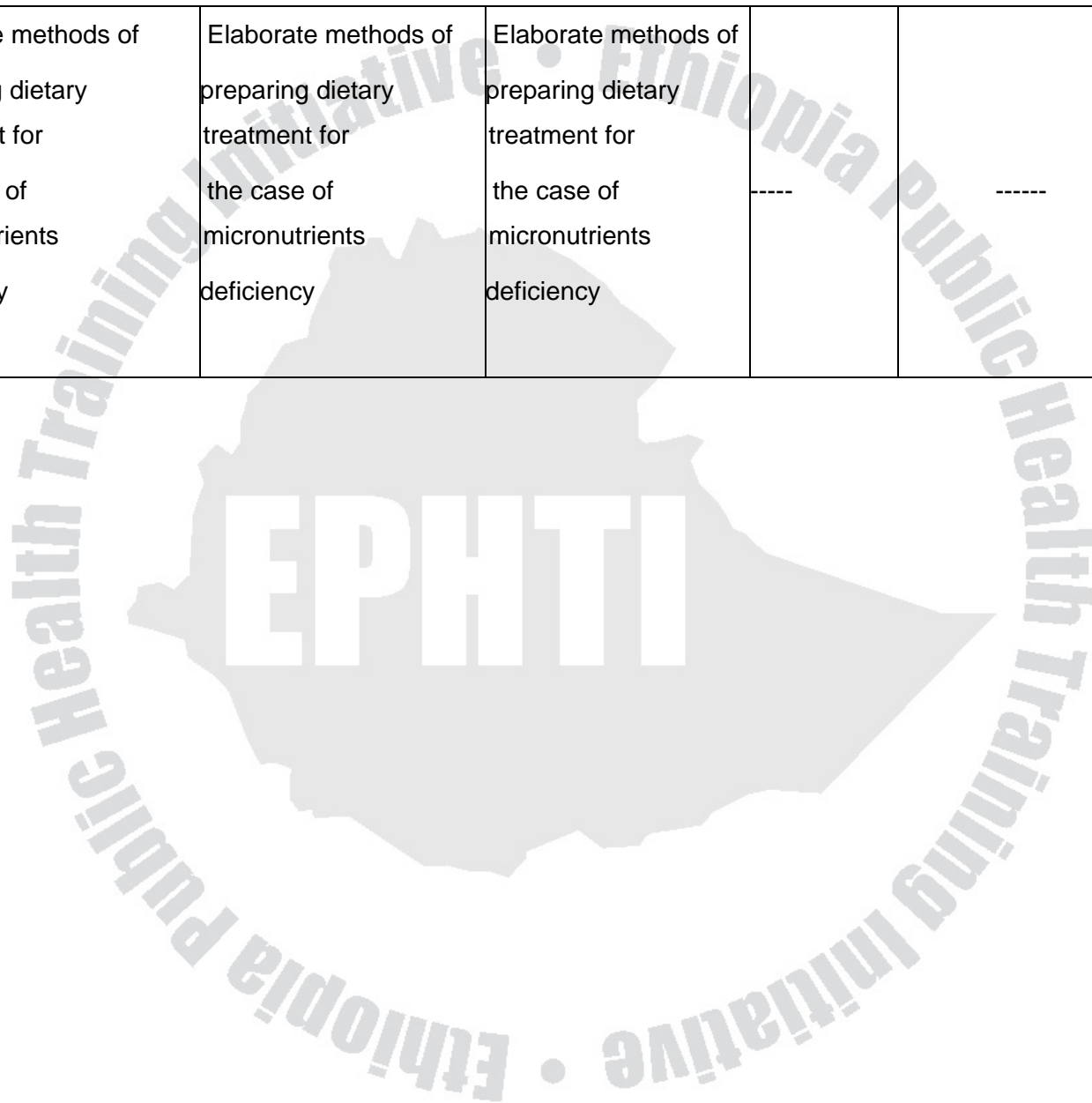


Table 4.3. Attitude objective and essential tasks of the health center team (health officer, Public health nurse, Medical laboratory technician and sanitarians)

	Learning Objective (Expected out come)	HO	PHN	EH	MLT	Activities
Attitude	Believe in the importance of weaning For children and promoting balanced diet for adults and practices in reducing morbidity due to micronutrients deficiency.	Instruct HEW (health extension workers)mothers and care gives in reducing morbidity to micronutrients deficiency	Instruct HEW (health extension workers)moth ers and care gives in reducing morbidity due to micronutrient s deficiency	Instruct HEW (health extension workers) mothers and care gives in reducing morbidity due to micronutrients deficiency	Instruct HEW (Health extension workers) mothers and care gives in reducing morbidity due to micronutrients deficiency	Advise HEW, mothers and care givers for the Utility of feeding micronutrient-containing diet in facilitating recovery from micronutrient deficiency state.

<p>Believe in promoting proper Feeding of infants and balanced diet for adults.</p> <p>Believe in utilization of health services</p> <p>Both by children and adults in order to reduce the burden of micronutrient deficiency.</p>	<p>Advocate continued Feeding of a child and balanced diet for adults.</p> <p>Advice mothers, care takers</p> <p>And CHW to promote the utilization of existing health services in order to minimize micronutrient deficiencies.</p>	<p>Advocate continued Feeding of a child and balanced diet for adults.</p> <p>Advice mothers, care takers</p> <p>And CHW to promote the utilization of existing health services in order to minimize micronutrient deficiencies</p>	<p>Advocate continued Feeding of a child and balanced diet for adults</p> <p>Advice mothers, care takers</p> <p>And CHW to promote the utilization of existing health services in order to minimize micronutrient deficiencies</p>	<p>Advocate continued Feeding of a child and balanced diet for adults</p> <p>Advice mothers, care takers</p> <p>And CHW to promote the utilization of existing health services in order to minimize micronutrient deficiencies</p>	<p>Advocate continued Feeding of a child and balanced diet for adults</p> <p>Advice mothers, care takers</p> <p>And CHW to promote the utilization of existing health services in order to minimize micronutrient deficiencies</p>	<p>-Educate mothers care give and (health extension workers, about the importance of balanced diet for children and adults to reduce micronutrient deficiencies.</p> <p>Teach about the importance of health services for children and adults to utilize the existing health services at the maximum possibility.</p>
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	<p>Up hold the idea that micronutrient deficiency is caused by deficiency of nutrients.</p>	<p>Educate mothers, care givers and CHW how to prevent Micronutrient deficiencies.</p>	<p>Educate mothers, care givers and CHW how to prevent Micronutrient deficiencies</p>	<p>Educate mothers, care givers and CHW how to prevent Micronutrient deficiencies</p>	<p>Educate mothers, care givers and CHW how to prevent Micronutrient deficiencies</p>	<p>Educate mothers, care givers and CHW how to prevent Micronutrient deficiencies</p>
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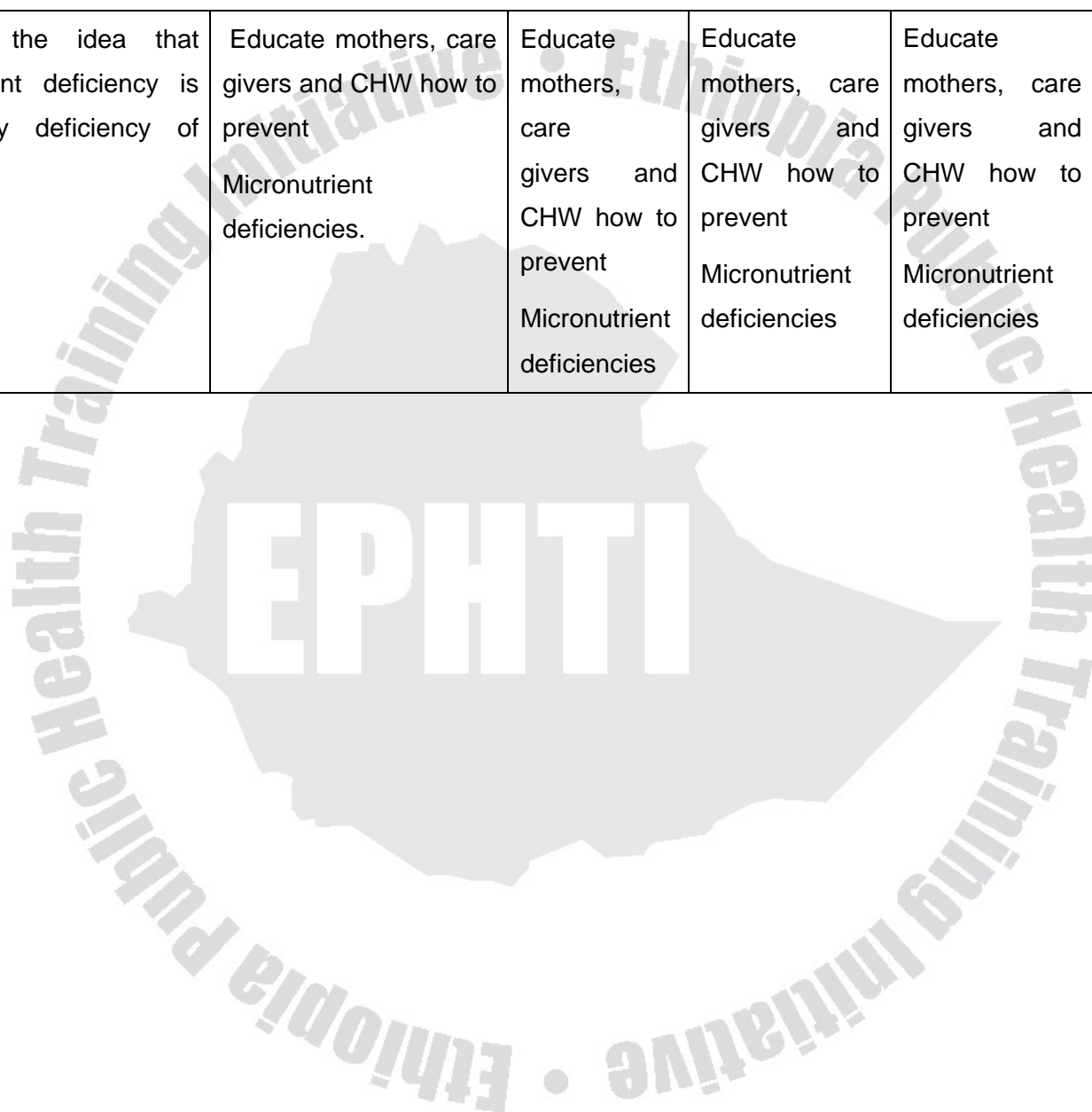


Table. 4.4. Practice objective and essential tasks of the health center team (health officer, Public health nurse, Medical laboratory technician and sanitarians)

	Learning Objective (Expected out come)	HO	PHN	EH	MLT	Activities
Practice	Demonstrate the process of assessing a child and adults with micronutrient Deficiency and identify its complications.	Take appropriate history and perform proper physical examination.	Assess vital signs and determine existence or note of micronutrient deficiencies and associated infections.	-----	-----	<ul style="list-style-type: none"> -Ask relevant symptoms - Look, at relevant signs and decide the degree of micronutrients deficiency - Determine if lab Investigation is needed.

	<p>Demonstrate how to do laboratory tests</p> <p>On micronutrient deficiencies.</p>	<p>Carry out laboratory investigation</p> <p>On micronutrient deficiencies</p>	<p>-----</p> <p>Demonstrate the preparation of dietary formula for the treatment of micronutrient deficiencies to mothers and care givers.</p>	<p>-----</p> <p>Demonstrate the importance of clean water and utensils in the preparation of food in feeding with rich micronutrients</p>	<p>Carry out laboratory investigation pertaining to micronutrient deficiency.</p>	<p>- Make a laboratory investigation on micronutrient deficiencies</p> <p>Show materials and ingredients to be used in the preparation and utilization of feeding formula in the treatment of micronutrient deficiency.</p>
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Learning Objective (Expected out come)	HO	PHN	EH	MLT	Activities
Identify a case of micronutrients deficiency and demonstrate appropriate management.	Demonstrate the management principle, identify the complication and manage accordingly	Demonstrate appropriate feeding and drug administration and also	-----	-----	Identify the case and its complication Mange the case by selecting appropriate treatment plan Refer PRN
Demonstrate propere communication to the mother or care givers for health education pertinent to Micronutrient deficiency.	Display Effective communication skills with mothers care givers and HEW in treatment prevention and control of micronutrient deficiency.	Display effective communication skills with mothers care givers and (health extension workers) on treatment prevention and management of micronutrient deficiency.	Display effective communication skills with mothers, care givers and (health extension workers)s on prevention and control micronutrient deficiency.	-----	Identity practical ways of educating mothers care givers or HEW on treatment prevention and control micronutrient deficiency.

Table 4.5. Knowledge objective and essential tasks of health extension workers and car givers

	Learning Objective (Expected out come)	Community Health Workers	Care Giver Workers	Activity
Knowledge	Describe the principle and treatment and methods of prevention on the deficiency of micronutrient deficiency.	- Describe how to prepare dietary feeding formula and its administration in treatment of micronutrient deficiency.	- Describe how to prepare dietary feeding formula and its administration in treatment of micronutrient deficiency	- Explain methods of preparation of feeding formula in the treatment of micronutrient to the care workers (HEW) - Explain what type of food to give and how much to give in the treatment of case micronutrient deficiency.
	List the major information, methods & targets for health education on micronutrient deficiency.	Describe methods of giving health education on micronutrient deficiency for The mothers care takers and community health workers.	- Explain major points the care giver/ mother need to tell to the family members regarding treatment and prevention of Micronutrient deficiency.	- List main methods used to communicate information on micronutrient deficiency for the different targets (HEW) - Enumerate main points that the care giver needs to instruct the family and the parent/care givers

	<p>List causes and risk factors for pro Micronutrient deficiency.</p>	<p>List the different causes of micronutrient deficiency and their association with risk factors.</p>	<p>- Explain the cause of micronutrient deficiency in general and what risk behaviors are associated to it.</p>	<p>- Explain the relationship between the risk factors and development of micronutrient deficiency (HEW) - Describe that micronutrient deficiency is caused by improper feeding, infection, diarrhea etc.</p>
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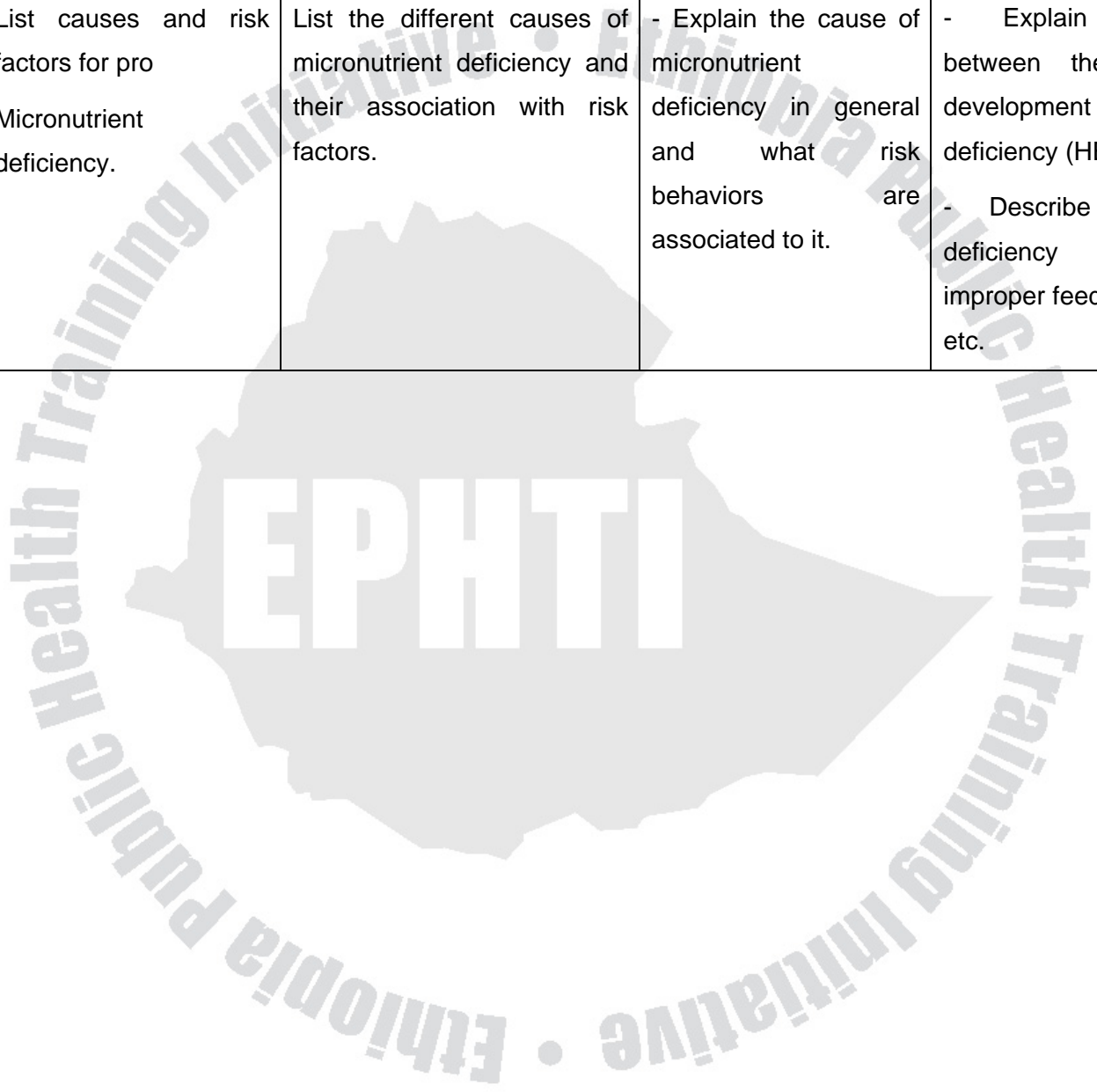


Table 4.6. Attitude objectives and essential tasks of health extension workers and care givers

	Learning Objective (Expected out come)	CHW	Care giver	Activity
Attitude	Promote utilization of health service facilities for the treatment of Micronutrient deficiency.	Advise care givers to bring a child with Micronutrient deficiency the health service units to consult health worker	Advise friends and families to visit health worker the health service units in case of Micronutrient deficiency.	<ul style="list-style-type: none"> • Educate care givers the importance of taking children with micronutrient deficiency to health d service institution • Encourage visits health service unit the case of Micronutrient deficiency.
	Advocate the importance of exclusive breast feeding in the first 4-6 months and continued feeding then after in reducing mortality and morbidity due to micronutrient deficiency.	Instruct mothers or care givers the importance of breast feeding in reducing morbidity and mortality from micronutrient deficiency..	Advise family friends and neighbors to continue breast feeding in a child with micronutrient deficiency.	<ul style="list-style-type: none"> • Advocate / Promote breast feeding practices in prevention of micronutrient deficiency (HEW) • Encourage breast feeding practices of , family, in the prevention micronutrient deficiency.

	Promote continued feeding of children with micronutrient deficiency.	Advocate and encourage proper feeding of children with micronutrient deficiency by mothers or caregivers.	Feed the child with micronutrient deficiency properly and encourage friends or peers to do so.	Emphasize on importance of feeding of a child with micronutrient deficiency (HEW) Feed the child with micronutrient deficiency and advise Friends or relatives to do so.
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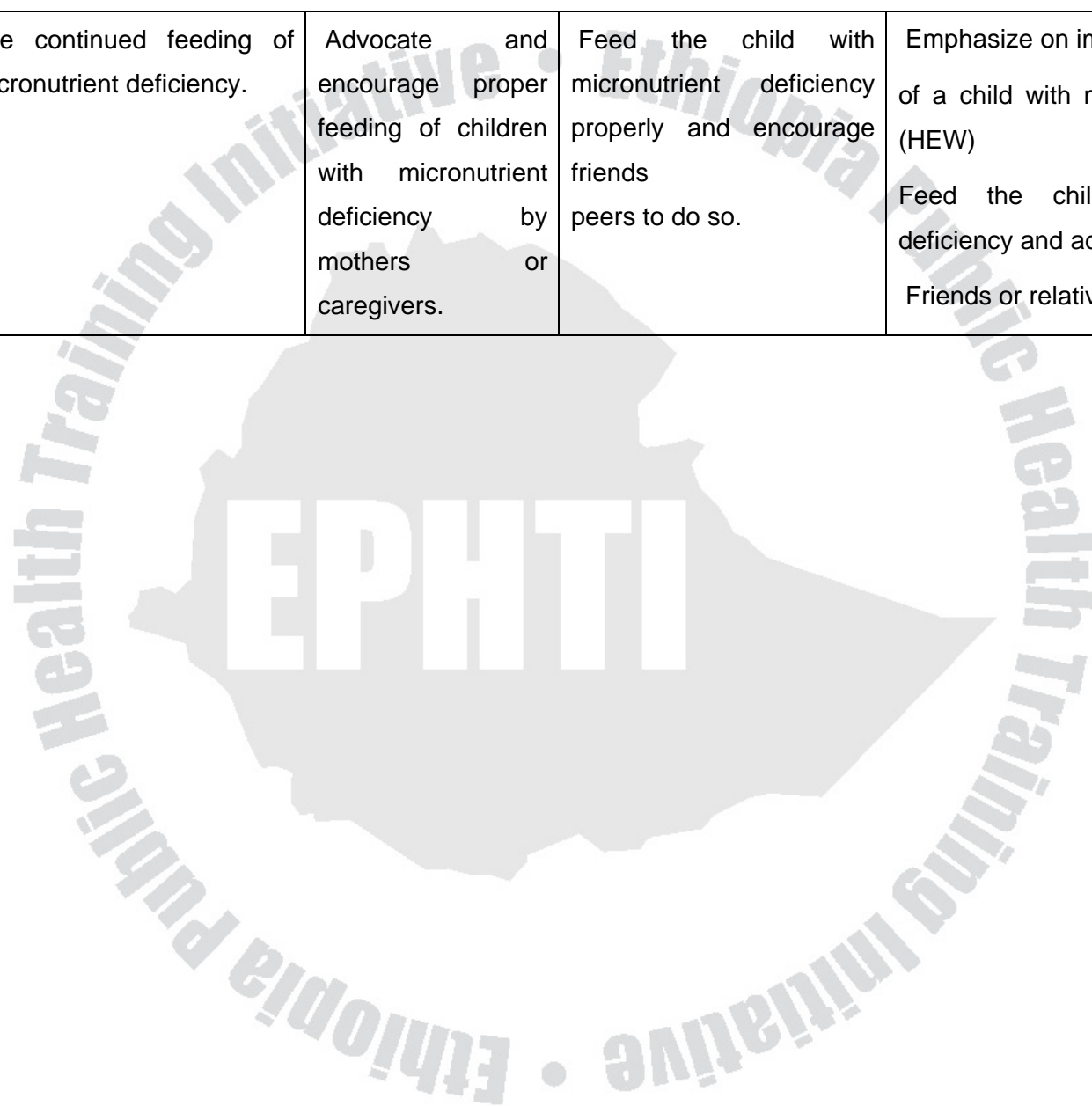


Table 4.7. Practice objective and essential tasks of health extension workers and car givers.

	Learning Objective (Expected outcome)	HEW	Care giver	Activities
Practice	Demonstrate preparation of feeding formula for the treatment of micronutrient deficiency and its proper use.	Demonstrate preparation of feeding formulas their administration to the case of Micronutrient deficiency.	Demonstrate properly how and what to prepare and administer to a child with micronutrient deficiency.	Show materials and ingredients to be used in the preparation of feeding formulas.
	Identify a case of micronutrient deficiency and demonstrate its appropriate management	Identify complications of Micronutrient deficiency and its degrees and advise the caregiver to feed the patient Properly.	Identify signs of symptoms of Micronutrient deficiency and its complications and decide whether there is a need for admission or referral	Identify signs and symptoms of Micronutrient deficiency and administer proper feeding Practices (see the core module).
	Demonstrate proper communication to mothers or care givers pertaining to micronutrient deficiency.	Display Effective communication skill with mothers or care givers on treatment and prevention of Micronutrient deficiency.	-----	Identify ways of educating Mothers/ care gives about micronutrient deficiency.

UNIT FIVE

Glossary & Abbreviations

□ **Anthropometric assessment:** - Measurement of different body dimensions and proportions at different nutritional states and interpretation of the result by comparing to the standard to determine whether a person is malnourished or well nourished.

□ **Antioxidant:** - Micronutrients like vitamins A, C, E, & minerals, selenium which detoxify (scavenge) free radical species formed in the body and protect body cells from oxidative damage.

□ **Catch up growth:** - Rapid increase in weight and height of children after a period of nutritional deprivation in response to corrective dietary intervention.

Communication: the means of sending or receiving information, such as interpersonal communication, group discussion and mass communication.

Folate: a vitamin of the B complex found especially in leafy green vegetables, liver, and kidney.

Fortification: Addition of a nutrient in to a food that does not naturally contain it to increase the nutritive value of (food) by adding vitamins.

Hygiene: conditions or practices conducive to maintaining health and preventing disease, especially cleanliness.

Latrine: a toilet, especially a communal one used by individuals or communities.

Malnourishment: suffering from malnutrition, which may be under nutrition or over nutrition.

Supplementation: Periodic administration of a nutrient in the form of tablets, capsules or injections to an individual or a group of people to prevent the occurrence of deficiencies of the nutrient.

□ **Day Care Nutrition Rehabilitation Centers (DCNRC):** Feeding and nutrition demonstration centers attached to health units where mothers/care givers bring their

malnourished children and get them fed and see how to prepare balanced diet from locally available foodstuffs.

- **Dehydration:** - Excessive loss of fluid and electrolyte from the body that impairs cellular function if not corrected timely.
- **Emotional deprivation:** - State of mood change in a child that occurs following neglect of child (poor care given to the child by the mother or care giver).
- **Exclusive breast-feeding:** - Breast-feeding of infants with no additional (supplementary) food or fluid administration.
- **Recovery Syndrome:** - Fluid over load, congestive heart failure and death due administration of high protein and high caloric to a malnourished child during the acute (stabilization) phase of the management of protein energy malnutrition.
- **Residential Nutrition Rehabilitation Centers (RNRCS):** - These are usually convalescent centers for children treated initially in hospitals where mothers may accompany their children. Nutrition education and demonstrations of food preparation and child feeding will be done to prevent the recurrence of the situation in the family.
- **Sensory stimulation:** - Stimulation of malnourished children using different toys, stories etc... in order to reverse the mood changes that followed the state of malnutrition in order to revive their appetite and facilitate the process of cure.
- **Starvation therapy:** - A harmful traditional practice in which mothers/ care givers deprive their child with diarrhea of food & fluid intake due to the wrong belief that giving food and fluid may increase the volume & attack of diarrhea.
- **Stunting:** - A state of chronic malnutrition characterized by normal weight for height (>80%) & low height for age (<80%) according to Waterlow's classification
- **Wasting:** - Is a state of acute malnutrition characterized normal height for age (>80%) & low (< 80%) weight for height according to water low classification.
- **Water low classification:** - Classification of malnourished children that uses two indices: weight for height and height for age for detection of acute and chronic states of malnutrition in the community

- **Weaning:** - Administration of food (solid or liquid including formula or cows milk) in addition to breast milk or without breast milk.



UNIT SIX

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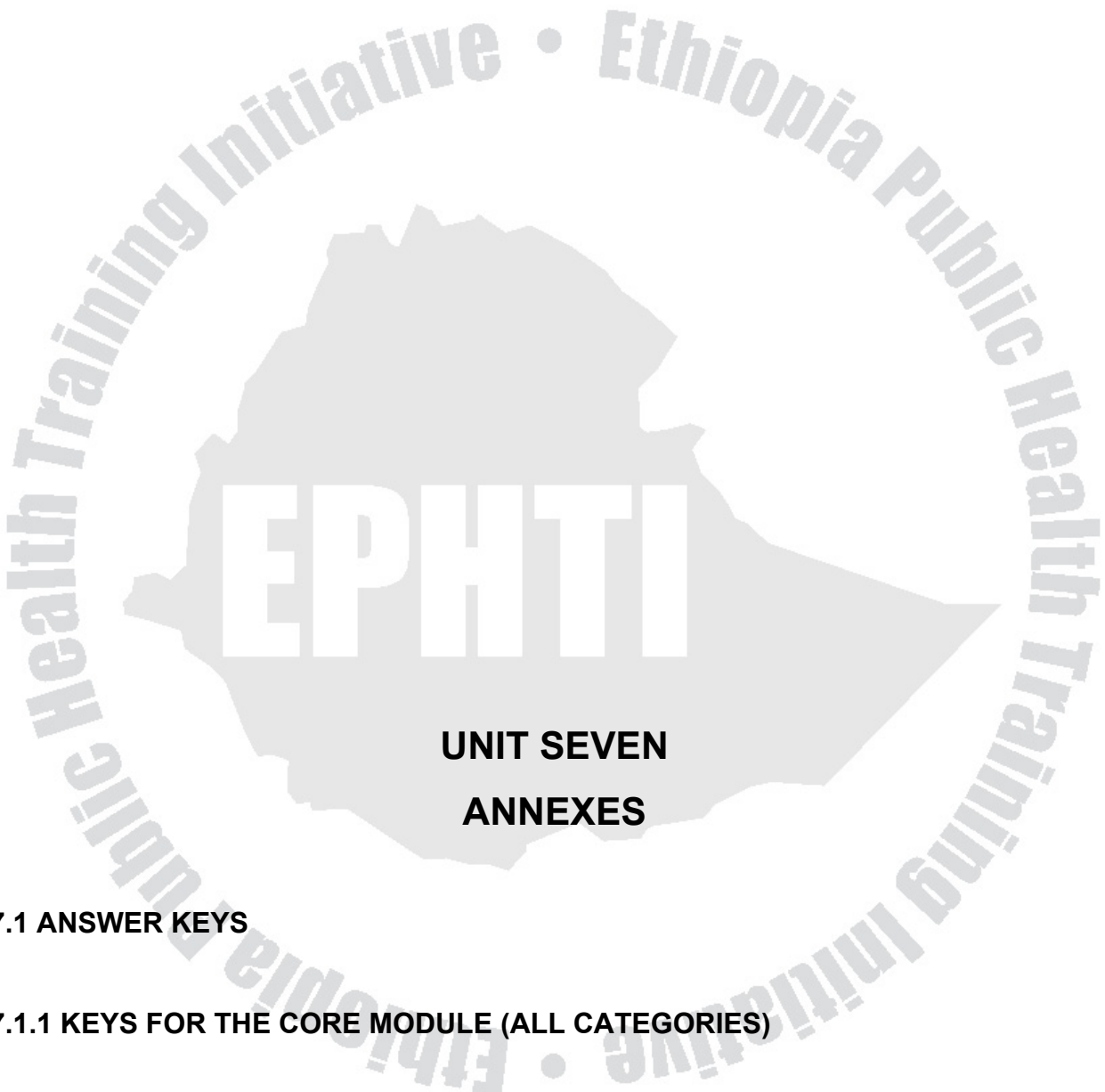
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**UNIT SEVEN
ANNEXES**

7.1 ANSWER KEYS

7.1.1 KEYS FOR THE CORE MODULE (ALL CATEGORIES)

Q.No.1. **C**

Q.No.2. **E**

Q.No.3. **E**

Q.No.4.**A Marasmus**

a. Kwashiorkor

- b. Marasmic –kwashiorkor**
- c. Underweight**
- d. Stunting and wasting**

Q.No.5. **D**

Q.No.6. **Kwashiorkor**

- B. Pitting edema**
- C. Gray and easily pluckable hair**
- D. Miserable and apathetic**
- E. Loss of muscle & preservation of subcutaneous fat**

Marasmus

- A. Loss of both subcutaneous fat and muscle (skin and bone appearance)**
- B. Irritability and moodiness**
- C. Wizen monkey faces (old man appearance)**
- D. Absence of edema**

Q.No.7.

- a. Anthropometric assessment**
- b. Biochemical or laboratory, assessment**
- c. Epidemiological (dietary assessment)**

Q.No.8.

- d. Acute stabilization phase**
- e. Rehabilitation phase**

Q.No.9. **Because it causes fluid overload and death from heart failure (a condition called recovery syndrome)**

Q.No.10. **D**

Q.No.11. **D**

Q.No.12. **D**

- Q.No.13. **E**
Q.No.14. **A**
Q.No.15. **D**
Q.No.16. **D**
Q.No.17. **D**
Q.No.18. **D**
Q.No.19. **D**
Q.No.20. **C**
Q.No.21. **B**
Q.No.22. **D**
Q.No.23. **D**
Q.No.24. **D**
Q.No.25. **E**

7.1.2.KEYS FOR SATELLITE MODULES (SPECIFIC PROFESSIONAL CATEGORIES)

7.1.2.1. HEALTH OFFICERS

- Q.No. 1. **E**
Q.No. 2. **D**
Q.No. 3. **E**
Q.No. 4. **A. Goiter with its complicatios**
B. Mental retardation and poor academic performance
C. Poor physical work out put
D. Poor Physical growth
Q.No. 5. **D**
Q.No. 6. **E**
Q.No. 7. **D**

- Q.No. 8 E
Q.No. 9. D
Q.No. 10. D
Q.No. 11. E
Q.No. 12. E
Q.No. 13. D
Q.No. 14. E
Q.No. 15. E
Q.No. 16. B
Q.No. 17. E
Q.No. 18. E
Q.No. 19. E
Q.No. 20. B
Q.No. 21. E
Q.No. 22. E
Q.No. 23. A
Q.No. 24. A
Q.No. 25. E
Q.No. 26. E
Q.No. 27. E
Q.No. 28. E

7.1.2.2. PUBLIC HEALTH NURSE

Key for Public Health Nurse

1.
 - Antenatal care
 - Delivery
 - Post-natal care/FP
 - Immunizations
 - Well baby clinic
 - Sick baby clinic

2. D.

3.

- Food diversification
- Food fortification
- Vit A supplementation

4. A

5. D.

6. C.

7. D.

8. 150 microgram per person

9. D.

10. Beef, cheeks, fish, Lamb, liver, and pork.

11.

- Prolonged breast feeding with out complementary feeding.
- Heammorhage.
- Infections
- Low consumption (Dietary)
- Repeated pregnancy.

13. "Dry Eye" in Greek.

- Function as anti oxidant
- Maintain normal taste and smell
- Promotes normal growth and development
- Aids wound healing
- Promotes normal fetal growth
- Helps synthesize DNA and RNA.
- Promotes cell division cell repair cell growth
- Maintain normal level vit A in blood.

- Zinc is part of the molecule structure for 80 or more enzymes. This particular enzymes work with red blood cells to make carbon dioxide from tissue and lungs.

7.1.2.3. MEDICAL LABORATORY TECHNOLOGY

Q.No. 1. **E**

Q.No. 2. **D**

Q.No. 3. **D**

Q.No. 4. **C**

Q.No. 5. **A**

Q.No. 6. **A**

7.1.2.4. SANITARIANS

Q.No. 1. **D**

Q.No. 2. **D**

Q.No. 3. **C**

Q.No. 4. **B**

7.1.2.4. PRIMARY HEALTH WORKER (PHW)/COMMUNITY HEALTH WORKER (CHW)

Q.No.1. **C**

Q.No.2. **A, B, C, D**

Q.No.3. **A, B, C, D, E**

Q.No.4. **E**

Q.No.5. Education of parents of children on:-

- A. Proper child feeding practices like exclusive breast feeding for the first 4-6 months, gradual weaning, using cup and spoon than bottle, continue feeding during diarrhea,

- B. Personal, environmental and food hygiene
- C. Importance of taking their children to the health institutions for Growth monitoring
- D. Importance of getting their children immunized
- E. Stimulation and proper treatment of children

7.2. Recommended Dietary Allowance (RDA) For selected micronutrients:

Estimate of adequate daily intake by the Food and Nutrition Board of the National Research Council, 1989 by age group.

FOLIC ACID

Age RDA

0-6 months 25mcg

6-12 months 35mcg

1-3 years 50mcg

4-6 years 75mcg

7-10 years 100mcg

Males

11-14 years 150mcg

15+ years 200mcg

Females

11-14 years 150mcg

15+ years 180mcg

Pregnant 400mcg

Lactating 1st 6 mos 280mcg

2nd 6 mos 260mcg

VITAMIN A

Age Retinol Equivalents International Units

0-6 months 375RE 2,100IU

6-12 months 375RE 2,100IU

1-3 years 400RE 2,000IU

4-6 years 500RE 2,500IU

7-10 years 700RE 3,300IU

MALES

11+ years 1,000RE 5,000IU

FEMALES

11+ years 800RE 4,000IU

Pregnant 800RE 4,000IU

Lactating 1st 6 mos 500RE +2,500IU

2nd 6 mos 500RE +2,500IU

VITAMIN D

Age RDA

0-6 months 7.5mcg

6-12 months 10mcg

1-10 years 10mcg

MALES

11-18 years 10mcg

19-24 years 10mcg

25+ years 5mcg

FEMALES

11-18 years 10mcg

19-24 years 10mcg

25+ years 5mcg

Pregnant 10mcg

Lactating 10mcg

IODINE

Age	RDA
0-6 months	40mcg
6-12 months	50mcg
1-3 years	70mcg
4-6 years	90mcg
7-10 years	120mcg
11+ years	150mcg
Pregnant	375mcg
Lactating	200mcg

IRON

Age	RDA
0-6 months	5mg
6-12 months	10mg
1-3 years	10mg
4-6 years	10mg
7-10 years	10mg

MALES

11-18 years	12mg
19+ years	10mg

FEMALES

11-50 years	15mg
51+ years	10mg
Pregnant	30mg
Lactating	15mg

Zinc

Age:	RDA:
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0-6 months	5mg
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6-12 months	5mg
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1-10 years	10mg
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Males:

11+ years	15mg
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Females:

11+ years	12mg
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