MODULE

Iron Deficiency Anemia

For the Ethiopian Health Center Team

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UNIT ONE

INTRODUCTION

1.1. Purposes and Use of the Module

This module is intended to serve as a general learning material about anemia (with particular emphasis on iron deficiency) by the health centre team; Health Officers, Public Health Nurses, Environmental Health Technicians (Sanitarians), and Medical Laboratory Technicians. The basic and general concepts about the disease and its causation, epidemiology, clinical picture, prevention and control strategies are discussed in simple and quite understandable way. It can also be used by other categories of health professionals. It should be noted, however, that it is not a substitute for standard textbooks. This module can also be used as a reference material for professionals working in health centers. It may be used as a learning material in trainings, workshops, and seminars for members of the health centre team and community health workers and as source of information for care givers and patients.

1.2. Directions for Using the Module

Before starting to read this module, please follow the directions given below:

- Go through all the contents of the core module by starting with the pre-test.
- Use a separate sheet of paper to write your answers and label it “Pre-test answers”. The pre-test has two portions: Part I and Part II.

Part I: Contains common questions to be answered by all categories of the health centre team.

Part II: The questions are prepared for the specific categories: Health Officer (HO), Public Health Nurse (PHN), Environmental Health Technician (EHT) and Medical Laboratory Technician (MLT). Select and do the questions of the portion indicating your professional category.

When you are sure that you are through with the core module proceed to read the satellite module corresponding to your profession or interest.

- Go through the task analysis for the health centre team members and compare it with that of your own.

Note : You may refer to the list of abbreviations and glossary at the end of the module for terms that are not clear.

UNIT TWO

CORE MODULE

2.1. Pre-test

Write the answers of the following questions on a separate sheet.

2.1.1. Part I (Pre-test for all categories of the Health Center Team)

Write "**True" or "False"** for questions 1 - 6.

1. Anemia is a more significant problem of developed countries than developing countries.
2. Conjunctiva, nail beds, tongue and palm are common sites for detection of anemia by physical examination.
3. The most important choice of therapy for nutritional anemia is iron therapy.
4. Early detection and treatment of the underlying causes of anemia is one of prevention and control measures.
5. Preventing the underlying causes cannot guarantee the prevention of nutritional anemia.
6. Vitamin B_{12}, Pyridoxine and Copper deficiency states have equal public health importance as iron deficiency anemia.

Give short answers for questions 7 - 12.

7. Define anemia.
8. What is the commonest cause of nutritional anemia?
9. List at least four symptoms/complaints made by anemic patients.
10. List at least three common signs observed on anemic patients.
11. What are the methods or steps used to detect anemia?
12. One of the control methods relevant to anemia is the assessment and appropriate management of risk groups. List at least 3 of these risk groups.

Write the correct letter of your choice for questions 13 - 26.

13. Which one of the following justifies why anemia is considered as public health problem in Ethiopia?
    A. It is highly prevalent in developing countries including Ethiopia.
    B. It has a negative impact on work performance.
    C. It results in poor growth and development in children and bad obstetric outcomes in women.
    D. All of the above.
14. Which of the following is a high risk group for anemia?
    A. Women above 50 years old.
    B. Adolescent men.
    C. Pregnant women.
    D. A and C
15. Which of the following is **true** about prevalence of iron deficiency anemia?
    A. It is higher in developing than developed countries.
    B. It affects more than 700 million people worldwide.
    C. It is higher in developed than developing countries.
    D. A and B
16. Which of the following is a cause of iron deficiency anemia?
    A. Hook worm infestation.
    B. Low dietary iron
    C. Blood loss due to trauma
    D. All of the above
17. Iron deficiency anemia is most commonly associated with:
    A. Vitamin B_{12} deficiency.
    B. Folate deficiency.
    C. Pyridoxine deficiency.
    D. Copper deficiency.

18. Decreased red blood cell production is mainly caused by:
    A. Lack of nutrients.
    B. Sickle cell disease.
    C. Gastrointestinal cancer.
    D. Parasitic infestation.

19. Identify the **wrong** statement among the following:
    A. Anemia results in decreased oxygen concentration of tissues.
    B. Menstruation and hemorrhage do not lead to iron deficiency anemia.
    C. Deficient iron content of food may result in iron deficiency anemia.
    D. Blood loss is the commonest cause of anemia.

20. Which one of the following is **not** true about anemia?
    A. It is reduction of red blood cell volume.
    B. It is the decrease in hemoglobin concentration.
    C. The level of hemoglobin or hematocrit to diagnose anemia is the same for different population groups.
    D. None of the above.

21. One of the following techniques is not used for diagnosis of anemia but can help in by physical examination. Diagnosing the underlying cause of anemia:
    A. Physical examination.
    B. Detailed history taking.
    C. Blood test for hemoglobin or hematocrit.
    D. Blood film for hemoparasite.

22. In diagnosing the cause of anemia, laboratory examination includes all of the following except:
    A. Stool examination.
    B. Urine examination.
    C. Blood film.
    D. None of the above.

23. The level of hemoglobin indicating anemia in pregnant women is:
    A. < 11 g/100 ml.
    B. < 14 g/100 ml.
    C. < 16 g/100 ml.
    D. None of the above.
24. It is possible to raise the hemoglobin level of an anemic patient by:
    A. Blood transfusion.
    B. Provision of foods like meat, liver and leafy vegetables.
    C. Administration of folic acid and iron.
    D. All of the above.
25. Identify the **wrong** statement about the measures taken for the prevention of anemia.
    A. Early detection and treatment of causes.
    B. Blood transfusion.
    C. Health education.
    D. Prevention of parasitic infestation.
26. Identify the **incorrect** statement about prevention of the underlying causes of anemia.
    A. Prevention of parasitic infestation.
    B. Prevention of chemical poisoning.
    C. Safety measures for the prevention of trauma causing blood loss.
    D. None of the above.

2.1.2. Part II (Questions specific to a category of the Health Center Team)

A. For Health Officers

Write "**True" or "False**" for questions 1 - 3.

1. Poor compliance is the major cause of failure of treatment response in patients with iron deficiency anemia.
2. Ascorbic Acid decreases the absorption of iron from the gastro intestinal tract.
3. The iron content of breast milk is sufficient until the baby reaches 2 years of age.

Give short answer for questions 4 - 6.

4. List the principles of management of iron deficiency anemia:
5. What are the stages of iron deficiency anemia?
6. Write the three major ways of following the response of treatment in patients with iron deficiency anemia.

Write the correct letter of your choice for questions 7 - 10.

7. Which of the following is/are major cause(s) of iron deficiency anemia in children in Ethiopia?
    A. Peptic Ulcer Disease (PUD)
    B. Hook worm infestation
    C. Gastro-intestinal tumors
    D. Malnutrition
    E. B and D
8. The commonest clinical finding in patients with iron deficiency anemia is
    A. Pallor
    B. Splenomegaly
    C. Shortness of breath
    D. Koilonychia
    E. Jaundice
9. A patient is said to have moderate anemia if the hemoglobin level is
    A. Between 5 and 7 gm/dl
    B. Between 7 and 10 gm/dl
    C. Between 10 and 12 gm/dl
    D. Between 9 and 13 gm/dl
    E. None
10. The typical laboratory feature of Red Blood Cell (RBC) morphology in Iron Deficiency Anemia is:
    A. Normochromic - Normocytic.
    B. Microcytic - Hypochromic.
    C. Macrocytic - Hypochromic.
    D. Normocytic - Hypochromic.
    E. Megaloblastic

B. For Public Health Nurses

Write "**True" or "False**" for questions 1 - 2.

1. Interrupting breast feeding during illness is helpful in preventing Iron Deficiency Anemia.
2. Weaning should be started before 4 months to prevent Iron Deficiency Anemia.

Give short answers for questions 3 - 5.

3. Write down three important subjective data you would collect from a patient with iron deficiency anemia.
4. In administration of Intra Muscular (IM) iron what method do you use? And why?
5. What are the side effects of oral iron medication?

Write the correct letter of your choice for questions 6 - 8.

6. One of the following is **not** among the possible nursing diagnosis for a patient with Iron Deficiency Anemia.
   A. Activity intolerance
   B. Altered oral mucous membrane
   C. Hyperthermia
   D. Anxiety
7. All of the following are high risk groups for development of iron Deficiency Anemia **except**:
   A. Infants
   B. Pregnant women
   C. Pre school children
   D. Adult men
8. One of the following is part of the management of patients complaining gastric irritation from oral iron.
   A. Giving antacid.
   B. Advice on taking of spicy foods
   C. Take the drug between meals
   D. No management is needed because it is accepted to occur.

C. For Environmental Health Technicians

Write **“True” or “False”** for questions 1 - 5.

1. Anemia is a public health problem in our country.
2. Blood loss is one of the causes of anemia.
3. Poor environmental sanitation does not lead to anemia.
4. Infectious diseases do not cause anemia.
5. Chronic diarrhea has an impact on the absorption of nutrients.

Write the letter of your choice for questions 6 - 12.

6. Which of the following situations may contribute to the occurrence of anemia?
    A. Inadequate diet
    B. Poor environmental sanitation
    C. Loss of blood due to accident
    D. Impaired absorption
    E. All of the above
7. Nutrition education on prevention of anemia should focus on the following points **except**:
    A. On the significance of balanced diet.
    B. On the consumption of food rich in iron.
    C. On conditions which affect the nutritional value of vitamins
    D. A and B
    E. None of the above
8. Identify the prevention and control methods of schistosomiasis
    A. Proper excreta waste disposal
    B. Avoidance of physical contact with contaminated water
    C. Destruction of intermediate hosts
    D. Health education
    E. All of the above
9. One of the following is **not** a method for prevention and control of hook worm.
    A. Proper waste disposal
    B. Wearing of shoes
    C. Treatment of cases
    D. Avoidance of drinking of contaminated water
    E. Health education

10. What causes **blue baby syndrome?**
    A. Lead poisoning
    B. Presence of nitrates in drinking water
    C. Presence of iron in drinking water
    D. Presence of fluoride in drinking water
    E. None of the above
11. Which of the following is a preventive measure applied to reduce accidents in occupational settings?
    A. Enclosure of machineries
    B. Personal protection devices
    C. Ensuring the safety rules
    D. Protection against electric shock
    E. All of the above
12. Which one of the following is **not** a source of lead pollution?
    A. Pollution from vehicle exhausts
    B. Effluents from paint producing factories
    C. Wastes from storage battery manufacturing plants
    D. Water pipes made or galvanized with lead
    E. None of the above

D. For Medical Laboratory Technicians

Give short answer for questions 1 and 2.

1. Write the possible sources of blood collection for the laboratory diagnosis of iron deficiency anemia.
2. Write the possible sites of puncture for collection of blood specimen in infants.

Write the correct letter of your choice for questions 3 - 12.

3. All of the following laboratory tests can be used in the diagnosis of iron deficiency anemia **except**:
    A. Hemoglobin determination
    B. Hematocrit determination
    C. Peripheral blood morphology
    D. White blood cell count
    E. None of the above

4. The fluid that serves as a diluent in Sahli Hellige method of hemoglobin determination is:
    A. 0.1 N HCl
    B. Hayen's solution
    C. Distilled water
    D. 1% HCl
    E. None of the above
5. The antiseptic that is widely used during collection of blood specimen is:
    A. Savalon
    B. Soap
    C. 70% alcohol
    D. Tincture of iodine
    E. All of the above
6. Which of the following is/are used as a diluent for red blood cell count?
    A. Hayen’s solution
    B. Gawer’s solution
    C. Brilliant cresyl blue
    D. A and B
    E. All of the above
7. Normocytic Normochronic anemia is seen in the case of
    A. Decreased RBCs production
    B. Hemorrhage
    C. Hemolysis
    D. B and C
    E. All of the above
8. In the examination of peripheral red cell morphology, the abnormal red cells is identified based on their:
    A. Size
    B. Shape
    C. Color
    D. All of the above
    E. None of the above

9. During red blood cells count, falsely low level occurs due to the following situation **except**:
    A. Delay in counting
    B. Improper mixing
    C. Clumping of cells or coagulation of the blood
    D. Blood drawn above the mark in the diluting pipette
    E. None of the above
10. The safety precautions that should be considered when handling blood specimen includes:
    A. Wearing a rubber glove
    B. Cover the area if there is any skin cut or abrasion
    C. Appropriate disposal of used needles and syringes.
    D. All of the above
    E. None of the above
11. Capillary blood is collected in a type of test like:
    A. Hemoglobin determination
    B. Hematocrit determination
    C. Erythrocyte sedimentation rate
    D. A and B
    E. All of the above
12. Capillary blood is preferable than venous blood because:
    A. It's easy to perform
    B. It does not require anti coagulant
    C. It is advisable for peripheral blood film
    D. A and C
    E. All of the above

2.2. Significance and Brief Description of Anemia

Anemia is a worldwide health problem that is highly prevalent in developing countries. The highest incidence of anemia is reported in South Asia and Sub-Saharan Africa, where a large proportion of women of reproductive age and pre-school children are affected. In areas where intestinal parasitic infestation and malaria prevail, the problems exacerbate resulting in decreased work performance,

higher morbidity and mortality during pregnancy, increased risk of infection, abnormal mental performance and behavioral change.

Although many causes of anemia have been identified world wide, it is agreed that nutritional deficiency, due primarily to low bio-availability of dietary iron, accounts for more than half the total numbers of cases. Anemia due to iron deficiency has serious implications in terms of increased morbidity and mortality rates in vulnerable groups. Impaired growth and cognitive abilities in children, impaired language development and scholastic achievement, psychological and behavioral effects (inattention, fatigue, insecurity, etc.), decreased physical activity, and reduced work capacity and poor obstetric performance in adult women are also possible outcomes. Iron deficiency anemia is the most common nutritional disorder in the world. Micronutrient deficiency anemias, particularly of iron, as well as anemia induced by infections such as malaria are common in Ethiopia.

2.3. Learning Objectives

Upon completion of the module, the reader will be able to:

1. Define anemia.
2. Recognize anemia as one of the most important public health problems in Ethiopia.
3. Recognize the etiology, pathogenesis and clinical features of the disease.
4. Describe the methods to diagnose anemia.
5. Describe the management of anemia.
6. Describe strategies for the prevention and control of iron deficiency anemia.
7. State the role played by each category of health professionals and family members.

2.4. Case study

Learning Activity I

W/ro Hawa is a 35-year-old mother from Kero Deda Village which is 15 km away from Alemaya Health Center. The village has no access to the main road. There is also no safe water supply and school in the village. It is a drought affected area and out-breaks of malaria occur frequently. Sorghum is the staple diet in the area. Hawa

lives with her husband Ato Hassen, who is a farmer, and her six children. Her last child was born at home a year back. The family lives in poor housing condition with their domestic animals including pets in a single roomed hut with no window. The small plot of land Ato Hassen tills couldn't produce enough money to buy clothes and shoes for the family. Open field disposal of waste is the usual practice in the village.

Since she gave birth to the last child Hawa feels poor health. She feels tired and as a result the routine activities like fetching water from the nearby river progressively became very difficult. She also has headache and loss of appetite. She repeatedly went to the traditional healer in her locality who gave her bitter dark plant juices every time. But there was no change in her problems; rather her sickness worsened. Two weeks back she developed fever and chills on top of the other symptoms. Noticing that this is malaria, which she had many times before, Ato Hassen took her to the community health post where she was given tablets. The fever and chills disappeared, but the other symptoms persisted. The tiredness and fatigue worsened and she started to feel shortness of breath. Preparing food for the family became very difficult. She spent most of the day lying in bed. Five days back she was taken back to the health post supported by her husband, but the Community Health Worker (CHW) was out of the village. When he came back after a day, Ato Hassen brought him home, and the CHW advised them to go to the health center immediately. The next day Ato Hassen sold two of his goats. Leaving the care of the house to the eldest daughter, Ato Hassen and some of his relatives carried Hawa all the way to Alemaya health center.

Exercise I

Attempt the following questions.

1. What is/are Hawa's health problem/s?
2. What predisposing factor/s did you identify for Hawa's illness?
3. What things should have been done at the health post?
4. What public health problems do you identify in Kero Deda village and what community measures should be taken?

Learning Activity II

(Story continued from the case study above).

After five hours of walking they reached the health center. At the OPD the health officer found Hawa very weak and noticed the following signs. Her pulse rate was rapid, the palms and conjunctivae were pale. After completing his examination he sent her for laboratory investigation. Hemoglobin was 7gm%, blood film was negative for hemoparasites.

Exercise II

Attempt the following questions.

1. What should be done to the patient at the health center?
2. What additional investigation is needed to identify the cause and type of anemia?

2.5. Definition

Anemia is defined as a reduction of the red blood cell volume or hemoglobin concentration below the level considered normal for the person's age/sex.

2.6. Epidemiology

According to WHO estimate of 1997, anemia is a major health problem world wide affecting two billion people mainly in developing countries. The two major groups at risk are children and pregnant women.

Young children and pregnant women are the most vulnerable and affected with an estimated global prevalence of 48% and 51% respectively. Anemia prevalence in school-age children is 37%, non-pregnant women 35% and adult males 18%.

Prevalence rates as high as 40.5% in the general population and 47.2% in children were reported from North Western Ethiopia. Higher rates of about 57% have also been reported in pregnant women in Jimma, Ethiopia.

Iron deficiency anemia is a problem of serious public health significance, given its impact on psychological and physical development, behavior and work performance.

It is the most prevalent nutritional problem in the world today, affecting more than 700 million persons.

Iron deficiency anemia is considerably more prevalent in the developing than in the developed world (36% or about 1.4 billion persons out of an estimated population of 3.8 billion in developing countries, versus 8% or just under 100 million persons out of an estimated population of 1.2 billion in developed countries).

Iron deficiency is by far the commonest nutritional cause of anemia; it may be associated with folate deficiency, especially during pregnancy. Other nutrient deficiencies such as vitamin B_{12}, pyridoxine and copper are of little public health significance due to their infrequent occurrence.

Malaria, nutritional deficiencies and intestinal helminthes all predispose to anemia. It is estimated to affect more than 103 million children aged 9 years and below in Africa. In malaria endemic regions of Africa community surveys show prevalence of anemia in children to be between 49.5 and 89%. It is estimated severe malaria associated anemia causes 190,000 - 974,000 deaths per year in children under the age of five years, with the highest mortality observed among infants.

In tropical regions where helminthiasis is nearly universal and nutrition is poor and among impoverished people, multi-parous women and premature babies or those breast-fed too long, and some traditional practices to let blood flow out from the body, with such related factors iron deficiency is a prevalent disorder with adverse consequences.

In areas in which intestinal helmenthiasis exists in a large proportion of the population, iron deficiency anemia is nearly universal.

Intestinal parasitic infections are highly prevalent in developing countries like Ethiopia, mainly due to poor sanitary facilities, unsafe human waste disposal systems, inadequate and lack of safe water supply and low socio-economic status in general indicating poor environmental conditions. Intestinal parasitic helminthic infections are among the most common infections worldwide. The world health

organization (WHO) estimates that there are over 800 million cases of ascaris, over 700 million cases of hook worm, 500 million cases of trichuris infection, 200 million cases of entameoba hystolytica.

Recurrent droughts and famines continue to characterize the Ethiopian history. This may be associated to a number of conditions like socio-cultural, political, ecological, demographic and economic factors that predispose the population to continue to suffer from the synergistic effects of drought, famine and malnutrition. Nutritional surveys in 1980 showed that nearly 80% of urban and 75% of rural children aged bellow five years were malnourished.

2.7. Etiology and Pathogenesis

Anemia can be caused by one or more of the following independent mechanisms.

- Decreased Red Blood Cell (RBC) production: Anemia will ultimately result if the circulating RBC mass that is normally destroyed each day is not replaced from the bone marrow. The causes for reduced RBC production include:
  - Lack of nutrients such as Iron, copper, vitamin B_6, vitamin B_{12} or folate.
  - Deficiency of protein in the serum.
  - Failure of bone marrow to produce RBC due to tumor infiltration, drugs, chemical poisoning, etc.

- Increase in RBC destruction (Hemolysis): The essential feature of hemolysis is a shortened RBC life span. This is due to destruction by:
  - Infections like malaria.
  - Drugs like dapsone.
  - Chemical poisoning such as lead.
  - Genetic diseases such as sickle cell anemia.

- RBC loss: Blood loss is the commonest cause of anemia. The bleeding may be due to:
  - Trauma, including surgical procedures
  - Parasites, like hook worm and schistosomiasis.

- Intestinal bleeding, e.g. peptic ulcer disease (PUD), and gastrointestinal Cancer.
- Menstrual loss.

Iron deficiency anemia can be caused by:

- Deficient iron content of the food: This is common in infants who are kept too long exclusively on milk diet and in native populations living on marginal and poor diets. Iron deficiency may occur in older people due to their limited food intake like meat due to dental problem and poverty.
- Deficient absorption of iron: Deficient absorption usually follow,
  - Poor dietary practice like, less consumption of diets rich in vitamin C which enhance iron absorption,
  - Drinking coffee and tea immediately after meal inhibits iron absorption,
  - Gastrointestinal tract operation. It may occur also in chronic malabsorption states or diseases and consumption of antacids, fibrous diet and heavy metals like calcium, zinc, magnesium.
- Deficient transport: A decrease in transferring (iron-binding protein) is associated with a number of inflammatory conditions particularly rheumatoid arthritis. This may result in a decrease body iron content and finally production of less pigmented (hypochromic) red blood cells.
- Abnormal loss of iron: It is commonly caused by loss of circulating red cells through hemorrhage, excessively heavy menstruation or due to parasites like hookworm and schistosomiasis.
- Increased physiologic requirements: This occurs primarily in children during active growth and in pregnant women. When the infant is put on prolonged exclusive milk diet, the need for iron is not met. Pre-term infants require more iron. Pregnancy and lactation also places heavy demands on the iron stores of the mother.

Anemia decreases the capacity of blood to carry oxygen. This may result in decreased oxygen concentration in the tissue (hypoxia) and damage to different organs because the RBC and its hemoglobin are important for the delivery of oxygen to tissues.

2.8. Clinical Features

Anemic patients may present with the following manifestations.

2.8.1. Symptoms

- Tiredness, weakness or fainting
- Fatigue
- Breathlessness (shortness of breath)
- Exercise intolerance
- Head ache
- Tinnitus (ringing in the ear)
- Blurred vision
- Nausea
- Poor appetite
- Palpitation (uncomfortable awareness of ones heart beat).
- Excessive desire to eat unusual substances (pica) such as clay or ice.

2.8.2. Signs

- Paleness (skin and mucus membranes)
- Edema in chronic and sever cases
- Irritability
- Poor growth and development in children

2.9. Diagnosis

The following steps are followed in the diagnosis of anemia.

2.9.1. Diagnosis of anemia

Anemia can be identified using the following methods:

- History: Detect clinical symptoms of anemia, dietary history.
- Physical Examination: Examine mucous membrane (mouth, conjunctiva), palm and finger nails (see figure 1).

Figure: 1. Areas where to check for paleness during physical examination.

- Laboratory Examination: Measure hemoglobin or hematocrit. The hemoglobin levels indicating anemia are shown in table 1.

Table 1: Levels of hemoglobin which indicates anemia in different population groups

Population groups	**Hemoglobin gm/100 ml**
Children 6 months to 4 years	< 11
Children 5 - 11 years	< 11.5
Children 12 - 14 years	< 12
Women/adolescent girls - Not pregnant	< 12
- Pregnant	< 11
Men/ adolescent boys	< 13

2.9.2. Diagnosis of causes

The possible causes of anemia are traced with the following steps.

- History: age, sex, pregnancy, diet, clinical symptoms etc.
- Physical examination: e.g. Signs of infection such as malaria.
- Laboratory examination:
  - Blood film for hemoparasites like malaria
  - Peripheral blood morphology
  - Stool examination for hookworm and schistosomiasis
  - Urinalysis
  - Pregnancy test

2.10. Management of Anemia

The general aims of management of anemia are:

- To raise the level of hemoglobin to normal value. The hemoglobin level can be raised by:
  - Provision of foods rich in iron like meat, liver, fish, leafy vegetables and vitamins.
  - Administration of medicinal iron is the most important choice of therapy if iron deficiency anemia is diagnosed.
  - Administration of folic acid and vitamins.
  - Blood transfusion.
- To treat underling causes (consider multiple causes)
- To make proper follow-up.
- During follow-up the important factors to consider are:
  - Subsequent hemoglobin tests and clinical progress.
  - Decision on added treatment if necessary.
  - Decision on when to stop treatment.
  - Decision on when to stop hemoglobin tests.
  - Further care in health post.
  - Health and nutrition education.

2.11. Prevention and Control

- Early detection and treatment of underlying causes (as discussed in section 2.7).
- Assessment and appropriate management of high risk groups:

  E.g.
  - Pregnant women
  - Pre-term infants
  - Lactating mothers
  - People with malnutrition
- Preventing the underlying causes of anemia
- Prevention of malaria
- Prevention of parasites like hook worm infestation
- Prevention of chemical poisoning, like lead poisoning.
- Safety measures for the prevention of trauma causing blood loss.
- Other public health measures such as:

- Birth spacing.
- Immunization.
- Improved water supply and sanitation.
- Dietary improvement.
- Food fortification.
- Supplementation with iron tablets.

- Health education pertaining to the causes, management and prevention of anemia.
- Nutrition Education emphasizing the avoidance of inhibitors of iron absorption with food and increased intake of enhancers of iron absorption with food.

Inhibitors of Iron absorption

- Phytates (in cereals and legumes)
- Fiber (cereals and legumes)
- Tanins (in tea, coffee)
- Heavy metals (Ca, Zn, Mg)
- Achylohydria
- Low altitude
- Antacids
- Depleted stores

Enhancers of iron absorption

- Ascorbic acid (in Jucies, fruits)
- Amino acids (in meat, fish, chicken)
- Alcohol
- High altitudes
- HCL
- Deficient stores

UNIT THREE

SATELLITE MODULE

3.1. Satellite Module for Health Officers

3.1.1. Direction for using this module

Before reading this satellite module be sure that you have completed the pre-test and studied the core module. Continue reading this satellite module

3.1.2. Learning Objectives

- Upon completing reading this module you will be able to:-
  - Identify the etiologies of anemia.
  - Describe the pathogenesis of anemia.
  - Diagnose anemia from the clinical features and laboratory finding.
  - Treat patients with anemia according to its severity and its causes.
  - Describe ways of preventing and controlling anemia.

3.1.3. Learning Activity III

Case study

(This is the continuation of the case study from the core module)

After looking at the result the health officer prescribed her ferrous sulfate tablets for one month. While taking the medication, Hawa developed burning abdominal pain and decided to stop taking the drug on the 7^{th} day. Two weeks later she started to develop dyspnea at rest, orthopnea of two pillows and leg swelling. Ato Hassen and his relatives took her back to the health center again after a week. On examination her blood pressure was 120/50 mmHg, pulse rate 114/min, conjunctiva, the palms and buccal mucosa were very pale. Her hemoglobin was 5gm/dL and stool examination revealed hook worm ova.

Exercise

1. What is the diagnosis of this patient?
2. What important parts of management were missed in the first visit?
3. What should be done to Hawa?

3.1.4. Etiology and Pathogenesis

Anemia can be caused by decreased RBC production, increased RBC destruction or RBC loss. Since iron deficiency anemia which results from decreased RBC production or decreased hemoglobin synthesis is the commonest cause in our country, its etiology and pathogenesis is discussed below.

Total iron content in an adult ranges between 3 to 5 grams. The erythrocytes account for approximately 70% of total body iron by incorporating it into the hemoglobin molecule. Iron in the tissue is available in two forms, namely storage and active forms. The storage forms are known as ferritin and hemosedrin in the liver and reticulo-endothelial cells. Active iron is present in myoglobin (muscle), mitochondria and other cellular constituents. A variable amount is bound to transferrin which is iron-binding protein of the blood and the principal transport protein. As a result of normal renewal of intestinal mucosal cells and minute hemorrhage approximately 1mg of iron is lost per day. The loss is higher in females of reproductive age due to normal menstrual flow.

Iron is needed to make the hemoglobin in the RBC. The stores are depleted if the iron lost from the body exceeds the iron absorbed from food. Depletion of the body iron stores results eventually in iron deficiency anemia.

3.1.4.1 Stages of iron deficiency anemia:

- Iron store depletion: The first stage in development of iron deficiency anemia is depletion of body iron stores. At this stage the patient does not have typical clinical and laboratory findings of iron deficiency anemia.
- Iron deficient erythropoiesis (RBC production). This stage is marked by limitation in RBC production. Still in this stage, there is no typical laboratory finding of iron deficiency anemia which is microcytic-hypochromic picture in RBC.

- Iron deficiency anemia: This stage indicates a prolonged negative iron balance (the requirement and/or the loss of iron exceeds the intake) and this eventually results in the production of poorly hemoglobinized cells (hypochromic - microcytic red blood cell morphology).

3.1.4.2. Causes of iron deficiency anemia

Diet:

Inadequate diet or nutrition: If the iron content of the food eaten is low, iron depletion may occur. The iron content of breast milk is inadequate for the rapidly growing infant and anemia may ensue after 9 months especially if the supplementary diet is poor in iron.

Malabsorption: This may follow operation on the GIT E.g. gastrectomy. Defective absorption of iron may also occur in chronic malabsorption states. E.g. Tropical sprue, celiac disease, giardiasis, sever protein energy malnutrition.

Physiological

Infancy: This is due to fast growth; in addition low iron store may occur in premature low birth weight infants and this can contribute to the development of iron deficiency anemia.

Adolescence: As above this is also due to an increase in the rate of growth.

Pregnancy: As a result of the growing fetus there is increased demand of iron.

Normal menstruation: As a result of blood loss.

Lactation: Requirement for iron increases.

Blood Loss

Gastro Intestinal Tract (GIT)

- PUD: acute or chronic blood loss form the ulcer site may predispose the person to develop iron deficiency anemia.
- Hook worm infestation: the amount of blood loss from the GIT is usually proportional to the degree of infestation.
- Blood loss due to schistosomiasis.

- Variceal bleeding: This follows chronic liver disease and there can be massive bleeding from the esophagus.
- Tumors: Polyps and carcinomas of the large bowel may cause chronic blood loss from the GIT.
- Hemorrhoids: Can cause intermittent frank bleeding from its site and cause chronic blood loss.
- Drug intake: (e.g. NSAIDs like aspirin)

Genitourinary tract (GUT)

- Excessive menstrual flow (menometrorhagia)
- Genital tumors (E.g. Cervical, Endometrial Ca, Myoma)
- Hematuria (e.g. schistosomiasis, renal stones, urinary tract tumors)
- Surgical blood loss and trauma
- Pulmonary Loss: (e.g. hemoptysis)
- Others: epistaxis, blood malignancies like leukemia.

3.1.5. Clinical features

In addition to the specific symptoms and signs mentioned in the core module, the following points should be included in assessing all patients with anemia.

History

- Ask history of drug intake (e.g. Aspirin)
- Dietary habit or nutritional history should be emphasized.
- Did the patient have any bleeding previously? Is he/she bleeding currently?
- Ask about history of malaria endemicity.
- Does the patient have symptoms of an acute or chronic illness?
- Does the patient walk barefoot or sit directly on soil?

Physical Examination

- Patients generally look pale; they are irritable or depressed.
- Check vital signs to detect hypotension due to acute blood loss and signs of infection e.g. Low blood pressure, tachycardia, or fever.
- Look for pallor in the conjunctiva, oral mucosa, tongue and finger nail beds, palm of the hand and sole of baby heel.
- Jaundice (icterus) in sclera in cases of hemolysis (e.g. Malaria)

- Palpate the lymphnodes for enlargement in cases of blood malignancies like leukemia and lymphoma.
- Examine the precordium - look for forceful apical impulse with low grade murmurs or any sign of heart failure.
- Hepatosplenomegaly may be detected in cases of anemia secondary to infections like malaria, malignancy, chronic liver disease etc.
- Check for peripheral edema which indicates long standing and severe anemia; this may be a sign of congestive heart failure. (severe anemia may result in the development of congestive heart failure)
- Look for spooning of the nails (Koilonychia).
- Angular stomatitis.

3.1.6 Laboratory Diagnosis

Detect Anemia

The following laboratory investigations should be undertaken in order to determine the presence of anemia.

- Packed volume of red cells (hematocrit) or concentration of hemoglobin in circulating blood.
- On average, hematocrit values (in %) are roughly equivalent to three times hemoglobin concentration (in gm%).
- Interpretation of results depends on age specific and sex specific standards as well as pregnancy or lactation status.
- Peripheral RBC morphology will show, established iron - deficiency anemia, (i.e. hypochromic microcytic, red cells), which are paler and smaller than the normal RBC
- Reticulocyte count: these are immature (young) RBC and are indicative of bone marrow activity and are less than normal under iron-deficiency anemia. (Normal reticulocyte count is 1% - 2%).

Anemia may be defined in all ages and sexes as

- **Mild** if hemoglobin is between 10gm% and cut off level
- **Moderate** if hemoglobin is between 7 – 10 gm%
- **Severe** if hemoglobin is less than 7gm%

Detect causes of anemia

In addition to the laboratory tests specific to detection of iron deficiency anemia, diagnostic tests which can help to detect the underlying cause should also be performed.

E.g.- Stool examination for hookworm, schistosomiasis, Diphyllbotryium latum.

- Blood film (thin and thick) for malaria parasite
- Urine analysis for schistosomiasis
- Pregnancy test.

3.1.7. Management of iron deficiency Anemia

3.1.7.1. Dietary management

Encourage patients to eat meat, liver, kidney, egg yolk, green vegetable, fresh fruit, small grain cereals like teff, millet, aja. etc.

3.1.7.2. Management of underlying causes like

- Anti-malaria drugs for malaria
- Anti-helmentics for hook worm infestation.
- Treatment of peptic ulcer disease.

3.1.7.3. Medicinal iron Therapy

a. Oral Iron Therapy

- Iron tablets can be given in the form of iron sulfate, iron gluconate, or iron fumarate.

Recommended dose is 60gm of elemental iron/day in case of mild anemia and 120 gm per day (2 x 60 gm) in case of moderate anemia.

The commonly used Fe SO_4 and Fe gluconate have preparation of 300 mg tablets (with elemental iron 60mg and 30 mg respectively)

For infants and children, the recommended dose is 3 mg/kg body weight/day of elemental iron. Tablets are better than liquid because they are less expensive and can be kept longer. Infants and very young children can be given the tablets ground up in spoon with water or orange juice.

Liquid preparations are found in the form of syrup or drops. They are expensive and deteriorate in storage. Liquid preparations are useful for administration to infants and children.

Combination with other nutrients:

- Iron and folic acid (Fefol) combination is used especially in pregnancy, as all pregnant women tend to become deficient in both iron and folate. It is prepared as folate 250 micro gram and ferrus sulfate 60mg
- Iron and ascorbic acid, (since ascorbic acid enhances absorption of iron from gastrointestinal tract).

Side Effects of oral iron therapy

- Gastrointestinal: Epigastric discomfort, nausea, vomiting, constipation and diarrhea
- Frequency of side effect depends on dose of iron intake (it can improve with smaller doses)
- Iron consumed with a meal is better tolerated than when it is taken on empty stomach although the amount of iron absorbed is reduced.
- To reduce side effects therefore, - reduce the dose of iron tablets and
  - advice to take the tablets with meal

b. Parenteral Iron Therapy

- Parenteral iron therapy is indicated only when oral administration causes severe vomiting that can not be stopped by lowering the dose of iron, or in case of persistent non – compliance
- Iron - dextran (imferon) is a type of parenteral iron. It can be given intramuscular or intravenous. The advantage of intravenous method is that complete iron requirement can be supplied in a single dose. This technique known as total dose infusion has been used especially in obstetric practice where it solves the problem of non-compliance, and permits the increased requirement during pregnancy to be met in full. IV iron should only be given under hospital setting. This is because patients may develop severe anaphylactic reaction.

The recommended IM dose is 100mg/2ml saline solution in Z pattern, in each buttocks or in anterior thighs.

Follow up:

In the follow up of patient on treatment with iron for iron deficiency anemia look for:

- Improvement in clinical symptoms: The first to improve is subjective complaint like irritability, fatigue, shortness of breath, poor appetite etc.
- Increment in reticulocyte level; it increases in around 3 - 4 days of therapy and peaks at 10 days.
- Serial hemoglobin increment; it increases 1 - 2 gm/100 ml in 2 - 3 weeks time.

If response does not occur, consider the following:

- Patient is non compliant (common).
- Persistent blood loss exceeding intake.
- Incorrect diagnosis.
- Coexisting disease (E.g. Bone marrow failure)

- **To stop treatment:**

- Although the response in terms of hemoglobin concentration is virtually months complete after 2 months, iron therapy should continue for another two to three to build up iron stores. In addition make sure that the underlying causes are treated.

- **Blood Transfusion**

For severe anemia and significant acute blood loss, the patients should be referred to where blood transfusion can be given, immediately.

3.1.8. Prevention and Control

There are four basic approaches in prevention of iron deficiency anemia.

Supplementation with medicinal iron

- It is targeted to risk group in greatest need of iron. There will also be rapid improvement in iron status.

- **Pregnant Women**
  - This is a priority group for iron supplementation.
  - The recommended daily dose is 2 tablets each containing 60mg elemental iron plus 250 micro gram (μg) of folate taken through out the 2nd half of pregnancy.

To ensure success with compliance, women must be convinced of the importance of iron for their health and the health of their unborn child.

- **Infants**

Preventing anemia in late infancy and in preterm infants includes:

- Promoting breast feeding for as long as possible given the high bio availability of breast milk iron, encouraging the timely introduction of weaning food at 4 - 6 months that have high iron content. Parents need to be motivated and taught how to prepare weaning foods rich in iron.

- **Increasing dietary intake of iron by:**
  - Ensuring larger amount of habitual food. So that energy needs are fully met.
  - Enhancing the bioavailability of the iron ingested. This is achieved by promoting the intake of iron absorption enhancers including haeme iron e.g. Ascorbic acid (Vitamin C)
  - Reducing ingestion of absorption inhibitors (E.g. tanins present in tea and to a lesser extent in coffee are iron absorption inhibitors). Phytates are present in wheat, certain vegetables and other cereals. Even small amount of phytates markedly reduces iron absorption; fortunately, this inhibitory effect can be counteracted with ascorbic acid.
  - Iron absorption is strongly influenced by combination of foods eaten in a given meal. In general, it may be culturally more acceptable to encourage the addition of an absorption enhancer to the meal than to discourage consumption of an inhibitor.

- **Control of Infections**

Effective and timely curative care could diminish the adverse nutritional consequences of viral and bacterial disease.

- It is vital to educate the family about proper feeding practice during and after period of infective illness. Especially in children, breast-feeding should not be interrupted because it helps much to prevent infectious diseases in addition to its effect on iron status.

- The control of many infections requires preventive public health measures such as immunization, safe water provision, improvement in environmental sanitation and personal hygiene.
- Parasitics infestation like hook worm and schistosomiasis play a role and cases should be properly treated.
- Control of malaria by using impregnated bed nets, destroying mosquito-breeding sites, and taking malaria prophylaxis is necessary in endemic areas.

- **Fortification of staple food with iron**
  - The fortification of a widely consumed and centrally processed staple food with iron is one way of controlling anemia in many countries. Fortification of iron is the addition of iron in processed dietary components in factories. In industrialized countries the most commonly fortified food products are wheat flour, bread, milk products including infant formulas, and weaning foods.

Public education

With the possible exception of food fortification, the success of all four technical approaches to anemia control depends on the active participation of the population.

The major changes in behavior that are needed emphasize on compliance with supplementation regimens, changes in cooking and eating habits, and measures for infection control, including better personal hygiene and more rational feeding of sick children responsibilities that in many societies are assigned primarily to women.

Now you are through with the core and satellite modules, but there are still some activities remaining as stated below.

1. Read the task analysis of the different categories of The Health Center Team on Unit 4.0.
2. Do the questions of pre-test as a post-test.
   N.B.: Use a separate answer sheet.
3. Compare your answers of the pre- and post-tests with the answer keys given on Annex I and evaluate your progress.

3.2. Satellite Module for Public Health Nurses

3.2.1. Direction for using this module

- Before reading this satellite module, be sure you have completed the pre-test and studied the core module.
- Continue reading the satellite module.

3.2.2. Learning Objectives

After completing the module, you will be able to.

- Identify common actual and potential human responses to Iron deficiency anemia.
- Implement the appropriate nursing interventions.
- Participate in preventive and control activities of Iron deficiency anemia.

3.2.3. Case study

Learning activity III (Continuation of case study in the core module)

Assessment of Hawa by a public health nurse:

From the history, Hawa verbalized fatigue during activity. She feels shortness of breath while doing her routine work at home. She is worried about her small kids because she cannot take care of them. Hawa and her husband thought her problem could be evil sprit and could not be treated with drugs. Moreover, from the history the nurse noticed her living condition including housing and nutrition will make her high risk to develop Iron Deficiency Anemia.

On physical examination, the public health nurse observed Hawa was breathing fast and failed to tolerate simple activities. Her vital signs revealed:

Pulse rate	100/min
Temperature	37.5° C
Blood pressure	100/60 mmHg
Respiratory rate	32/min

Laboratory investigation was done and the hemoglobin was found to be 7 gm/dl. Stool exam showed ova of hook worm.

Hawa was given oral iron for her problem and was given appointment after three weeks.

Answer the following questions

1. State the nursing diagnoses for patients with Iron Deficiency Anemia.
2. Identify the major nursing interventions.
3. Identify the preventive methods for Hawa's problem.
4. On the day of appointment for check up, she complained of burning sensation over the epigastric area and wants to stop the medication. What advice would you give her?

3.2.4 Nursing Case Management

Assessment:

Patients should be assessed for the presence of the following characteristics.

- **Subjective data**
  - Weakness
  - Shortness of breath, palpitation
  - Ringing in the ear
  - Sore gum, tongue and lips
  - Pica (in severe cases) = desire to eat unusual things
  - Fainting
  - Anxiety
  - Loss of appetite
  - Palpitation
  - Nutritional: the food items consumed commonly in the family.
  - Awareness about the disease problem and preventive measures.

- **Objective Data**
  - Decreased hemoglobin level (Refer to the normal Hgb for each age group in the core module.)
  - Increased pulse rate. (taccycardia)

- Pallor (nail beds, conjunctiva, palm)
- Edema (in severe cases)
- Living standard - personal hygiene
- Shoe wearing habit

Nursing Diagnosis

The possible Nursing diagnoses in patients with Iron Deficiency Anemia are

- Activity intolerance related to weakness and fatigue.
- Altered oral mucus membrane related to the disease process.
- Altered nutrition less than body requirement related to inadequate intake of iron.
- Anxiety related to inability to perform activity of daily living.
- High risk for infection related to decreased immunity.
- Knowledge deficit regarding the nature of the problem and its preventive measures.
- Non-compliance to drug regimen related to side effects of oral iron medication.

Plan

Goals: Patient will:

- Develop tolerance of activity with minimum energy consumption.
- Have normal mucous membrane integrity.
- Maintain adequate nutrition.
- Experience less anxiety.
- Demonstrate absence of infection or complication.
- Be aware of the disease process and its preventive measures.
- Comply to the drug regimen.

Interventions

- Encourage frequent rest and activities as tolerated
- Postpone the activities that cause undue fatigue until endurance increase.
- Frequent oral hygiene with mild and cool tooth pest, and water (before and after meal).
- Avoid irritant foods, beverages example coffee.
- Avoid unnecessary exertion.

- Encourage taking well balanced diet.
    - High protein and high calorie food, iron rich foods.
    - Fruits and vegetables such as kele “Yehabesha Gomen”.
    - Avoid alcohol intake and spicy foods
- Encourage patient to express feeling of anxiety.
- Decrease contact with infected individuals and source of infection.
- Practice good hand washing and personal hygiene.
- Advice on health seeking behavior.
- Administration of prescribed medication.
    - Use Z-tract method in IM medication to prevent local pain and staining.
    - Use straw in syrup administration to prevent staining of the teeth.
    - Avoid ant acid tablets or suspension with oral iron medication.
    - Advice intake of vitamin C or citrus fruit along with iron medication to enhance absorption.
    - Oral iron should be given between meals to avoid gastric irritation.

Note: Clients should be advised to seek health service for any unusual bleeding from GUT, GIT or with any other compliant.

Patient teaching:

- Advice on nutrition:
    - Eat iron rich foods (Liver, kidney, heart, poultry, beans, leafy vegetables like kele/Yehabesha Gomen).
    - If consuming plant origin iron rich foods, take it with vitamin C or citrus fruit.
    - Avoid foods with phytates, polyphenoles, tannins, e.g. Tea after meal because of inhibition of non-haeme iron absorption
- Encourage client to comply with drug regimen by explain the duration, importance and side effect of drug therapy.
- Provide information on side effects of iron medication.
    - stool color change,
    - gastric irritation,
    - skin and teeth staining,

- **Evaluation**

Expected out comes:

Patient will:

- Demonstrate tolerance to activities of daily living.
- Skin and mucous membrane integrity maintained.
- Experiences less anxiety.
- Be free of infection and complications.
- Develop awareness about the nature of the disease, duration of therapy and its prevention.
- Attain adequate nutrition.
- Demonstrate compliance to the drug regimen.

3.2.5. Prevention and control

I. Supplementation with medicinal iron.

It can be targeted at the population groups in greatest need of iron or at greatest risk of becoming iron deficient. Supplementation programs do best if concentrated on high-risk groups such as pregnant women, infants and preschool children.

Target groups

- **Pregnant women**
  - Supplementation should be given primarily during the second half of pregnancy.
  - Women must be convinced of the importance of iron for their health and the health of the fetus.

- **Pre-school children**
  - Iron supplementation prevents impairment of language development and scholastic achievement.
  - Iron also helps for normal growth and development.

- **School children**
  - Anemia is not highly prevalent in school children as compared to pre school children. However, if there exist cases, they can be reached at their school through school health service.

- **Infants**
  - Protect and promote breast feeding for infants as long as possible.
  - Encourage timely introduction of appropriate weaning foods. (Foods rich in iron and/or vitamin C).

II. Dietary Diversification

- Ensure consumption of larger amounts of staple diet so that the energy needs is fully meet.
- Advice on consumption of bio available iron (heme iron ingestion.)
- Advice on intake of iron absorption enhancers (heme iron) or on reducing the ingestion of absorption inhibitors such as coffee and tea.
- Encourage common household processing methods (germination, malting and fermentation) because they enhance absorption of iron.

III. Control of viral, bacterial and parasitic infections

- Proper curative service (early detection and management of infectious diseases).
- Family education about proper feeding practice during and after periods of infective illness.
- Continuation of breast feeding (should not be interrupted during infectious illness).
- Provision of safe water supply.
- Improvements in environmental sanitation and in personal hygiene.
- Deworming with simultaneously eradicating the reservoir of infection. For example mass treatment for hookworm and eradication of snails from water sources.
- Advice on wearing shoe.
- Drainage or filling of stagnant water (prevent mosquito breeding).
- Proper human waste disposal.

IV. Dietary Modification

- **Food fortification**

Food fortification is one of the most effective ways of preventing iron deficiency. But, it has limitations such as identifying a suitable food for fortification, affordability of the fortified food and technical difficulty of iron fortification than other nutrient fortification, the need for centrally processed product she need for quality control measures and bio availability of iron for the fortified food vehicle.

Now you are through with the core and satellite modules, but there are still some activities remaining as stated below.

1. Read the task analysis of the different categories of The Health Center Team on Unit 4.
2. Do the questions of pre-test as a post-test.
   N.B.: Use a separate answer sheet.
3. Compare your answers of the pre- and post-tests with the answer keys given on Annex I and evaluate your progress.

3.3. Satellite Module for Environmental Health Technicians (Sanitarians)

3.3.1 Directions for using this module

- Before reading this satellite module be sure that you have completed the pre - test and studied the core module.
- Continue reading this satellite module.

3.3.2 Learning Objectives

After reading this module the leaner will be able to:

- Identify the causes of anemia.
- Identify the preventive and control measures of anemia.

3.3.3 Causes of anemia

One or the combination of the following situations may contribute to the occurrence of anemia.

- Inadequate diet (nutrition)
- Environmental conditions, like poor sanitation leading to infections, chemical pollution such as lead, and the presence of nitrates in water supplies.
- Blood loss due to trauma, infections, repeated pregnancy, menstrual disorders, etc.
- Impaired absorption due to chronic diarrhea, removal of part or whole of the stomach and chronic alcoholism. Chronic alcoholism often causes inadequate iron intake and loss of iron through blood from the gastrointestinal tracts.
- Genetic Factors; For example, Sickle Cell Anemia

The above points signify that the causes of anemia are multiple and complex. From the professional aspect the causes related to environmental conditions are of special interest to the Environmental Health Technician. The causes of anemia related to environmental conditions are thus associated to the following.

- **Poor environmental sanitation**

Poor environmental sanitation especially open deification leads to increased prevalence of parasitic infections such as hookworm and schistosomiasis that lead to anemia due to blood loss.

Worldwide, as many as 200 million persons may be infected with schistosomiasis and infection of entire community is common.

Hook worm infection is a wide spread disease in areas where the soil is sandy clay, moist and covered with vegetation. In Ethiopia, the disease is quite common in hot areas (Qola), areas with elevations of up to 1800m above sea level that are covered with vegetation and temperate areas (Weynadega), with elevations from 1800 to 2400m, where the soil structure and climate agree with the above description.

A cross-sectional parasitological survey conducted in November 1997 in Asendabo Elementary and Junior secondary schools of Omo - Nada woreda, Jimma zone, indicated an overall intestinal parasite prevalence rate of 86.2%. A total of 10 species were identified with Ascaris lumbricoides leading (56.4%) followed by hookworm (25.5%).

A community based cross-sectional study to assess the association between hookworm infection and anemia was also carried among the population of Wolisso in Nov. – Jan. 1994/95. Analysis of the result showed hookworm infection was significantly associated with low hemoglobin level.

An infected person may harbor as many as 2000 or more hookworm parasites, and it has been estimated that a single female hookworm sucks from its victim 0.38cc to 0.85cc of blood daily. As a result a victim of hookworm is often anemic and malnourished. Hookworm infection is a common cause of iron deficiency anemia in Ethiopia.

The major clinical presentation of schistosomiasis is bloody diarrhea, some times associated with protein loss and anemia.

- **Environmental pollution**

Surface and ground water sources may be contaminated with toxic substances such as nitrates and heavy metals like lead in the form of leachates from improperly disposed solid and liquid wastes.

Dissolved nitrogen-nitrates (NO_3) are a health hazard when present in water above the permissible level of concentration. The presence of more than 45 mg/liter concentration of NO_3 in water supply causes a disease known as methaemoglobinaemia (blue babies syndrome) in infants less than three months old. This can happen when babies consume food or milk prepared with water which has a high nitrate concentration. The disease is restricted mainly to infants of less than three months, because only the intestinal bacterial floras of infants of this age are able to convert the nitrate to nitrite. The mechanism of the disease is believed to be as follows: In infants, in whom the pH of the gastric Juice is relatively high (over 4.9), nitrate - reducing bacteria grow in the intestines, producing nitrite, which is absorbed in the blood stream. The nitrate combines with the hemoglobin, the blood pigment which is responsible for the circulation of oxygen, reducing it incapable of absorbing oxygen and thus resulting in oxygen deprivation of the body tissues.

The commonest sources of nitrates are water supply sources contaminated by run offs of nitrate fertilizers from farms, effluents from fertilizer industries, and leachats from dairy farms and from waste disposal sites.

Lead is also known destructor of red blood cells leading to anemia. The following are some of the sources of lead pollution to the environment:

- Air and land pollution from vehicle exhausts. Lead is usually an additive in petrol and gasoline.
- Water pipes made or galvanized with lead.
- Effluents from chemical factories such as those producing paints.
- Wastes from storage battery manufacturing plants.
- Effluents from garages especially where batteries of vehicles are repaired.
- Effluents from metallurgy industries.
- Toys.
- Wastes from lead soldering cottage industries and black smiths.

- Leachets from solid waste disposal sites such as dumps of old vehicles, old batteries, radios and electrical appliance wastes.

These conditions may lead to pollution of soil, water, and air. There are also studies which indicate lead is absorbed by plants including food vegetables.

3.3.4 Prevention and control of Anemia

The following are major areas of focus requiring proper environmental management for the prevention of anemia.

- Prevention and control of infestations by parasitic worms (helminthes) such as hook worm and schistosomiasis.
- Prevention and control of infections such as malaria.
- Prevention of accidents in living, recreational and work areas to reduce risks of blood loss.
- Control of environmental pollution from toxic chemicals and heavy metals like lead that are known destructors of red blood cells.

More over nutrition education and health education on the causes, the predisposing factors, the prevention and control measures are important considerations.

1. Prevention and control of helmintic infestations

The basic of excreta-borne helminthic infestations prevention lies on isolating human excreta from reaching the human host. This is achieved through the use of properly maintained sanitary latrines as well as the safe and hygienic disposal of sewage.

There are various acceptable technologies and methods for the disposal of human excreta at individual, family or community level. It is thus the role of the Environmental Health Technicians to introduce these technologies for choice to the public.

Besides the proper use of latrines, the wearing of shoes and avoidance of wadding in water bodies are essential actions in the prevention of hookworm and schistosomiasis respectively. Snail control is also a strategy in control of schistosomiasis.

2. Prevention and control of malaria

Malaria is recognized as being one of the major diseases in the world today. Between one and two billion people live in areas at risk of infection, and each year it is estimated that up to 500 million people contract the disease resulting in three to five million deaths Over 90% of these deaths occur in Africa, south of Sahara.

Over 65% of the land area is malarious and over 75% of the population of Ethiopia is believed to be exposed to malaria. Malaria is caused by parasites carried by mosquitoes, in which the infectious agent plasmodium invades and destroy red blood cells leading to anemia. The anemia due to malaria is most common in children under five years of age, older patients with splenomegaly, pregnant women and people with sickle cell disease.

The following measures can be implemented to prevent and control malaria:

- Drainage of stagnant water and swampy areas to prevent mosquito breeding.
- Proper disposal of rubbish to eliminate breeding sites of mosquitoes.
- Screening of windows and openings.
- Use of personal protection methods, like bed-nets, ointment (repellents), and wearing of clothes to cover the body.
- Prophylaxis
- Treatment of cases.
- Applications of insecticides/residual insecticides, and larvicides like used oil.

3. Prevention of accidents to reduce blood loss

Working, recreational and living areas should be controlled from conditions leading to accidents. Safety rules should be ensured in occupational settings. Enclosure of machinery and tools will reduce potential for accidents. Personal protective devices and protection from electric shock accidents should be encouraged. Moreover, proper illumination is one means to reduce the occurrence of accidents.

4. Controlling environmental pollution

This can be ensured with the following considerations

- Legal aspects prohibiting discharge of substances that have hazardous effects to the environment.
- Routine inspections with proper actions of potential pollution sources.
- Environmental monitoring by carrying appropriate laboratory investigations as applicable.
- Identification and follow-up of potential and actual pollutant sources and work for their control in collaboration with concerned government agencies.
- Public education on possible environmental hazards associated to cause anemia.

5. Nutrition education

The life span of each red blood cell is about four months and so the red bone marrow is constantly manufacturing new cells to allow for replacement. This process requires protein, minerals and vitamins, all of which must originate in food consumed. Therefore, nutrition education is important and should focus on the following main points.

- Education in the significance of balanced diet
- Education on the consumption of food rich in iron
- Education on conditions which can affect the nutritional value of foods. For example nutrients such as vitamin C originally present in food can be lost during cooking and on long standing after cooking and on reheating.

In many rural households food for the day is all cooked at the same time providing two meals that may be eaten as much as 12 hours apart.

Education on common household processing methods like germination, malting and fermentation which can enhance iron absorption by increasing the vitamin C contents should also be encouraged.

6. Health education

The success of all technical approaches to prevent anemia depends on the active participation of the population. Health education is to ensure community participation. Therefore, the need for health education support strategy based on careful analysis of behavioral change is required.

The major changes in behavior that are needed center on compliance with supplementation regimens, changes on cooking and eating habits, and measures for infection control including better personal hygiene and more rational feeding of sick children.

3.3.5 Exercise: Learning activity III

Identify the environmental sanitation problems in Kero Deda village (refer to the case study of learning activity I of Section 2.4 in the core module)

Now you are through with the core and satellite modules, but there are still some activities remaining as stated below.

1. Read the task analysis of the different categories of The Health Center Team on Unit 4.
2. Do the questions of pre-test as a post-test.
   N.B.: Use a separate answer sheet.
3. Compare your answers of the pre- and post-tests with the answer keys given on Annex I and evaluate your progress.

3.4 Satellite Module for Medical Laboratory Technicians

3.4.1. Directions for using this module

- Before reading the satellite module, be sure that you have completed the pre test and the core module.
- Continue reading the satellite module.

3.4.2. Learning Objectives

3.4.2.1. General

The aim of this satellite module is to enable the learner to acquire knowledge, attitude and practice concerning laboratory diagnosis of iron deficiency anemia.

3.4.2.2. Specific

After completing of this satellite module, the learner will be able to:

- Identify the possible sites of blood collection both in adults and infants.
- Collect blood specimen from capillary or veins.
- Perform the various laboratory tests that are essential for the diagnosis of iron deficiency anemia.
- Explain the sources of errors associated with the different tests in laboratory diagnosis of iron deficiency anemia.
- Know how to report laboratory findings.
- Explain the importance of quality control.

3.4.3. Collection of blood specimen

Proper collection and reliable processing of blood specimen is an essential part of the laboratory diagnosis of anemia. The method of blood collection is determined by the amount of blood needed and the type of tests to be done. Some tests need only few drops of blood, while others need large quantities of blood.

In order to obtain accurate and precise laboratory findings, due attention should be given for correct collection and analysis of blood specimen. The techniques of blood tests are concerned mainly with the cellular elements of blood, their number or

concentration, the relative distribution of various types of cells and the structural or biochemical abnormalities that promote disease.

3.4.3.1. Safety precautions

- All blood specimens of human origin should be regarded as capable of transmitting infections.

  Example: - Human immuno deficiency virus (HIV)
  - Hepatitis B virus

- During collection of blood, always wear protective rubber gloves.
- Cuts, abrasions or skin breaks on the hands should be covered with adhesive tape.
- All materials used for puncture should be sterile.

  Example: - Syringes and needles
  - Blood lancets

- If needle - stick injury occurs, immediately encourage bleeding, wash with large quantities of water and finally scrub the wound with cotton swab soaked in 70% alcohol solution.
- Disposable blood lancets, needles and syringes should be discarded in a safe place after a single use.

3.4.3.2. Sources of blood collection

There are two possible sources of blood specimen to perform laboratory diagnosis of anemia.

- Capillary blood collection and
- Venous blood collection

A. Capillary blood collection

Capillary blood collection is a method of obtaining of blood from capillaries. It is frequently used when small quantities of blood are required. Tests like hemoglobin (Hgb) determination, hematocrit (HCT) determination, white blood cell count, red blood cell count and peripheral blood smear preparations need only few drops of blood.

It is also used when venipuncture is impractical, such as in:

- Infants,
- Cases of severe burns,
- Extreme obesity where location of veins could be a problem, and
- Patients whose arm veins are being used for intravenous medication.

- **Sites of Puncture**

A specimen of capillary blood can be obtained from the following sites.

For adults and children

- From palmar surface of the ring finger or free margin of the ear lobe (see figure 2).

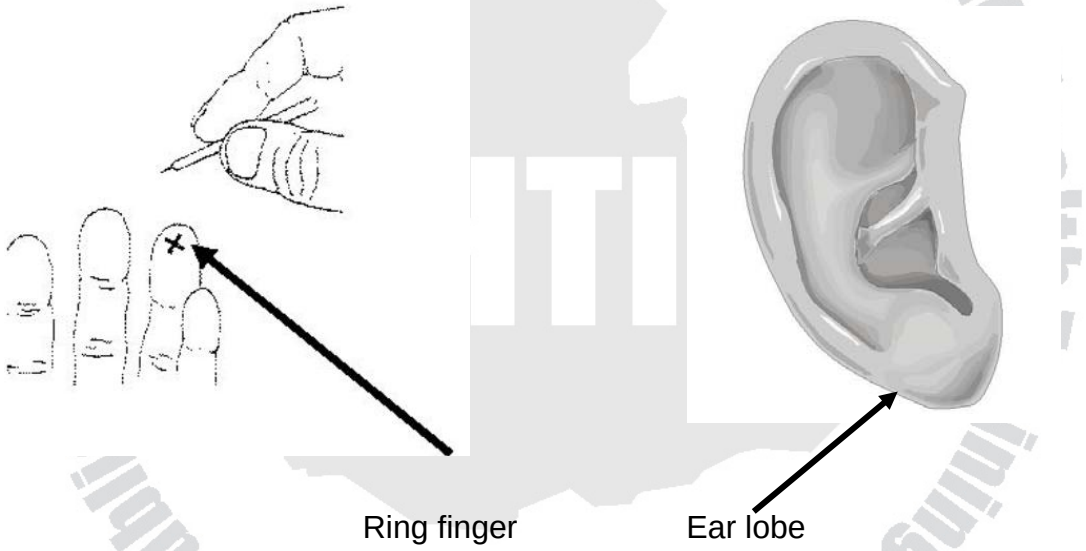

Figure: 2. Sites for taking blood sample for adults and older children.

For infants

- Plantar surface of the great toe or heel (see figure 3).

The puncture should be about three millimeter deep. An oedematous or a congested part should not be used. If the area to be punctured is cold and cyanotic, warm it by massaging or else erroneous results of hemoglobin and cell counts may be obtained

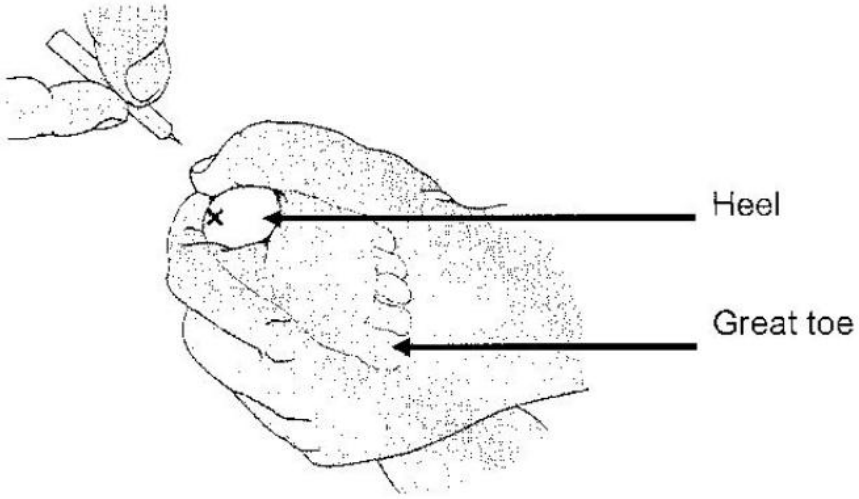

Figure: 3. Site for taking blood sample for infants.

- **Materials required**
  1. 70% alcohol or similar antiseptic.
  2. Gauze pads.
  3. Dry cotton.
  4. Sterile blood lancet.
  5. Rubber gloves.

- **Procedure**
  1. Clean the site to be punctured with cotton moistened with 70% alcohol.
  2. Dry the skin with sterile gauze pads.
  3. Make a puncture of 2 - 3 mm deep using sterile blood lancet.

     N.B. The first drop of blood which contains tissue juices should be removed.
  4. Stop the blood flow by applying pressure with cotton swab at the site of puncture.

Advantages of capillary blood collection

- It is easy to perform.
- It does not require anticoagulant.
- It is the preferred specimen to make peripheral blood films.

Disadvantages of capillary blood collection

- Only small amount of blood can be obtained.
- Repeated tests require new specimens.

- Has less precision than venous blood because of variation in blood flow and dilution with interstitial fluid.
- Hemolysis can occur when blood is drawn in micro tubes.

B. Venous blood collection

This procedure is carried out when large quantities of blood is required. For routine laboratory tests, 2 ml to 10 ml of blood is usually sufficient.

- **Sites of Puncture**

In adults, the veins that are generally used for veinipuncture are veins of the fore arm, wrist or ankle.

The veins in the antecubital fossa of the forearm are the most practically convenient sites for venous blood collection for the following reasons:

- they are larger than veins of the wrist or ankle.
- they are easily located.
- they are easily palpated in most people.

In infants and children, venipuncture is sometimes difficult due to small size of the veins and problems in controlling the patient while collecting the blood specimen. However, Jugular vein in the neck region and the femoral vein in the inguinal area are the preferred sites for collection of blood specimen.

- **Materials required**

1. 70% alcohol or similar antiseptic.
2. Tourniquet.
3. Gauze pads.
4. Dry cotton.
5. Sterile needles and syringes.
6. Anticoagulant (EDTA)
7. Test tubes.
8. Rubber gloves.

- **Procedure**

1. Identify the patient and allow him/her to sit in a suitable position.
2. A tourniquet is placed and tightened on the upper arm (above the bend of the elbow). It is important to reduce venous blood flow in the area, enlarge the veins and make them prominent and palpable
3. The patient is asked to make a fist.
4. The puncture site is cleaned with 70% alcohol and dried with sterile gauze.
5. Puncture the vein with sterile needle and syringe.

N. B. Check that the bevel of the needle faces towards the direction of the graduation mark on the syringe. A 20 or 21 gauge needle is preferred in children and infants since their veins are not yet well developed.

6. Make gentle suction with the syringe in order to obtain the blood specimen. The tourniquet should be removed when blood starts entering the syringe.
7. Apply cotton swab to the punctured site and gently withdraw the needle.
8. Cover the needle with its cap, remove it from the nozzle of the syringe and slowly transfer the blood into a test tube containing anticoagulant.
9. Mix the blood with the anticoagulant properly by gentle agitation.
10. Label the tubes.

- **Advantages of venous blood collection**
  - Provides sufficient amount of blood.
  - Allows various tests to be repeated in case of accident or breakage or for checking a doubtful results.
  - Allows the performance of additional tests that may be suggested by the results of those already ordered.
  - Aliquots of the specimen may be frozen for future reference.
  - Reduces the possibility of error resulting from dilution with interstitial fluid.

- **Disadvantages of venous blood collection**
  - Long procedure and requires more preparation than capillary method.
  - Practically difficult in children and obese individuals.
  - Hemolysis must be prevented to get reliable test results.
  - Blood clot formation inside or outside the veins can occur.

3.4.4. Laboratory diagnosis of iron deficiency anemia

Iron deficiency anemia a can be diagnosed commonly using a variety of hematological tests such as hemoglobin determination, hematocrit determination, red blood cell count, examination of peripheral red cell morphology and reticulocyte count.

3.4.4.1. Hemoglobin determination

The objective of measuring hemoglobin is to estimate the oxygen carrying capacity of blood in addition to providing an assessment of red blood cell production.

- **Method**
  - Sahli Hellige (Acid Hematin)

- **Principle**

Hemoglobin in a sample of blood is converted into a colored compound known as acid hematin by treating with 0.1N HCl after allowing the diluted sample to stand for 5 minutes. Then the acid hematin is further diluted with distilled water until its color matches with the color of the standard glass.

- **Materials required**

1. Sahli hemoglobinometer with its graduated tube.
2. Sahli pipette (hemoglobin pipette).
3. Stirring glass rod.
4. Dropping pipette.
5. Absorbent cotton.
6. Distilled water.
7. 0.1 N HCl

- **Procedure**

1. Fill hemoglobin tube till 20 mark with 0.1N HCl.
2. Draw venous or capillary blood up to 0.02ml mark of the hemoglobin pipette.
3. Transfer the blood from the pipette into the graduated tube containing 0.1N HCl
4. Allow the mixture to stand for five minutes.
5. Stir the mixture of acid and blood in the tube.

6. Dilute the mixture with distilled water until the color is matched with the glass standard (comparator).
7. Read the lower level of fluid meniscus of the tube written in gm /100ml or (gm %) of blood.
    - Normal ranges
        - Men …….. 13.5 gm% - 17.5 gm%
        - Women…….. 2.0 gm% - 16.0 gm%
        - New born (both genders)…… 14.0 gm% - 20.0 gm%.
    - Sources of error
        - inappropriate in sample collection and dilution procedures.
        - faded glass standard.
        - inaccurate reading of results.

- **Reporting system**

Read and report values of hemoglobin corresponding to the graduated tube written in gm% or gm/100 ml.

3.4.4.2. Determination of hematocrit or packed cell volume

Hematocrit is the volume of red cells expressed as a percentage of the volume of whole blood in a sample of capillary or venous blood. The purpose of this test is to determine the red blood cell mass by measuring space occupied by packed red blood cells. It is the most reproducible hematological test

- **Method**
    - Micro hematocrit

This method is commonly used to determine the hematocrit values from capillaries or venous blood sample in most laboratories.

- **Principle**

When whole blood is subjected to high centrifugal force, the cells are packed and separated from their plasma. Then the volume occupied by the cells is known as the hematocrit reading.

- **Necessary materials**

1. Heparinised capillary tubes.
2. Micro hematocrit centrifuge.
3. Micro hematocrit reader.
4. Sealing wax (plasticine).

- **Procedure**

1. Fill 3/4th of the capillary tube with the blood sample.
2. Seal one end of the filled capillary tube with sealing wax.
3. Put the sealed capillary tube in the grooves of the microhematocrit centrifuge facing the sealed end away from the center of the centrifuge.
4. Centrifuge the sealed tube for five minutes at a speed of 10,000 - 15,000 revolution per minute.
5. Read the hematocrit value (packed cell volume) using micro hematocrit reader.

- **Normal values**

  - Men…… 40 % - 54%
  - Women…… 37 % - 47%
  - New born (both genders)…. 50 % - 62%

- **Sources of error**

  - Incomplete packing due to insufficient centrifugation.
  - Incorrect reading of results.
  - Using of hemolysed or clotted samples.
  - Excessive use of anticoagulant.
  - Improper filling of the tube (sampling error).
  - Failure of proper sealing.
  - Incorrect labeling.

- **Reporting system**

The results are read and expressed as the percentage of red cells in a volume of whole blood.

3.4.4.3. Red blood cell count

The red blood cell count determines the total red blood cells found in a cubic millimeters of blood. It is an important measurement in the diagnosis of anemia.

- **Principle**

A sample of blood is diluted with a diluent (Hayen's or Gawer's solution) that maintains the shape of red blood cells.

- **Necessary materials**

1. Improved Neubauer country chamber with its cover glass.
2. Thoma red cell diluting pipette.
3. Rubber sucking tube.
4. Smooth chamber cleaning cloth.
5. Diluting fluids (Hayen's or Gawer's solution).

N.B. The diluting fluid should be isotonic so that red blood cells are not hemolysed.

- **Procedure**

1. Draw blood up to 0.5 mark in the red blood cell pipette.
2. Wipe tip clean and draw diluting fluid to 101 mark of the pipette.
3. Shake for about three minutes.
4. Load the counting chamber with the diluted blood.
5. Count the cells in five red cell counting areas (four at the corner and one at central of the Improved Neubauer counting chamber) using 40X objective.

- Counting and calculation

Area of one RBC section = 0.2mm x 0.2 mm

= $\underline{0.04\ mm^2}$

Depth of the counting chamber = 0.1 mm

Volume of one RBC section = Area x Depth

= $0.04\ mm^2$ x 0.1mm

= $\underline{0.004\ mm^3}$

RBC count / mm^3 = No. of cell counted x volume correction factor x Dilution factor

Where, Volume correction factor = volume desired / Volume used

= 1/ 0.02 (50)

Dilution factor = total volume of red cell pipette / Volume of sample

= 100 / 0.5 (200)

Substituting the above figures;

RBC count / mm^3 = No. cell counted x 50 x 200

= No. cell counted x 10,000

- **Normal ranges**
  - Men…… 4.2 - 5.4 x 10^6 cells/mm^3
  - Women…….. 3.6 - 5.0 x 10^6 cells/mm^3
  - Infants (both genders)…… 4.0 - 6.0 x 10^6 cells/mm^3
  - Children (both genders)…… 4.0 - 5.0 x 10^6 cells/mm^3

- **Falsely high counts occur due to:**
  - Not wiping away the blood on the outside the tip of pipette.
  - Blood drawn above the mark in the pipette.
  - Diluting fluid not taken till the requisite mark.
  - Improper mixing.
  - Uneven distribution in the counting chamber.
  - Presence of extraneous materials (yeast, dirt, etc.)
  - Errors in calculation

- **Falsely low counts occur due to:**
  - Dilution of the blood sample with tissue due to edema or squeezing.
  - Delay in counting.
  - Blood not drawn up to the requisite mark.
  - Diluting fluid taken in excess of the requisite mark.
  - Improper mixing.
  - Uneven distribution in the counting chambers.

- Cells lost through hemolysis.
- Errors in calculation.
- Clumping of cells or coagulation of the blood.

- **Apparatus errors**
  - Pipettes with chipped tips should be avoided.
  - Markings on pipettes should be clearly visible.
  - Only optically plane cover glasses should be used.

- **Reporting system**

Count the cells in five red blood cell sections (80 small squares). Then calculate the total red cell count and report the result as cells counted per mm^3.

3.4.4.4. Peripheral red cell morphology;

The morphology of red cells in stained blood film is the basis for the laboratory diagnosis of iron deficiency anemia. It is done for examination of nucleated red cells and abnormal erythrocytes.

The abnormal erythrocytes differ from normal erythrocytes in their:

- Shape
- Size
- Colour

- **Necessary materials**

1. Clean glass slide
2. Wright's staining solution
3. Staining jar
4. Distilled water
5. Pencil (for labeling of the film).
6. Oil immersion

- **Procedure**

1. Make thin blood smear using the blood sample.
2. Allow it to air dry.
3. Flood the smear with Wright's staining solution.

4. Allow the film to air dry after washing it with water.
5. Examine the film using oil immersion power.

- **Source of error in staining procedure**
  - Too thick films
  - Prolonged staining
  - Inappropriate washing
  - Use of unclean slides
  - Use of expired staining solution

- **Abnormalities which may be seen on stained blood film.**

1. Anisocytosis (a marked variation in the size of red blood cells).

   Example: *A. Microcytes*
   - Have diameter less than normal RBCs.
   - Have area of central pallor.
   - Mostly seen in iron deficiency anemia, anemia of chronic diseases and thalasemia.

   B. Macrocytes
   - Have diameter greater than normal RBCs.
   - Commonly seen in megaloblastic anemia

2. Poikilocytosis (variation in the shape of RBCs).

   Example *A. Sickle cells*
   - Are crescent shaped RBCs.

   B. Ovalocytes
   - Are oval shaped RBCs.
   - Mostly seen in all types of animias.

3. Abnormalities in red cell hemoglobinization.

   Hypochromic red cells contain less than the normal amount of hemoglobin

4. Haemoparasites. E.g. Malaria parasite

- **Morphologic classification of anemias**

1. Normocytic normochromic anemias.
   - There are normal sized RBCs with normal hemogolobinizaiton.
   - Common in decreased RBCs production, hemorrhage, and hemolysis.
2. Microcytic hypochromic anemias.
   - There are small and incompletely hemoglobinized RBCs.
   - Commonly seen in iron deficiency anemia
3. Microcytic normochromic anemias.

3.4.4.5. Reticulocyte count

Reticuloytes are immature red cells which still contain the remains of ribo-nuclear protein. The number of reticulocytes in the peripheral blood is a fairly accurate reflection of erythropoietic activity (red blood cell production).

- **Principle**

Reticulocyte count is based on the property of ribosomal RNA to react with basic dyes such as new methylene blue or brilliant cresyl blue to form a blue precipitate of granules or filaments. More reliable results are obtained with new methylene blue than Brilliant Cresyl blue. This is because the former stains the reticulo - filamentous materials in the reticulocytes more deeply and uniformly than does the latter.

- **Necessary materials**

1. Incubator (if available)
2. Test tube
3. Clean slide
4. Anticoagulant (EDTA)
5. Pasteur pipette
6. 1% new methylne blue solution or 1% BCB staining solution.
7. Oil immersion

- **Procedure**

1. Deliver equal volume of filtered stain and capillary or venous blood in a test tube and mix well.
2. Incubate at 37° C for 10 - 30 minutes.

3. Remix the tube contents and spread one drop of the stained blood in a slide making a thin film.
4. When the slide dries, examine the film with the oil immersion power.

- **Counting of cells**

An area of the film should be chosen for the count where the staining is good and the cells are undistorted. The counting procedure should be appropriate for the number of reticulocyes estimated on the stained blood smear. When the reticulocyte number is small, high numbers of cells should be searched in order to obtain accurate count.

When the reticulocyte count is expected to be 10%, a total of 500 red blood cells should be counted considering the number of reticulocytes.

If less than 10% reticulocytes are expected, at least 1000 red blood cells should be counted.

Formula:

$$\text{Reticulocyte count (\%)} = \frac{\text{Reticulocyte number}}{\text{RBC number}} \times 100$$

- **Normal values**
  - Infants at birth …… 2.0% - 6.0%
  - Children up to 5 years …… 0.2% - 5.0%
  - Adults …… 0.2% - 2.0 %

- **Sources of error**
  - Insufficient number of cells counted.
  - Confusion of reticulocytes with other red cell inclusions.

- **Reporting system**

Calculate the cells counted and report the results in percentage.

Note: The correct diagnosis of iron deficiency anemia can be made by determining the serum iron, the transferrin iron-binding capacity, and the serum ferritin; even though it is not applicable at the health center level.

3.4.5. Quality Control

Quality control helps to make sure that when you have done a test, the result is correct. Every effort of the laboratory work must be made, by constant checking to avoid or minimize errors to produce data of firmly established reliability.

You can check whether you have done the test correctly and that the results are reproducible by repeatedly doing the tests on a sample of venous blood or by taking several finger pricks of blood and measuring each one.

Now you are through with the core and satellite modules, but there are still some activities remaining as stated below.

1. Read the task analysis of the different categories of The Health Center Team on Unit 4.
2. Do the questions of pre-test as a post-test.
   N.B. : Use a separate answer sheet.
3. Compare your answers of the pre- and post-tests with the answer keys given on Annex I and evaluate your progress.

3.5. Satellite Module for Community Health Workers

3.5.1. Introduction

3.5.1.1. Purpose and use of the module

This satellite module on anemia is prepared for community health workers. It emphasizes on the involvement of community health workers in detection, early referral and prevention of anemia. Moreover it will help in their active participation in dissemination of information about anemia to the community. However, in order for this module to be very effective, it should be translated to local language. Meanwhile, the health center team should take the responsibility of conveying the message of this module to the community health workers.

3.5.1.2. Direction for using the module

- Start by attempting all the pre-test questions; write your answers on a separate sheet of paper.
- Read the whole text of this part of the module in sequence of its appearance including the task analysis.
- Do the post test on separate sheet and compare your answer with the key.

3.5.2 Pre-test

Answer either true or false for questions 1-2.

1. Anemia can be prevented
2. Breast-feeding and timely weaning practice with iron rich food such as kele “Abesha Gomen” prevents anemia in small children.

Choose the best answer for questions 3-6.

3. Which one of the following is true about anemia?
   a. It is the reduction of white blood cell.
   b. It is the increase in red cell.
   c. It is decrease of red blood cell.
   d. All of the above.

4. The causes of anemia include:
   a. Bleeding from the body.
   b. Eating food poor in iron content.
   c. Infection by malaria and hookworm.
   d. All of the above.
5. One of the following is the presentation of anemia.
   a. Abdominal pain.
   b. Tiredness and weakness.
   c. Cough
   d. Diarrhea
6. One of the following is true in the management of anemia.
   a. Patients should take medication as prescribed from the health unit.
   b. Eating tomato and beetroot.
   c. Community health workers cannot detect presentations of anemia in patients.
   d. Taking holy water cures anemia.

3.5.3. Learning objectives

After reading this satellite module, you will be able to:

1. Define anemia
2. List causes of anemia
3. Identify the patients with presentations of anemia
4. Describe management of anemia
5. Discuss on the prevention of anemia.

3.5.4. Significance and description of anemia

Anemia is one of the major health problems all over the world. It is more common in developing countries than developed countries. Therefore, anemia is our health problem. Women of reproductive age group (15 - 49 years) and small children are commonly affected by anemia. In areas where intestinal parasitic infestation and malaria are common, the problems related to anemia are more serious.

When it occurs in children it causes poor growth and development. In pregnancy anemia can cause bad outcomes of labor. In other adults when they have anemia their work performance will decrease. Anemia due to shortage of mineral called iron

is the commonest nutritional disorder in the world. It is also common in Ethiopia due to presence of food shortage.

The above conditions tell us why we consider anemia as one of our important health problems and study it.

3.5.5. Definition, cause and disease development

3.5.5.1. Definition

Anemia is a reduction of red blood cells below the accepted amount for a healthy person.

3.5.5.2. Causes of anemia

- Bleeding from the body due to trauma and accidents and in females because of vaginal bleeding
- Malaria.
- Intestinal worms that enter through the skin such as schistosoma species and hook worm.
- Pregnancy because the growing baby shares the mothers food.
- Intake of food with low mineral (iron)
- Not starting additional food between 4 - 6 months for small babies.

3.5.5.3. Disease development process

When a person has bleeding from any site of the body or if the diet lacks the iron mineral the person may develop anemia.

3.5.6. Patient presentation

The patient with anemia will present with the following features:

- Tiredness/weakness,
- Fainting/dizziness,
- Ringing in the ears,
- Lack of appetite
- Shortness of breath,
- Paleness (loss of normal skin pigmentation this is called "Megertat" in Amharic),
- Palpitation (uncomfortable recognition of once heart beat)
- Desire to eat clay.

- Rapid heart beat (taccycardia).

Patients with the above presentations should go to the health unit for examination.

3.5.7. Management

Anemia can be treated with medications given from health unit and supplement of food rich in iron. But, the medicines should be taken for a long time. Therefore, the CHW should encourage the patients to complete their treatment and eat food rich in iron by making home visits. Moreover, if the patient's complaints are not better or if they worsen, the CHW should persuade the patients to visit the health unit again.

3.5.8. Prevention and control

- Educating the community about:
  Nutrition
  - people should be taught to take food items which have high iron content such as liver, kidney, red meat, egg, chicken, fish (if available).
  - They should also be encouraged to take leafy vegetables and fruits such as kele “Abesha Gomen”.
  - Misconceptions on feeding of pregnant women. E.g. Some communities restrict the pregnant lady from eating egg, mutton, or even advice her to eat lesser than she is used to eat. This is bad misconception and therefore, should be discouraged.
  - Promoting breast feeding and timely weaning practice (at 4 - 6 months) with iron rich foods.
  - Misconception about treating anemia by food stuffs from the community.
    e.g. People tend to eat and drink any thing which has red color like beet root rather than taking medicines. They may also go to traditional healers and use holy water.

- Encouraging pregnant ladies to have regular visits to the health unit.
- Wearing shoes to prevent penetration of worms through the skin of the foot.
- Draining stagnant water, and avoiding marshy areas and allow the spray of insecticide in their houses to prevent malaria. As well use of bed net should be encouraged.

- Proper environmental sanitation, latrine construction and use of latrine
- Identify people with presentations of anemia and send them to the health unit early

Now you are through with the module, but there are still some activities remaining as stated below.

1. Read the task analysis for community health workers on section 3.4.9
2. Do the questions of pre-test as a post-test.
   N.B. : Use a separate answer sheet.
3. Compare your answers of the pre- and post-tests with the answer keys given at the end of this unit to evaluate your progress.

3.5.9. Task analysis for community health workers

3.5.9.1 Knowledge, objectives and activities

Learning objectives	Learning activities
1. To define anemia	- Study anemia and define anemia
2. To describe causes of anemia	- Identify different causes of anemia which may coexist.
3. To Identify the presentation of anemia	- Study and recognize different presentations of patients with anemia
4. To describe management of anemia	- State that medicines should be taken from the health unit - Recognize management of anemia
5. To discuss ways of preventing anemia.	- Be able to mention different methods used for preventing and controlling anemia.

3.5.9.2. Attitude, objectives and activities

Learning objectives	Learning activities
- To believe that anemia is treatable and preventable	- Advocate that treatment cures anemia and that it is also preventable.
- To believe that anemia treatment takes long time.	- Encourage the patient to continue the treatment.
- To accept that anemia results from known causes.	- Showing interest and willingness in convincing the community about the cause and associated factors of anemia.

3.5.9.3. Practice, objectives and activities

Learning objectives	Learning activities
- To identify the patients with presentation of anemia	- Detect the presence of anemia by finding its presentations.
- To follow anemia patients	- Make home visitings to patients on treatment of anemia. - Identify patients who defaults and encourage them to continue their treatment. - Refer back to health institutions those who do not respond to treatment
- To give Health education to the community about anemia.	- Disseminate information about the causes, treatment and prevention of anemia. - Give nutritional advises to pregnant ladies and about appropriate weaning practices. Examples include egg yoke (yeenkulal asqual), carrot, peas and beans (Ater and bakela), Yehabesha Gomen and bread.

3.5.10. Answer keys for the Pre- and Post-tests for community health workers

1. True
2. True
3. C
4. D
5. B
6. A

3.6. Take Home Message for Lay Care Givers/Self Care

3.6.1. Take home message

What do you know about anemia?

Many people think that anemia is decreased volume of blood in the body, but it is a reduction of cells in the blood that carry/transport oxygen to the tissues (reduction in red blood cell concentration).

Causes of anemia:

- Due to shortage/lack of iron and other essential nutrients in the diet.
- Because of intestinal worm infestations such as hook worm.
- Diseases like malaria and schistosomiasis.
- Excessive/prolonged bleeding from any part of the body.
- Excessive menstrual bleeding.
- Chemical poisoning such as lead.

Who are affected more by anemia?

- Pregnant women.
- Young children.
- Malnourished persons.
- Infants with delayed supplemental feeding.
- Elderly due to low intake of food.
- Female adolescents.
- People with chronic infections.

Signs and symptoms of anemia?

- Paleness of inner eyelids, palms and finger nail beds.
- Tiredness.
- Fainting and dizziness.
- Anxiety.

- Shortness of breath.
- Palpitation (increased heart beat).
- Excessive desire to eat clay.
- Edema in severe cases.

Management of anemia:

- Any person showing the above signs and symptoms should go to a health institution for examination and appropriate treatment.
- Provide adequate food and foods rich in iron like liver, kidney, and green leafy vegetables like kele “Yehabesha Gomen”, beans, lentils, egg yolk.

Prevention of anemia:

- Adequate and balanced diet.
- Keeping proper environmental sanitation.
- Avoid walking bare foot (to prevent infection by hook worm).
- Early treatment of infections like hook worms, schistosomiasis, and malaria.
- Start supplemental feeding for infants at the age of 4 to 6 months.
- Antenatal follow-up for pregnant women.
- Safety precautions to prevent accidental blood loss.

Dangers of anemia:

If anemia is not detected and treated early the following problems may result.

- Poor growth and development in children, such as impaired language development and scholastic achievement.
- Excessive bleeding may lead to death.
- Decreased physical activity.
- Low birth weight.

UNIT FOUR

ROLE AND TASK ANALYS

4.1. Knowledge, objectives and learning activities

No.	Learning objectives	Learning Activities			
		HO	PHN	EHS	MLT
1.	To define anemia	- Define anemia	- Define anemia	- Define anemia.	- Define anemia
2.	To identify the etiology and pathogenesis of anemia.	- Study the various causes of anemia. - Study the mechanism of the development of anemia	- Study the different causes of anemia particularly iron deficiency anemia. - Study the mechanism of development of iron deficiency anemia.	- Study the different causes of anemia. - Study the mechanism of development of iron deficiency anemia.	- Study the different causes of anemia. - Study the mechanism of development of iron deficiency anemia
3.	To describe the Epidemiology of anemia.	- Study the prevalence iron deficiency anemia	- Identify the prevalence of iron deficiency anemia.	-Study the prevalence of iron deficiency anemia.	- Study the prevalence of iron deficiency anemia.
4.	To explain the public health significance of anemia.	- Recognize the consequences of iron deficiency anemia.	- Recognize the implication and consequences of iron deficiency anemia.	- Recognize the consequences of anemia especially iron deficiency.	- Recognize the implication, consequence of anemia especially iron deficiency anemia.
5.	To identify the clinical features of anemia.	- Learn signs and symptoms of anemia.	-Learn the subjective and objective data manifested by client with iron deficiency anemia.	- Learn the signs and symptoms of iron deficiency anemia.	-Learn the signs and symptoms of detecting iron deficiency anemia

6.	To explain the methods of detecting anemia.	- Study the techniques of history taking and physical examination in diagnosing anemia.	- Study the different diagnosing approaches of iron deficiency anemia: History, sign and symptom, Laboratory examination. - Study the common nursing diagnosis for patient with iron deficiency anemia.	- Recognize the different methods for diagnosing anemia (history, physical examination, laboratory examination).	-Study the different methods of detecting anemia. - Study the different laboratory procedures and interpretation of results.
7.	To identify the risk groups and factors of anemia.	- Know the population groups at risk of anemia - Learn the various pre-disposing factors of anemia.	- Know the population groups at risk for iron deficiency anemia. - Learn the various predisposing factors for iron deficiency anemia.	- Know the population groups at risk for anemia. - Learn the various predisposing factors for anemia.	- Know the population group at risk for anemia. - Learn the various predisposing factors.
8.	To mention the methods of diagnosing causes of anemia.	- Study the methods in - diagnosing causes of anemia. - Know the techniques of History taking and physical examination to diagnose causes of anemia. - Know the laboratory techniques used to diagnose causes of anemia.	- Recognize the diagnostic approach for the possible causes of anemia (e.g. infections).	-Recognize the different approaches to detect causes of anemia.	-Study the steps in diagnosing the causes of anemia. -Study the different laboratory technique to detect the causes of anemia.

9.	To describe the management of anemia.	- Understand the need for early detection early treatment and balanced diet in management of anemia.	-Understand the Pharmacological and nutritional management of iron deficiency anemia. - Identify the possible nursing interventions for client with iron deficiency anemia.	- Understand the need for early detection, early treatment and the need for balanced diet in management of anemia.	- Understand the need for early detection, treatment and the need for balanced diet on management of anemia.
10.	To explain the preventive and control measures of anemia.	- Study the preventive and control measures of anemia.	- Recognize the control methods of iron deficiency anemia. - Study the different preventive measures of iron deficiency anemia such as nutritional, personal hygiene etc.	- Study the different preventive measures of anemia. - Study the various environmental health actions to prevent the predisposing factors of anemia.	- Study the preventive and control measures of anemia.
11.	To recognize the interdisciplinary roles of the different health center team members in the prevention, management, and control of anemia.	-Learn the roles of other team members.	- Learn the roles of the other health center teams.	- Learn the roles of the other team members.	-Learn the roles of other health center team member.

4.2. Attitude, objectives and learning activities

No.	Learning objectives	Learning Activities			
		HO	PHN	EHS	MLT
1.	To recognize anemia is a significant public health problem in Ethiopia.	- Realize that anemia is a major health problem of Ethiopia.	- Realize that anemia is a major health problem in Ethiopia.	- Realize that anemia is a major health problem in Ethiopia	- Realize that anemia is a major health problem
2.	To appreciate the various causes of anemia.	- Give emphasis to the various causes of anemia.	-Give emphasis to the various causes of anemia.	- Give emphasis to the various causes of anemia.	- Give emphasis for the various cause of anemia.
3.	To give emphasis to detecting anemia.	- Give value to the need of detecting anemia.	- Be attentive to detect Anemia. - Advocate the need of detecting anemia.	-Recognize the need of advocacy for early detection of anemia.	-Be attentive to detect anemia - Recognize the need of advocacy for early detection of anemia.
4.	To appreciate the signs and symptoms of anemia.	- Recognize the need of advocacy for early detection of anemia. - Focus on the importance of clinical features.	- Focus on the importance of clinical features of anemia. -Give due attention to the patient's response to anemia.	- Give emphasis to inform/educate about the signs and symptoms of anemia	- Recognize the sign's symptoms of anemia.
5.	To believe that nutritional anemia is preventable.	-Get convinced that nutritional anemia can be prevented through adequate balanced diet. - Give value to health education on nutritional anemia prevention.		-Get convinced nutritional anemia can be prevented through adequate and balanced diet. - Give value to health education on nutritional anemia prevention.	- Give value for health education on nutritional anemia prevention. - Believe nutritional anemia can be prevented by adequate and balanced diet.
6.	To give attention to people at higher risk of anemia.	- Give emphasis to people at higher risk of anemia.	- Give special emphasis for the risk groups of anemia. - Believe that there are population groups of higher risk of anemia.	- Believe that there are population groups of higher risk to anemia. - Give special attention at increasing the public awareness to recognize the groups at risk.	- Believe that there are population groups of higher risk to anemia.

7.	To give value to the diagnostic techniques of anemia.	- Appreciate the importance of diagnostic techniques of anemia.	-Give respect and show concern to the client during the whole diagnostic procedure.	- Believe on the need of advocacy to increase the Public awareness that anemia can be easily diagnosed in health institutions.	- Appreciate the steps of anemia diagnosis. - Recognize the different laboratory diagnostic techniques and procedures of anemia. - Give attention for the interpretation of laboratory results.
8.	To give emphasis to appropriate management of anemia.	- Give importance to appropriate treatment regimen to raise hemoglobin level of anemia patients.	- Give value about the curability of anemia through proper medical and nursing management.	Realize the value for need of appropriate management to treat anemia. - Believe that anemia can be treated.	- Realize the value for need of appropriate management to treat anemia. - Believe that anemia can be treated.
9.	To give emphasis to prevention and control measures of anemia.	- Believe on the importance of health education to prevent anemia.	- Give more emphasis to health education as a main preventive and control measure for anemia.	- Believe that there are specific measures to prevent and control anemia. - Give attention to health education. -Recognize the environmental control measures.	- Believe that health education is the most important measure to prevent anemia.
10.	To appreciate the role of the different health center team members in prevention management and control of anemia.	- Recognize the roles played by the other team members in the management and prevention of anemia.	- Recognize the role of the health center team members in prevention, management and control of anemia.	- Recognize the role of all the health center team members in preventing, managing and controlling anemia. - Believe that health service delivery is a team approach.	- Recognize the role of all the health center team member in prevention, management and control of anemia.

4.3. Practice, Objectives and Learning Activities

No.	Learning objectives	Learning Activities			
		HO	PHN	EHT	MLT
1.	To perform appropriate diagnostic measures of anemia.	- Take appropriate history, perform proper physical examination and do hemoglobin or hematocrit determination	- Utilize the nursing process to diagnose the client's response to anemia.	- Give health education on the signs and symptoms of anemia to the community.	-Conduct appropriate lab. test
2.	To detect the different root causes of anemia using the various methods.	- Take appropriate history; perform proper physical examination and blood film, peripheral morphology, stool examination and urine analysis.	- Assess the anemic client properly for the possible causative factors.	- Give health education on the root causes of anemia, and the need for medical check-up in health institutions.	- Carry out the different laboratory methods like stool examination, blood film and peripheral blood morphology to detect the cause of anemia. - Record the result and report to the appropriate person.
3	To conduct appropriate tests to detect nutritional anemia.	- Perform/request lab. test for peripheral morphology	- Collaborate with the other health center team members in conducting diagnostic tests to anemia.	- Conduct health education to the community that nutritional anemia could be detected by laboratory means in health institutions.	- Perform peripheral blood morphology to detect iron deficiency anemia.
4.	To carry out screening to identify high risk groups for anemia.	- Perform history and physical examination on pregnant mothers and children and determine/request lab. Test for hemoglobin level routinely.	- Using the nursing process, assess and identify the risk groups for anemia.	- Give health education on the advantages of creening practices for identifying risk groups.	-Participate in screening the high risk groups of anemia.

5.	To follow the appropriate steps to diagnose anemia.	-Conduct history, physical examination and hemoglobin or hematocnit determination in that sequence.	- Follow the appropriate client assessment in diagnosing client's response for anemia.	- Give health education on the various methods that may be utilized to diagnose anemia.	_
6.	To apply proper management of anemia.	- Prescribe medicinal iron therapy and advice on proper administration of the drug. - Detect and manage underlying causes (antimalarial drugs, antihelmentics, etc). - Advice on taking iron rich diet. - Refer sever cases to where thepatient can get blood transfusion. - Proper follow up	- Carry out the appropriate nursing management for client with anemia (intervene appropriate nursing action for each nursing diagnosis).	- Teach on the nutritional and environmental management of anemia.	

7.	To conduct appropriate prevention and control measures of anemia.	- Prescribe iron supplements to high risk groups. - Health education on breast feeding and increasing dietary intake of iron. - Plan and organize preventive measures on the root causes like malaria, hook worm, etc. - Ensure community involvement in the prevention of the root causes.	- Give health education to individuals, family, and community on the prevention and control of anemia: About: . nutrition . personal hygiene and wearing shoes. . prevention of infections and infestations that cause anemia. . avoidance of chemical poisoning such as lead. . early treatment of cases.	- Give health education on: . the need of early detection and treatment of anemia. . the need for balanced nutrition. . diets rich in iron. . environmental causes and environmental management. . the need for use of sanitary toilets and shoe wearing. . the need for control of environmental pollution with toxic chemicals. . prevention of pollution of water sources by organic matter. - Demonstrate the - Construction of sanitary latrines.	- Give health education to the community about the prevention and control measure of anemia.
8.	To communicate with other members of the health center team for appropriate management /intervention.	- Coordinat the roles played by each health center team.	- Create inter collaboration with the other health center team members in management / intervention of anemia.	- Create proper links to use information on levels of anemia, prevalence in the community from the other health center team members. - Discuss with the health center team members on how to prevent and control anemia in the community.	- Participate in the management of anemia with other health center team.

UNIT FIVE

GLOSSARY

Anaphylaxis: An abnormal acute systemic hypersensitivty reaction.

Anticoagulant: A chemical substance which prevents, further clotting of blood by binding with ionic calcium that is present in the blood.

Bioavailability of iron: The proportion of iron that enters the circulation.

Clot: A gel like mass formed in whole blood composed of fibrin, platelet and erythrocytes.

Coagulation: The process by which several glycoproteins interact with polateletes to form an insoluble blood clot to stop blood loss.

Epistaxis: Bleeding from nose

Erythropoiesis: Red blood cells production

Gastrectomy: A surgical operation in which the whole or a part of the stomach is removed.

Hematuria: Blood in Urine

Heme iron: A type of dietary iron with high bioavailability i.e. high absorption; which is present in meat, fish and poultry as well as in blood products.

Hemolysis: Destruction of the red blood cells.

Hemoptysis: Expectoration of blood from the respiratory tract.

Hypochromic: Deficient in pigmentation or in hemoglobin of red blood cells.

Iron fortification: Addition of iron supplements in processed dietary components in factories.

Jaundice: Yellowish discoloration of the sclera or skin.

Koilonychia: The development of brittle spoon shaped nails.

Menometrorrhagia: Too frequent and too much menstrual bleeding.

Microcyte: An abnormally small red blood cell.

Non heme iron: A type of dietary iron in which bioavailability is determined by the presence of enhancing and inhibiting factors consumed in the same meal and found in all foods of plant origin.

Pica: Craving for dirt, soil or paint.

Reticulocyte: A young immature non-nucleated cell of the erythrocyte series formed in the bone marrow.

Splenomegaly: Enlargement of the spleen.

Stomatitis: An inflammation of the oral mucosa.

Supravital staining: Staining of unfixed cells from a living organism using a dye that does not kill the cells.

UNIT SIX

ABBREVIATIONS / ACRONYMS

BCB	-	Brilliant Cresyl Blue
Ca	-	Cancer
CHW	-	Community Health Worker
EDTA	-	Ethyl Diamine Tetra Acetic Acid
E.g.	-	Example
EHT	-	Environmental Health Technicians
Fefol	-	Ferrous folate
$FeSO_4$	-	Ferrous Sulfate
GIT	-	Gastro Intestinal Tract
gm	-	Gram
gm/100 ml	-	Gram per 100 milliliter
GUS	-	Genitourinary System
GUT	-	Genito Urinary Tract
HCl	-	Hydro Chloric Acid
HCT	-	Hematocrit
HO	-	Health Officer
Hgb	-	Hemoglobin
IM	-	Intra Muscular
LBW	-	Low Birth Weight
MLT	-	Medical Laboratory Technician
0.1NHCL	-	0.1. Normal Hydrochloric Acid
NSAID	-	Nonsterioidal Anti-inflammatory Drugs
OPD	-	Out Patient Department
PCV	-	Packed Cell Volume
PHN	-	Public Health Nurses
PUD	-	Peptic Ulcer Disease
RBC	-	Red Blood Cell
RNA	-	Ribonucleic Acid
SCD	-	Sickle Cell Disease
WBC	-	White Blood Cell
WHO	-	World Health Organization

UNIT SEVEN

BIBLIOGRAPHY

1. American journal of clinical nutrition, 1998; 68: 171-6. Printed in USA.
2. Fishbach, F., A manual of Laboratory and diagnostic tests, USA, JP Lippincot, 4th ed. 1992.
3. Africa health. UK, Vol. 23, No. 6, September 2001; PP 25 - 31.
4. Topley, E., Anemia in Rural Africa: Community support for control activities where malaria is common, 1998.
5. Brunner's Textbook of Medical Surgical Nursing, 7th ed, 1992. PP 785.
6. Brunner's Textbook of Medical Surgical Nursing, 8rh ed, 1995. PP. 782
7. Ehlers and Steel, Municipal and Rural Sanitation. 6th international student edition.1965
8. EPHA, Ethiopian journal of health development., Volume 13, Number 2, August 1999, PP 157 - 161. Ethiopia, Addis Ababa University Press.
9. EPHA, Ethiopian journal of health development, Vol. 11, Number 2, August 1997. Ethiopia, Addis Ababa University Press.
10. EPHA, Ethiopian journal of health development, Vol. 11, No. 2, August; 1999; PP 157. Ethiopia, Addis Ababa University Press.
11. EPHA, Ethiopian journal of health development, Vol. 12, No. 3, December 1998; PP 217-223. Ethiopia, Addis Ababa University Press.
12. EPHA, Ethiopian journal of health development, Vol. 13, No. 1, April 1999; PP 33. Ethiopia, Addis Ababa University Press.
13. Food and Nutrition, 1993; 2nd ed. Addis Ababa, Ethiopia.
14. Gebre-Emanuel, T., Human waste disposal. A practical approach to Environmental health, 1984; Ethiopia.
15. Hematology for students and practitioners (including practical hematology) 4th ed., 1996. New Delhi.
16. Fauci, and et.al., Harrison's principles of Internal medicine, 14th ed. Mc Graw Hill, 1998. Vol. 1, USA.
17. Introduction to Medical Laboratory Technology, 6th ed., 1985.
18. Sood,R., Lynche Raphael S. Medical Laboratory Technology, 4th ed, PP 630. W.B. Sounders Company.1983.

19. Maxy-Rosenau, Preventive medicine and public health. 14th ed. New York, USA.
20. Modern Nutrition in health and disease, 8th ed., 1994.
21. Sood, R., Medical Laboratory Technology Methods and Interpretations. 5th ed., 1999. New Delhi.
22. Nelson Textbook of Pediatrics. 15th ed.,
23. Park. K, Textbook of Preventive and Social Medicine, 15th ed. M/s Banarsidas Bhanot Publishers. 2000.India
24. Preventing and controlling iron deficiency Anemia through primary health care. 1989; Geneva.
25. EPHA, Proceedings of the seventh annual conference of the Ethiopian Public Health Association. Ethiopia, AAUP, 1996; PP. 23.
26. Teluram L.P, Second revised edition, Environmental Health and Hygiene. Vikas Publishing house PVT.LTD. 1993. Delhi.
27. The merck manual of diagnosis and therapy. 16th ed, 1992.
28. Tropical Merck Manual and international health. Vol. 5, No. 3, March 2000; PP. 214 - 221.
29. Up to date approach to the patient with anemia vol. 7, 1999.
30. Water supply. An introduction to environmental health practice, 1977; Ethiopia.

UNIT EIGHT

ANNEXES

Annex I

Answer keys to pre and post tests

PART I

1. False
2. True
3. True
4. True
5. False
6. False
7. Anemia is a reduction of the red blood cells volume or hemoglobin concentration below the level considered normally for the person's age/sex group
8. Iron deficiency
9. - Tiredness, weakness or fainting.
   - Fatigue
   - Shortness of breath
   - Exercise intolerance
   - Head ach
   - Tinnitus
   - Blurred vision
   - Nausea
   - Lack of appetite
   - Palpitation
   - Excessive desire to eat unusual substance such as clay or ice.
10. Paleness (skin and mucous membranes)
    - Edema in chronic and severe cases
    - Irritability
    - Poor growth and development in children

11. - History
    - Physical examination
    - Laboratory examination

12. - Pregnant women
    - Preterm infants
    - Lactating mothers
    - Persons with malnutrition

13. D
14. C
15. D
16. D
17. B
18. A
19. B
20. C
21. D
22. D
23. A
24. D
25. B
26. D

PART II

A. For Health Officers

1. True
2. False
3. False
4. - Dietary Management
    - Management of underlying causes
    - Medical Iron therapy
    - Blood transfusion
5. - Iron store depletion
    - Iron deficient erythropoiesis

- Iron deficiency anemia

6. - Clinical symptom
   - Reticulocyte count
   - Serial hemoglobin determination
7. E
8. A
9. B
10. B

B. For Public Health Nurses

1. False
2. False
3. - Weakness
   - Shortness of breath
   - Palpitation
   - Anorexia
   - Anxiety
   - Sore gum, tongue and lips
   - Fainting
4. Z - tract because IM iron administration will cause local pain and staining.
5. - Gastric irritation
   - Stool color change
   - Skin and teeth staining
6. C
7. D
8. C

C. For Environmental Health Technicians

1. True
2. True
3. False
4. False

5. True
6. E
7. E
8. E
9. D
10. B
11. E
12. E

D. For Medical Laboratory Technicians

1. Capillary and venous blood collection
2. - Great toe or heel for capillary blood collection
   - Jugular and femoral veins for venous blood collection.
3. D
4. A
5. C
6. D
7. E
8. D
9. D
10. D
11. D
12. E

Annex II

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