

MODULE

Iodine Deficiency Disorders

For the Ethiopian Health Center Team



**Ethiopia Public Health
Training Initiative**

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UNIT ONE

INTRODUCTION

1. Purpose and use of the Module

Iodine is essential for human health as it is a constituent of thyroid hormones, which play an important role in physical and mental development. Iodine is one of the leading causes of preventable mental retardation and brain damage in the world. Iodine deficiency not only leads to goiter and cretinism but also to a much broad spectrum of disorders. Iodine deficiency is the single most common cause of preventable mental retardation and brain damage in the world. The deficiency has an immediate effect on child learning capacity, women's health, the qualities of life in communities and economic productivity. However, there is lack of specific learning and training materials targeted to equip health workers with knowledge and skills towards the management, prevention and control of Iodine deficiency disorders.

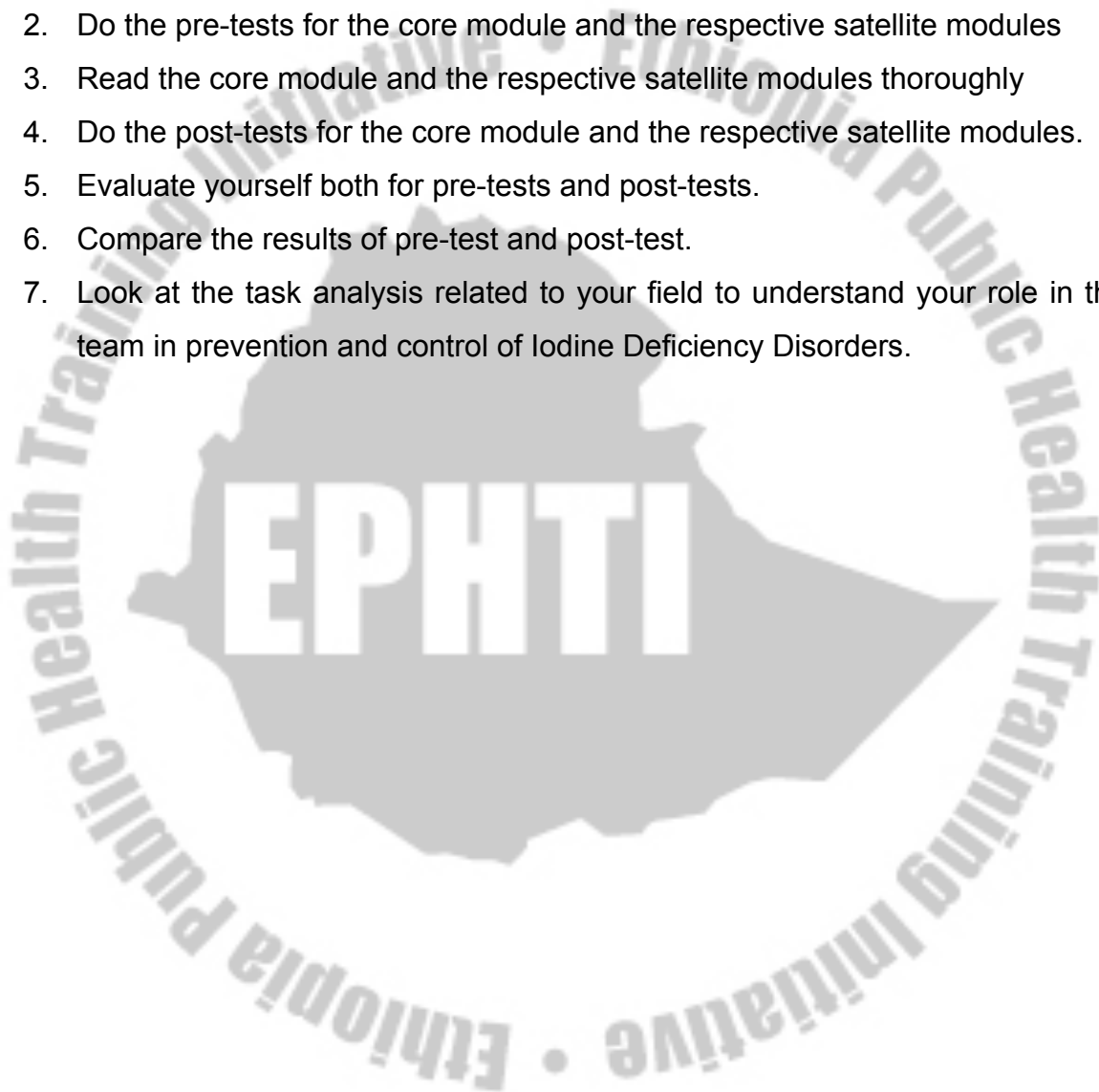
This module is prepared in accordance with the National guideline for the control and prevention of micro nutrient deficiencies of the Federal Democratic Republic of Ethiopia Ministry of Health and WHO/UNICEF/ ICCIDD guideline, Geneva.

The module is basically intended to be used for pre-service and in-service training of the health center team, health extension workers and care givers. However, it was not meant to replace standard textbooks or reference materials but can be used as a supplement to enhance the teaching and learning process.

2. Directions for Using the Module

In order to use the module appropriately, the users should follow the following directions:

1. Read the Introduction
2. Do the pre-tests for the core module and the respective satellite modules
3. Read the core module and the respective satellite modules thoroughly
4. Do the post-tests for the core module and the respective satellite modules.
5. Evaluate yourself both for pre-tests and post-tests.
6. Compare the results of pre-test and post-test.
7. Look at the task analysis related to your field to understand your role in the team in prevention and control of Iodine Deficiency Disorders.



UNIT TWO

CORE MODULE

.1 Pre-and Post Test

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

1. Which one(s) of the following is (are) types of an iodine deficiency disorder?
 - b. Hypothyroidism
 - c. Cretinism
 - d. Goiter
 - e. Mental retardation
 - f. All of the above
2. Which one of the following is true?
 - a. Eighty percent of Ethiopian population consumes Iodised salt
 - b. Goiter is a hereditary disease with family tendency
 - c. People living in low land areas are affected by IDD.
 - d. Goiter is the severest form of IDD.
 - e. Iodine deficiency affects learning ability of students
3. The distribution of IDD is not affected by
 - a. Race
 - b. Sex
 - c. Age
 - d. Geographical location
 - e. Diet
4. Which of the following is (are) consequence of insufficient iodine consumption?
 - a. Abortion and still birth
 - b. Mental retardation
 - c. Growth retardation
 - d. Goiter

- e. All of the above
5. Which of the following is incorrect?
- a. Life time iodine requirement is equivalent to one tea spoonful
 - b. Iodine deficiency is a public health problem if prevalence of goiter is greater than 5%
 - c. Iodine is required before birth
 - d. Iodine Deficiency Disorder is a threat to social and economic development of a country.
 - e. Iodine is not a major public health problem for developed countries.
6. All people living in areas of Iodine deficient soil are at risk of IDD.
- a. True
 - b. False
7. What are the two strategies to control IDD?
- a. _____
 - b. _____
8. Which one(s) of the following is (are) the causes of IDD?
- a. Low level of Iodine in the soil
 - b. Poor consumption of seafood like fish
 - c. Increased consumption of goiterogens like cabbage, cassava, etc.
 - d. All of the above
 - e. None
9. Which group of people are at greatest risk of IDD?
- a. Children
 - b. Pregnant ladies
 - c. Lactating mothers
 - d. Adolescents
 - e. All of the above
10. Which one(s) of the following is (are) an Indicator of IDD
- a. Prevalence of Goiter in school children
 - b. Thyroid size in school children
 - c. Medium urinary iodine in school age children
 - d. Neonatal TSH level

e. All of the above

11. The amount of Iodine needed to iodize a kg of salt to provide 150mcg per person per day is

- a. 10-20 mg b. 20-40 mg c. 150 mg
c. 100-150 mg d. 100 mg

12. What are the techniques for measuring iodine level in the salt?

13. When iodine intake falls below the recommended level in the human body?

- a. Thyroid gland produces high amount of thyroid stimulating hormone.
b. Hyperthyroidism will develop
c. Cretinism will occur
d. Goiter could be the complication
e. All except b

14. In which area is iodine deficiency is more common?

- a. Bank of ocean
b. Mountainous area
c. Areas having frequent flooding
d. Low land areas
e. b & c

15. The universal method for correction of IDDis:

- a. Salt iodisation
b. Iodised oil
c. Iodised water
d. Eating of foods like meat, milk, cassava, cabbage, etc.
e. Eating sea fish

16. Mention the severest consequences of iodine deficiency disorder

- a. _____
b. _____

- c. _____
- d. _____

17. Who are in the risk group for iodine deficiency disorder?

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

18. What is the recommended dietary allowance range of iodine level per person per day?

- a. <50mcg b. 50mcg-200mcg e. 90mcg-200mcg
- c. 100mcg-200mcg d. > 200mcg

19. Which types of food have sufficient iodine?

- a. Sea food b. Milk e. Bread
- c. Oil d. Salt

20. The common methods of monitoring iodinate level

- a. Saliva iodine b. Urinary iodine e. Salt iodine level
- c. Blood iodine d. b & c

21. Which chemical forms are widely used for salt iodisation?

- a. HI b. KIO₃ c. I₂ d. KI e. b & d

22. The simple test to assess efficiency of iodide cellular transport system is

- a. Urine iodine test
- b. Saliva serum iodine ratio
- c. Iodide salt concentration
- d. All
- e. None

23. Which test is used as a good marker for recent dietary iodine intake?

- a. Iodide salt concentration
- b. Saliva/serum iodine ratio
- c. TSH level

- d. Urine iodine test
- e. All

24. In case of IDD, which one is true?

- a. T₄ level decreased
- b. T₃ level increased
- c. TSH level decreased
- d. T₄ and TSH levels increased
- e. All

25. Which test is used to detect IDD?

- a. T₃, T₄ and TSH test
- b. Thyroglobulin test
- c. Urine iodine test
- d. All
- e. None

26. List the laboratory tests for IDD

27. What is the disadvantage of Rapid kit test?

.2 Significance and Brief Description of the Problem

Iodine is a trace element sparsely distributed over the surface of the earth. It is essential for the synthesis of the thyroid hormones, which are necessary for human growth and development. Inadequacy of iodine intake due to environmental deficiency of this essential element is the main causes of disorders related to insufficient iodine supply. Iodine deficiency is one of the major public health problems worldwide. The problem is more pronounced in pregnant women and young children. Hence iodine metabolism and thyroid function is closely related. The human body normally contains 20 – 30 mg of iodine with more than 75% in the thyroid gland and the rest distributed throughout the body particularly, in the lactating mammary gland, gastric mucous and blood. When people consume diet lacking sufficient iodine several important health consequences known as iodine deficiency disorder (IDD) will result.

Iodine deficiency is a major public health problem for populations throughout the world, particularly for the pregnant women and young children. It is a threat to the social and economic development of countries. The most devastating outcomes of iodine deficiency are increased perinatal mortality and mental retardation. Iodine deficiency is the greatest cause of preventable brain damage in childhood, which is the primary motivation behind the current worldwide thrive to eliminate it. .

According to WHO, UNICEF and ICCIDD the daily recommended dietary allowance (RDA) is 90, 120, 150, 200 mcg of iodine for preschool children, school children, adults and pregnant and lactating women respectively. The optimum daily requirement is more in growing children, and pregnant or lactating women. The need

for iodine increases in pregnancy because the fetus must derive its iodine requirement and reserve from the mother.

The main factor responsible for iodine deficiency is a low dietary supply of iodine. It is highly prevalent among populations living in high land areas where the soil has low iodine content as a result of past glaciations or the repeated leaching effects of snow, water and heavy rainfall. Crops grown in this soil is therefore; do not provide adequate amounts of iodine when consumed. Seafood is usually a good source because the ocean contains considerable amount of iodine. Other important factors, which also cause iodine deficiency, may include goitrogenic substances, Protein Energy Malnutrition (PEM) and vitamin A and selenium deficiencies. Moreover, poverty and general malnutrition may worsen the effects of iodine deficiency. Dietary iodine absorbed from the small intestine follows two main pathways within the body. Approximately 30% is removed by the thyroid gland and used for synthesis of thyroid hormone; the remainder is excreted. Endemic goiter does not occur when the adult iodine intake ranges upwards from 0.075 mg per day

The recommended strategy for IDD control is correcting the deficiency by increasing iodine intake through supplementation or food fortification. There are four main components to implement this strategy: 1) correction of iodine deficiency, 2) surveillance including monitoring and evaluation, 3) inter-sectorial collaboration and 4) advocacy and communication to mobilize public health authorities and educate the public. The Federal ministry of health adopted a strategy to control and prevent IDD. These are universal iodisation of salt for human and animal consumption and supplementation of iodine capsules to populations in highly endemic areas, where iodated salt is in accessible.

Commercial iodised salt contains 0.01% KIO_3 . Assuming that the average adult uses 6 – 7 gm of salts daily, the iodine intake amounts to 0.048 mg, or more than twice the normal requirement, thus is providing amply for sufficient reserves. In Ethiopia, 81% of the people are reported to use iodised salt by the Demographic Health Survey (DHS) of 2005 suggesting the salt iodisation strategy as a control measure is in good progress.

.3 Learning Objectives

At the end of this module the students/ readers will be able to:

1. Define IDD
2. Mention the major cause of IDD.
3. Explain the aetiology and pathogenesis of IDD.
4. Describe epidemiology of IDD.
5. Identify and describe the clinical manifestations of IDD.
6. List and describe the laboratory diagnostic methods of IDD.
7. Outline the principles and methods of IDD management.
8. Demonstrate the process of assessing IDD.
9. Describe the strategies for the prevention and control of IDD.
10. Recognize the diagnostic methods and tools to assess IDDs in the community.

.4 Case Study; Learning activity

Alefech was born in a mountainous village called Bezaho near to Aykel. During her childhood she was beautiful, active and loved by everybody in the village. At the age of 8 she joined the nearby elementary school and her performance was outstanding. Her teachers liked her, friends and everybody wants to play with her.

A problem happen when she was grade 6. She starts to observe a swelling over her neck, which grows steadily. She then accustomed to wear scarp in order to cover the swelling. Hell comes to her life when her friend Fitfit saw the swelling and tells to everybody in the school and neighbourhood. People start to call her '**Inkirtam**' and nobody wants to play with her .She was annoyed with her destiny and preferred to discontinue her education and stay at home.

The swelling increase in size and creates difficulty of breathing, speaking and throbbing headache. Her uncle Derese from Gondar came to visit his families and was sad about that happened to the beautiful girl in recent years. He felt guilty for not visiting them frequently and for not helping them early. He took her with him to Gondar and visited University of Gondar hospital where she was seen by a Doctor

and admitted. The swelling was removed by surgery and this day was the happiest day in her life. Alefech resumes her education and currently she is a Nurse, married and has two lovely kids.

1. What is (are) the risk factor(s) for her to acquire Goiter?
2. What abnormal clinical features she presented with?
3. What can be done at the early stages of the swelling?
4. Discuss important laboratory investigations that can be done for her?
5. Discuss the preventive methods for Goiter in a village like Bezaho.

.5 Definition

Iodine Deficiency Disorders refer to a spectrum of health consequences resulting from inadequate intake of iodine. The adverse consequences of iodine deficiency lead to a wide spectrum of problems ranging from abortion and still birth to mental and physical retardation and deafness, which collectively known as Iodine Deficiency Disorders (IDDs).

.6 Epidemiology

Iodine deficiency is the single most important cause of preventable mental retardation. Globally more than two billion (or over 38% of the population living in 130 countries) are estimated to be at risk of IDD and 260 million people in Africa are at risk and 150,000 are affected by goiter. In Ethiopia, according to a situational analysis carried out by Ministry of Health (MOH) and the /United Nations Children's Fund (UNICEF) in 1993, 78% of the total population of Ethiopia are exposed to iodine deficiency, 62% are iodine deficient, 26% have goiter and at least one in 1000 people is cretin; with about 50,000 prenatal deaths. This report claims that many health problems in the country are attributable to iodine deficiency. The most recent national survey of IDD conducted by Ethiopian Health and Nutrition Research Institute (EHNRI, 2005) indicated a high prevalence goiter rate as nearly 40% in school age children and 36% in mothers. The high level of iodine deficiency continues to be a major problem even in a recent study conducted by Ethiopian Health and Nutrition Research Institute (EHNRI) in 2005.

Other small-scale studies conducted have shown goiter rates of 50% to 95%. According to WHO a goiter rate above 5% constitutes a public health problem. A profile analysis from different studies in different countries showed that from all babies born to iodine deficient mothers, 3% will have severe mental and physical damage, 10% show moderate mental retardation and the remaining 87% show some form of mild intellectual disability.

.7 Aetiology and Pathogenesis

Iodine deficiency occurs when either iodine intake is inadequate or the presence of goitrogens (anti thyroid) in the diet is high. It is a natural ecological phenomenon that occurs in many parts of the world. The erosion of soils in areas with river due to loss of vegetation from clearing for agricultural production, over grazing by livestock and tree cutting for firewood, results in a continued and increasing loss of iodine from the soil. Groundwater and foods grown in these areas lack iodine.

When iodine intake falls below recommended levels, the thyroid gland may no longer be able to synthesize sufficient amounts of thyroid hormone. The resulting low level of thyroid hormones in the blood (hypothyroidism) is the principal factor responsible for the damage done to the developing brain and the other harmful effects known collectively as the Iodine Deficiency Disorders (IDDs). Consequently, if severe enough, iodine deficiency will impair thyroid function, resulting in a lower metabolic rate, growth retardation and brain damage. The long-term consequence is irreversible mental retardation

.8 Clinical Features (Signs and Symptoms)

Clinical features of IDD in general have a wide spectrum according to age of the individual. This spectrum of IDD is as follows:

- **Fetus**

- Abortion
- Still birth
- Endemic cretinism
- **Neonate**
 - Neonatal goiter
 - Neonatal hypothyroidism
 - Endemic mental retardation
- **Child and adolescent**
 - Goiter
 - Impaired mental development and function
 - Hypothyroidism
 - Retarded physical development
- **Adult**
 - Hypothyroidism
 - Impaired mental function

Most important consequences of the spectrum of IDD are:

- Goiter
- Mental retardation
- Hypothyroidism
- Cretinism
- Increased morbidity and mortality of infants and neonates

All consequences of iodine deficiency stem from associated hypothyroidism

i. Goiter

- Children and adolescents most commonly present with diffuse goiters, while adults have nodular goiter.
- More common in girls than in boys.
- Iodine deficient goiter for many subjects is a cosmetic concern
- In some, particularly, older adults goiter may be large enough to cause compression of trachea or oesophagus.
- The size of enlarged palpable goiter indicates the degree of longstanding iodine deficiency

- Based on thyroid size and degree of goiter WHO grades goiter in three stages/grades as follows:
 - Grade 0 - No palpable or visible goiter
 - Grade 1 - A goiter that is palpable but not visible when the neck is in the normal position
 - Grade 2 - A swelling in the neck that is visible when the neck is in a normal position

N.B: - An enlarged thyroid (Goiter) may have normal, decreased or increased function. (Euthyroid, Hypothyroid, Hyperthyroid).

ii. Hypothyroidism

- Manifestation may occur at different age groups
- Rarely recognized in the new born since the signs and symptoms are usually not sufficiently developed and difficult to diagnose.
- Have various manifestations particularly in children

1. Children

- Feeding difficulty and choking during feeding
- Prolonged lactation
- Sluggishness
- Large tongue with respiratory difficulties.
- Cry little, sleep much
- Constipation
- Large abdomen and umbilical hernia
- Low body Temperature
- Cold and mottled skin particularly extremities.
- Retarded physical and mental growth (3-6 month)
- Stunted, short extremities
- Widely open anterior fontanel
- Dentition is delayed
- Late in learning to sit and stand
- Hypotonic muscles

- During the critical periods of CNS development, it leads to permanent mental retardation and in its severe form called cretinism

iii. Cretinism

- Severe mental retardation and
- Other neurological defects

Divided into:

a) Neurological cretinism - characterized by

- Mental retardation
- Deaf mutism
- Gait disturbances
- Spasticity
- But not hypothyroidism

b) Myxedematous cretinism - characterized by

- Mental retardation
- Short stature
- Hypothyroidism

2. Adult: Hypothyroidism in adults, cause the following:

- Tiredness, weakness
- Feeling cold, Dry skin
- Difficult to concentrate and poor memory
- Constipation
- Weight gain with poor appetite
- Hoarse voice
- Menorrhagia
- Paresthesia
- Myxedema (putty face, hand & feet)
- Diffuse alopecia
- Bradycardia.

.9 Diagnosis

A) History, physical examination

B) Lab

- **Iodine level is best assessed by measurement of**

- Urinary iodine
- Thyroid size
- Serum T₃, T₄, TSH and Thyroglobulin
- Saliva /serum iodine ratio
 - Urinary Iodine concentration indicate current iodine nutrition
 - Thyroid size and serum thyroglobulin reflect iodine status over a period of months or years.

- ❖ **Urine Iodine**

- Urinary iodine concentrations of 100ng/l and above suggest no iodine deficiency.
- Twenty-four hour sample urine collection is difficult to obtain but it provides adequate assessment
- Iodine concentration in early morning urine (child/adult) provides an adequate assessment of iodine status
- The degree of iodine deficiency can be detected based on urinary iodine concentration. Severity of IDD can be categorized in children as indicated below:

Severity of IDD	Median Urinary Level (µg/dl)
Normal/optimal iodine intake	> = 10
Mild iodine deficiency	5.0 – 9.9
Moderate iodine deficiency	2.0 – 4.9
Severe iodine deficiency	< 2.0

- ❖ **Thyroid size**

- Sensitive marker for iodine deficiency
- Assessment by palpation is too crude (see clinical features in the core module)
- Ultrasonography gives a precisely quantifiable and easily performed measurement
- " Measurement of serum TSH, thyroid hormone (T₃, T₄) and Thyroglobulin

- Needs radioimmunoassay or ELIZA technique
- TSH and Thyroglobulin concentration increases in iodine deficiency
- T4 concentration decreases
- T3 concentration may decrease or normal
- " Other tests
- X-ray
- Shows osseous (bone) development retardation
- Some Important radiological presentations are:
- " Absent epiphysis
- " Multiple ossification center (epiphysis)
- " Large fontanels and wide sutures(skull x-ray)
- " Delayed eruption of tooth
- Other tests like thyroid radioiodine uptake can be performed but is not practical in most places.

.10Management

Management of Iodine deficiency disorder

- Treatment of Iodine deficiency disorder prevents further complication of the disease and its impact on socioeconomic effects. Correction of the deficiency dramatically improves school performance, agricultural out put and per capita income as it typically results in educable and economically productive population
- Preventing IDD is a more superior approach than treatment as there are non-reversible consequences following treatment.
- There are two components of IDD management.

A) General Medical Care

- **Correction of an iodine deficiency**
- Multi vitamins that contain iodine typically contain 150mcg of iodine for adults or more for children and lactating mother.
- Use of Iodized salt
- Alter feeds like milk, egg yolk, and fish.
- Adding iodine drops to drinking well water or injecting with iodized oil.

- **Supportive care**
- Maintain air way patent and normal breathing pattern
- Encourage activities with no restrictions as tolerated
- Maintain normal body temperature
- Relieve the patient's anxiety feeling
- Promote normal bowel habit
- Encourage the patient to take high calorie and high protein diet to improve nutritional status
- Patient education
- Manage and prevent infections and potential complications.

B) Specific Management

- **Treatment of non toxic goiters**
- **Sodium L thyroxin (L-T4)**
 - Decrease goiter size
 - But it is said to be generally not effective in adults and older children
 - Not routinely recommended for goiter patients because of deleterious effect on cardiac and bone health.
- **Potassium Iodide**
 - Like lugol's solution, SSKI (saturated solution of potassium iodide)
 - Equilibrates iodine concentration in ECF and is specifically concentrated in the thyroid gland
 - **Dose**
 - Adult
 - Lugols solution 6300mcg/gtt
 - SSKI 35,000 mcg/d po
 - Infant 50-90mcg/d po
 - 1-11 years: 90-120mcg/d po
 - Patients should be checked so that they wouldn't become thyrotoxic. Potassium iodide should not be given to toxic multi-nodular goiter patients as it worsens hyperthyroidism
- **Surgical Management**
 - Goiter for most patients is a cosmetic concern

- Thyroidectomy is indicated for patients with compressive symptoms of a large goiter.

N.B - Using iodized salt is the simplest and least expensive modality of management.

Treatment of Hypothyroidism

- The goal is to restore normal growth and development
 - L. Thyroxin
 - Is treatment of choice
 - Chemical content of iodine is 60%
 - More expensive preparation than other forms of iodine
 - TSH levels should be monitored carefully
 - Contra indication
 - ❖ hypersensitivity (Documented)
 - ❖ Uncorrected adrenal insufficiency
 - Safe in pregnancy
 - Dose
 - 6-12 months: 50-75mcg/day
 - 1-5yrs: 75-100mcg/day
 - 6-12 yrs: 100-150mcg/day
 - >12 yrs: 150mcg/day
- Adjust dose every 4-6 week to maintain TSH in the lower reference range

Follow up

- Follow with spot urine test for iodine & thyroxin
- Continuous supplementation of iodized salt or once daily multiple vitamin contains sodium iodide

Prognosis

- Cretinism is not reversible
- Large nodular goiter do not reduce in size
- After 1-2 years following discontinuation of iodine supplementation thyroid volume, prevalence of goiter, and urinary iodine levels may return.

.11 Prevention and Control of IDD

Iodine deficiency is a significant environmental problem. Iodine is essential for the synthesis of thyroid hormones and cannot be synthesized by the body. Leaching of iodine from the soil due to erosion of heavy rain, deforestation, overgrazing and clearing lead to loss of iodine from the soil and water. Subsequently the iodine content would be low in water, animal and plant products originated from such iodine deficient soils. Hence, an iodine deficient environment requires the continued addition of iodine. The following methods are intended as a major strategy:

1. Food fortification

Fortification of foods with iodine is an effective means of long-term prevention and control of many iodine deficiencies, and one that has been shown to be cost-effective in many countries.

❖ Universal salt iodization

- Iodization of salt for both human and livestock consumption is required
- Use iodized salt in the food industry to the population on a continuous and self sustaining basis

2. Supplementation

In areas with lack of transportation and small salt producers are available

- Administration of iodized oil capsule
- Direct administration of iodine solution such as Lugol's iodine at regular intervals
- Iodization of water supplies by addition of iodine solution

3. Health education

- Create awareness about the consequences of iodine deficiency disorder, specially for high risk groups (infants, pregnant and lactating women)
- Advise the people to use iodized salt for household consumption
- Educate the public to eat iodine rich food items like sea fish, kelp, etc and avoid goiterogenic foods.

4. Set surveillance technique to monitor the distribution of adequately iodized salt in the community.

STRATEGIES

The main strategies to control and eliminate iodine deficiency are:

1. Universal iodization of salt for human and animal consumption
2. Supplementation of iodine capsules to populations in highly endemic areas

1. Universal Iodization

IDD can be eliminated by daily consumption of iodized salt. All age, socio-economic, cultural, and religious groups throughout the year use salt universally. Iodized salt is both a preventive and corrective measure for iodine deficiency and is the most effective, low cost, long-term solution to this major public health problem. Iodized salt should be used on a daily basis in an iodine deficient environment and the daily requirement of iodine for adults is 150 micrograms.

The Correct Level of Iodine in Salt

Salt regulations stipulate the iodine content as either ppm (or mg/kg) of iodine or ppm (mg/mk) of KIO_3 , and it is necessary to be able to work with both formats. The KIO_3 content in the salt is the same as the iodine content times 1.68, i.e., $KIO_3 = I \times 1.68$. In Ethiopia an iodine content of 80-100 ppm is required as KIO_3 at the port of entry or at the packaging factory. Iodine required for a level of 80 mg/kg KIO_3 in one ton of salt = 80kg KIO_3 /ton salt.

2. Supplementation of Iodine Capsules

As a short-term strategy in highly endemic areas, Lipiodol (iodized oil capsules), should be distributed on a one-time basis to individuals. This will cover the recipients for one to two years until salt iodization processes are in place.

Dosage is:

- One capsule for pregnant women and children under 5
- Two capsules for women of reproductive age and children 5 to 14 years of age

SUPPORTIVE ACTIVITIES

The following activities need to be carried out to strengthen the National Iodine Deficiency Control and Prevention Program:

1. Strengthen Legislation

- Include iodized salt in food rations
- Reinforce legislation for importation and production of iodized salt
- Collaborate with neighbouring countries for the control of un-iodized salt smuggling and mutual cooperation in the production of iodized salt
- Facilitate all mechanisms and provide incentives to invite investors to invest in salt production and iodization

2. Training and advocacy

- Follow up establishment of micronutrient committees at the regional level
- Implement advocacy for universal consumption of iodized salt and demand creation
- Conduct training for health workers and laboratory technicians in all regions
- Provide training for salt producers on how to iodize salt
- Coordinate with concerned government bodies and international and nongovernmental organizations

3. Strengthen Laboratories

- Strengthen regional laboratories in order to perform tests to detect the level of iodine especially titration procedures in all regions
- Establish laboratory facilities at salt importation sites in conjunction with Quality and Standards and Customs Authorities to control iodization levels in imported salt.

MONITORING AND EVALUATION

1. Monitoring Quality of Iodated Salt

A monitoring system for IDD control and quality control mechanisms must be established. All salt should be checked for its iodine content and monitoring

procedures should be carried out on an ongoing basis as part of routine health assessments.

Frequent tests need to be performed at iodization plants to exercise timely correction of errors when they occur and monitoring should continue even after effective IDD control has been achieved.

Stability of Iodine in Salt

The required amount of iodine in iodated salt is maintained only when the following conditions are avoided.

Exposure to:

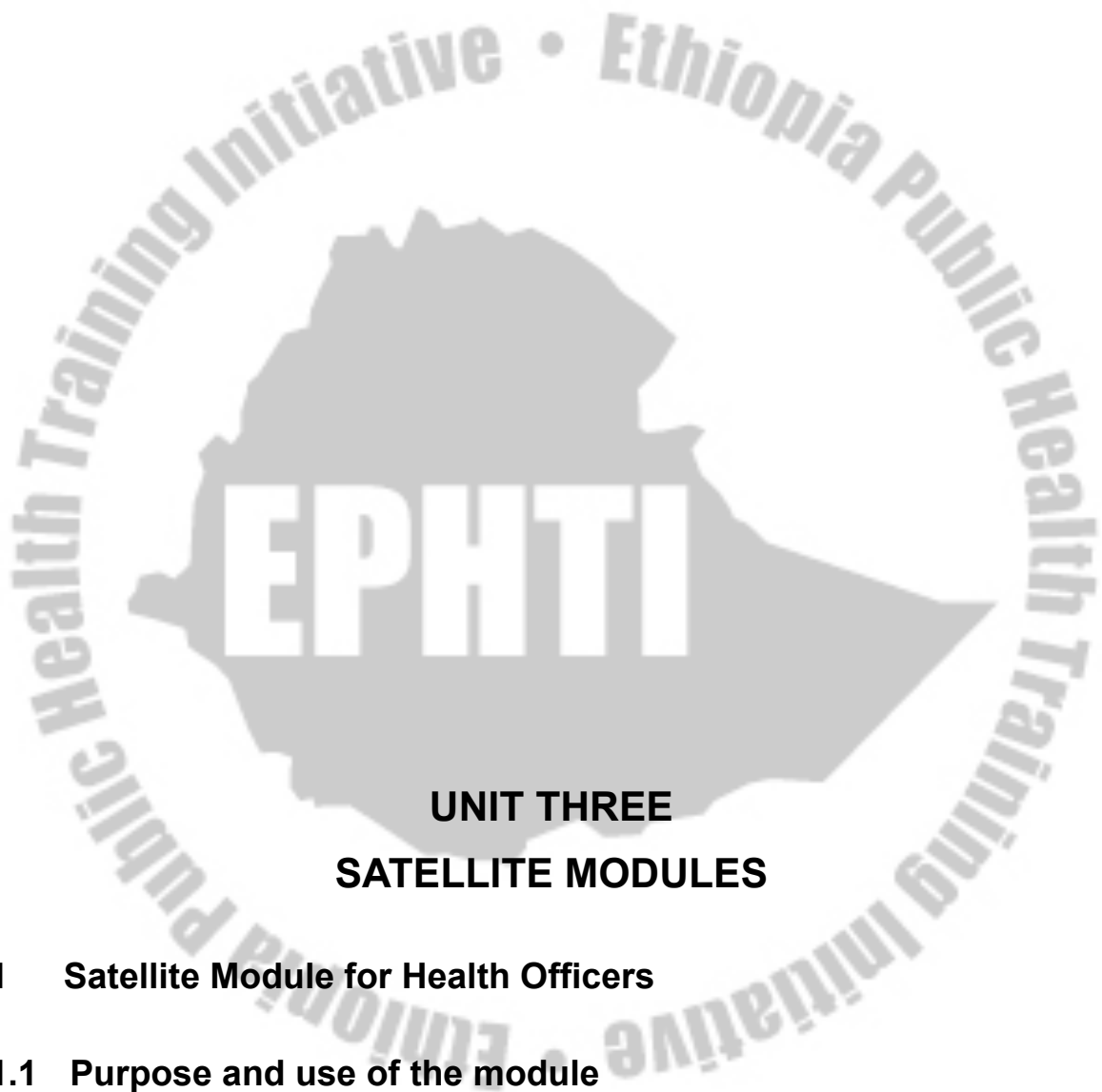
- Moisture
- Sunlight or high temperatures
- Oxidizing contaminants in particular ferric ions
- Use of ordinary containers
- Washing salt before use
- Storing more than recommended time

Potassium iodate (KIO_3) is more convenient than iodides for salt iodation. Iodates such as KIO_3 are resistant to oxidation and do not require the addition of stabilizers. Iodates are less soluble than iodides and are less prone to migrate out of the salt when the fabric of the container absorbs the moisture of the salt.

2. MONITORING IMPACT

Health information systems must be strengthened at all levels for the smooth running of the program, i.e., creation of a coordinated and computerized documentation system for data collection and compilation.

This monitoring could be done by identifying sentinel sites or through surveys to measure the biological impacts of iodization: urinary iodine excretion, estimates of thyroid hormones, and evaluation for goiter prevalence in children (TGR: Total Goiter Rate).



UNIT THREE

SATELLITE MODULES

.1 Satellite Module for Health Officers

.1.1 Purpose and use of the module

The purpose of this training module is to enable health officers to competently diagnose, treat and apply the principles of prevention and control of IDD.

.1.2 Directions for Using the Satellite Module

For a better understanding of this module, health officers are advised to follow the directions below:

- i. Do the pre-test prepared in the core module
- ii. Read the satellite module thoroughly
- iii. Read the case study and try to answer questions pertinent to it.
- iv. Evaluate yourself by doing post-test and comparing with the pre-test result

.1.3 Pre-test

Refer to the core module.

.1.4 Significance and brief description of the Problem

Refer to the core module.

.1.5 Learning objectives

For effective diagnosis, management, prevention and control of IDD, the health officer will be able to:

1. Describe the Epidemiology of IDD.
2. Describe the Etiology and Pathogenesises of IDD.
3. Identify and describe the clinical features of IDD.
4. List the laboratory diagnostic methods for IDD.
5. Describe the principles and methods of management of IDD.
6. List and describe the strategies of IDD prevention and control.

.1.6 Case study

Refer to core module

.1.7 Epidemiology

Refer to the core module

.1.8 Aetiology and pathogenesis

Refer to the core Module

.1.9 Clinical features

Refer to the core Module

.1.10 Diagnosis

Refer to the core Module

.1.11 Management

Refer to the core Module

.1.12 Prevention and control of IDD

Refer to the core Module

.2 Satellite Module for Nurses

.2.1 Introduction

A person who presents with iodine deficiency is advised to seek medical care. The symptom should not be ignored, since supplementation of iodine does not reverse cretinism or reduce the large nodular goiter. The magnitude of the problem relating to iodine deficiency in Ethiopia is immense and people of all ages can be affected but

the most devastating complication of IDD occurs when iodine is deficient during fetal and neonatal growth.

Therefore, Health workers particularly nurse in collaboration with the other professionals play a major role in diagnosing, managing and successfully controlling IDD (iodine deficiency disorder). This team approach can reduce infant and child morbidity and mortality and lead to improve physical and mental growth and development

.2.2 Purpose and use of the module

The purpose of this satellite module is to equip nursing students with the appropriate knowledge and skill to effectively identify, manage, control and prevent iodine deficiency disorders. It further helps them to identify the actual role and responsibilities in relation to the other Health center team.

.2.3 Directions for Using the Satellite Module

Before reading this satellite module

- Do the pre-test in the core module
- Read or refer to the core module thoroughly
- Continue reading the satellite module
- Evaluate your score by referring to the answer key given

.2.4 Pre test

Refer to the Core Module

.2.5 Significance and brief description of the Problem

Refer to the Core Module

.2.6 Learning Objective

Up on completion of this satellite module, the Nurse students should be able to:

- Demonstrate comprehensive assessment of iodine deficiency disorders
- Describe the pertinent Nursing diagnosis of iodine deficiency disorder (IDD)
- Provide holistic Nursing care for patients with IDD.
- Describe the essential prevention and control measure of iodine deficiency disorder.
- Apply the Nursing process as frame work for patient care

.2.7 Learning activity

Almaze is 10 years old child from Teda village 15 k.m away from Gondar town. From history, Almaze verbalized fatigue, chilliness, and constipation. She was one of the beautiful girl in the family. She said that her neck bulged out into ugly mass gradually with in a two years duration. She was also worried by her poor performance. On physical examination, the respiration was fast, her tongue protruded, and her neck enlarged. Her vital signs revealed.

- Pulse rate 48 beats/min
- Temperature 37.5 °C
- Respiratory Rate 45/min.

Answer the following questions

1. State the Nursing diagnosis for the above patient.
2. Identify the major Nursing intervention.
3. What advice would you give Almaz regarding her illness including its control and prevention strategy?

.2.8 Epidemiology

Refer to Core Module

.2.9 Aetiology and pathogenesis

Refer to Core Module

.2.10 Clinical features

Refer to Core Module

.2.11 Diagnosis

Refer to Core Module

.2.12 Management

.2.12.1 Client care using the Nursing procedure

.2.12.2 Nursing Assessment

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

Subjective data

- Weakness
- Loss of appetite
- Feeling of nervousness
- Cold intolerance
- Depression (anxiety)
- Constipation
- Muscle cramp or spasm.
- The habit of food items consumed commonly in the family.
- Has he/she lived in the endemic area or in high land area?
- Lack of awareness about the disease problem and preventive measures.

Objective data

- Vital sign - decreasing pulse rate.(bradycardia)
 - Abnormal temperature (hypothermia)
 - Respiratory assessment (respiratory difficulty or dyspnea-
- Integumentary system
 - Dry and cool skin, coarse, thin and brittle hair.
- Tongue Enlarged or protrude (macroglosia)
- Mental status- lethargy or confusion

- Nutritional or developmental assessment (growth, muscle size, arm circumference, head circumference)
- Conduct pertinent diagnostic tests.

.2.12.3Nursing Diagnosis

The Nursing diagnoses listed below are actual and potential symptomatic patient's problems.

1. In effective breathing pattern related to iodine deficiency Disorders (IDD)
2. Impaired gas exchange related to goiter (IDD).
3. Anxiety related to inability to perform activity of daily living.
4. Activity intolerance related to fatigue and weakness.
5. Altered body temperature (hypothermia)
6. 6. Constipation and diarrhea related to severe iodine deficiency disorder (IDD)
7. 7. Altered body nutrition related to IDD.
8. Knowledge deficit related to the nature of the problem and its control and preventive Measures.
9. Body image disturbance related to physical changes.
10. High risk of infection related to decrease in immunity.
11. High risk of fluid volume deficit related to hyperthyroidism.
12. Self care deficit related to fatigue secondary to hyperthyroidism.

.2.12.4Plan

Goal: the nurse should be able to:

1. Ensure Patent air way.
2. Maintains effective breathing pattern.
3. Reduce anxiety
4. Encourage activity with minimum energy consumption.

5. Maintain normal body temperature
6. Improve bowel elimination.
7. Correct fluid volume deficit.
8. Maintain adequate nutrition according to the body's requirement.
9. Improve knowledge status regarding the cause of the problem and its control and prevention measures.
10. Improve the ability to cope with symptoms and changes in physical appearance.
11. Assess absence of infection and complications with all patients with IDD/ Hypothyroidism

.2.12.5 Intervention

1. Improve respiratory status and maintain a normal breathing pattern.
 - Monitor respiratory rate, depth, pattern; and pulse rate.
 - Encourage deep breathing and coughing exercise (to prevent atelectasis and to promote adequate ventilation)
 - Maintain patent air way through suction and ventilator support.
 - Be alert and report signs of ventilatory insufficiency (such as decrease respiratory rate, respiratory distress, the signs of respiratory obstruction)
2. Encourage frequent rest and activities as tolerated.
3. Maintenance of normal body temperature.
 - Provide extra layer of clothing or extra blanket to minimize heat loss
 - Monitor patient body temperature and report any abnormalities
 - Protect from exposure to cold.
 - High fluid intake
4. Encourage the patient to express feeling of anxiety
 - Maintain comfort and reduce situations that cause anxiety e.g reduce noise
5. Return of the normal bowel behaviour.
 - Encourage high fluid intake
 - Provide high fiber diet
 - Administer laxatives or enema as ordered.
 - Monitor bowel function.

6. Attaining fluid balance.

- Maintain input and out put record.
- Administer fluid and electrolyte if needed

7. Improve nutritional status

- Assess food intake and tolerance.
- Advise high protein diet
- Monitor the nutritional status; weight, height and arm circumference
- Low calorie (in hypothyroidism)
- Feed the patient.

8. Conduct health education session on prevention and control of IDD.

N.B: In teaching patients with goiter the following should be notes:

- Symptom associated with hypothyroidism and cretinism may affect the client's learning and retention ability.
- Carefully explain the treatment regimen (dose of medication and adverse effects of the therapy)
- Advise about nutrition
 - Eat iodine rich food (milk, egg yolk, fish)
 - Avoid food and drugs with goitrogenic effect (carrots, millet, cassava, cabbage, and, excess iodine, salicylates, sulfonamides, propylthiouracil)
- The patients should be advised to notify the nurse if symptoms worsen or any adverse drug effect occurs

9. Prevention of infection and complication

- Wash hands before and after procedure.
- Be alert to early indication of infection e.g. high grade fever
- Prevention of compressive symptoms of large goiter.
- Decrease contact with infected individual and source of infection
- Apply standard infection control measures

.2.12.6Evaluation

- Maintain breathing with in normal range.
- Activity tolerance increased.

- Anxiety is reduced.
- Normal body temperature Maintained.
- Bowel behaviors normal
- Attain fluid balance and maintain skin integrity.
- Absence of complication or infection.
- Assumed responsibility for own care.
- Developed awareness about the nature of the disease, duration of therapy; prevention and control method.

.2.13 Prevention and control of IDD

Refer to Core Module

.3 Satellite Module for Medical Laboratory Technicians

.3.1 Purpose and use of the module

This module helps laboratory technology students to know their specific tasks and roles in the diagnosis and management of IDD.

.3.2 Directions for Using the Satellite Module

For a better understanding of this module the students should follow the following direction.

- Do the pre test
- Read the core module in detail
- Understand the contents of the satellite module
- Evaluate yourself by doing post test and referring to the answer keys given

.3.3 Learning objectives

After completing this module students will be able to:

- Describe how to collect, handle and process blood, urine and saliva specimens.

- List the biochemical tests used in diagnosis of IDD.
- Determine the concentration of iodine in biological specimens.
- Describe the concepts of laboratory diagnosis associated with IDD.
- Understand the procedure of iodine detection.

.3.4 Case study

W/rt Almaz is a twelve-year-old girl who lives in a high land in a usually erosion-affected area. One day the girl went to a health center for medical check up. On examination, she has weakness, loss of appetite, cold intolerance, constipation, protruding tongue and confusion. Based on protruding tongue the above information answer the following questions

1. What do you understand from this data?
2. What types of laboratory investigations are required?

.3.5 Pre test

Refer to core module

.3.6 Significance and brief description of the Problem

Refer to core module

.3.7 Epidemiology

Refer to core module

.3.8 Aetiology and pathogenesis

Refer to core module

.3.9 Clinical features

Refer to core module

.3.10 Diagnosis

.3.10.1 Laboratory tests of IDD

I. Detection of the saliva/serum iodine ratio

The simple test to assess the efficiency of the iodide cellular transport system is greatly needed in order to quantify the degree of defect, damage or inhibition of that system in patients with decreased efficiency of the iodide transport system. The saliva radio iodide/serum radio iodide ratio is used in neonates with elevated TSH and low thyroid hormones in order to confirm a congenital iodide supporter defect.

Method:

The subject ingests 50 mg of elemental iodine (4 tablets of Iodoral). For the loading test, the amount of the load excreted in the following 24 hrs urine collections is measured. Whole body sufficiency for iodine is achieved if 90% or more of the load is recovered in the 24 hrs urine collection. For the iodide transport efficiency test, 24 hr + 2 hrs following the intake of the 50 mg load, a serum sample is collected concomitant with a sample of mixed saliva. Iodide levels in the serum and saliva sample are measured.

RESULT

In a patient with an inefficient cellular iodide transport mechanism, the absorbed iodine/ iodide is rapidly excreted in the urine resulting in low serum iodide level 24 hrs following a load of 50 mg iodine/iodide.

II. Rapid test kit

Rapid kit test is a test used to detect the presence of iodine in a solution. A test is performed by adding iodine to a test tube that contains a stabilized starch based solution .One drop of the salt solution placed in a salt containing iodine produces a blue or purple color. This kit therefore is regarded as qualitative than quantitative because coloration indicates the presence of iodine but not the amount.

III. Urinary Iodine Determination

Urinary iodine (UI) analysis is a common method used for the biochemical assessment of IDD, since UI output directly reflects recent dietary iodine intake. As IDD elimination programs are put in place, the frequency distribution of UI should show an upward shift towards normal UI ranges.

There are many different UI methods available for use, including highly sophisticated automated methods and technically simple manual methods that are suitable for use in public health programs. Comparisons between some of the available methods, including technically advanced and simple procedures, have been conducted to determine the level of agreement between commonly used manual techniques, and the more advanced automated methods.

Most UI methods involve with or without the spectrophotometric measurement of iodine in the Sandell- Kolthoff reaction. This is an iodine-catalyzed reduction of yellow ceric (IV) ions to colorless cerous (III) ions by arsenic (III). A reaction, which is first, order with respect to iodine in acidic conditions. The color change that occurs during the reaction can therefore be used to determine the iodine concentration in an unknown urine specimen, when compared to a set of known iodine standards.

RECOMMENDED UI METHODS

The methods described below are recommended because they offer a number of advantages, especially for laboratories in developing countries where resource limitations often exist. Advantages include:

- Safe digestion process (ammonium persulfate is the digestion medium)
- Simple manual method
- Avoids expensive or sophisticated instrumentation
- Reagents can be made in the laboratory, so the method is not reliant on diagnostic suppliers
- Good performance characteristics
- Cost effective and sustainable

PRINCIPLE:

Most methods depend on iodide's role as a catalyst in the reduction of ceric ammonium sulfate (yellow color) to the cerous form (colorless) in the presence of

arsenious acid (the Sandell - Kolthoff reaction). A digestion or other purification step using ammonium persulfate or chloric acid is necessary before carrying out this reaction, to rid the urine of interfering contaminants.

1. Methods with ammonium persulfate

Small samples of urine (250 - 500 ml) are digested with ammonium persulfate at 90 - 110° C; arsenious acid and ceric ammonium sulfate are then added. The decrease in yellow color over a fixed time period is then measured by a spectrophotometer and plotted against a standard curve constructed with known amounts of iodine. This method requires a heating block and a spectrophotometer, which are both inexpensive instruments. About 100 -150 unknown samples can be run in a day by one experienced technician.

2. Methods with chloric acid

Chloric acid can be substituted for ammonium persulfate in the digestion step, and the colorimetric determination carried out as for method no 1. A disadvantage is the safety concern, because the chemical mixture can be explosive if residues dry in ventilating systems. Handling these chemicals in a fume cardboard is strongly recommended.

3. Other methods

A modification of Method 2 uses the redox indicator ferroin and a stopwatch instead of a spectrophotometer to measure color change. Urine is digested with chloric acid and color changes in batches of samples measured relative to standards of known iodine content. This places samples in categories (e.g., below 50µg/liter, 50- 100 µg/l, 100 - 200 µg/l, etc.) that can be adjusted to desired levels. This method is currently being adapted to ammonium persulfate digestion.

REAGENTS:

1. Ammonium persulfate solution - Dissolve 228.2g $(\text{NH}_4)_2 \text{S}_2\text{O}_8$ in 1L H_2O . Store in darkness, stable for 6 months.
2. Arsenious acid solution - In a 1 L volumetric flask, place 5 g As_2O_3 and 25g NaCl, then add 200 ml 5 N H_2SO_4 (prepared by slowly adding 140 ml concentrated H_2SO_4 to H_2O to make 100 ml). Add water to about 500 mL, heat gently with stirring to dissolve, then cool to room temperature. Dilute with H_2O to 1L Store in darkness, stable for 6 months.
3. Ceric ammonium sulfate solution - Dissolve 24 g ceric ammonium sulfate in 1 L 3.5 N H_2SO_4 (prepare by slowly adding 97 ml concentrated H_2SO_4 to H_2O to make 1000 ml). Make up at least 24 hours before use, and store in darkness stable for 6 months.
4. Iodine standard - Solution A: Dissolve 0.168 g KIO_3 in H_2O and make to 1000 ml in a volumetric flask. This solution is equivalent to $100\mu\text{g/mL}$. Store in refrigerator, stable for 6 months. Solution B: Dilute 0.5 mL to 100mL with H_2O in a volumetric flask. This solution is equivalent to $0.5\mu\text{g/mL}$. Store in refrigerator, stable for 1 month.

Procedure:

1. Allow urine specimens and standard solution B to come to room temperature
2. Mix urine specimens to suspend sediments, and pipette $250\mu\text{L}$ into 13 X 100 mm test tube.
3. Prepare standards by pipetting 0,10,20,40,60,100 μL of standard solution B in duplicate into 12 test tubes containing 250, 240,230,210, 190 and 150 μL . of H_2O respectively, to give a volume of 250 μL in each tube. This gives the standard curve with the following iodine concentrations - 0,20,40,80,120 and 200 $\mu\text{g/L}$ in case of photometric method.
5. Add 1.0 ml of ammonium persulfate solution to each tube, mix gently by agitating tube rack.
6. Heat all tubes for 1 hour at 91 - 95 °C in a dry bath incubator.
7. Cool tubes to room temperature
8. Add 3.5 ml arsenious acid solution to each tube, mix by vortex and stand for about 15 minutes.

9. add 400 μ L citric ammonium sulfate solution to each tube at 30 second time intervals, mixing each with vortex after addition
10. Exactly thirty minutes after addition of citric ammonium sulfate to the first tube, read its absorbance at 420 nm, and read successive tubes at 30 second time intervals

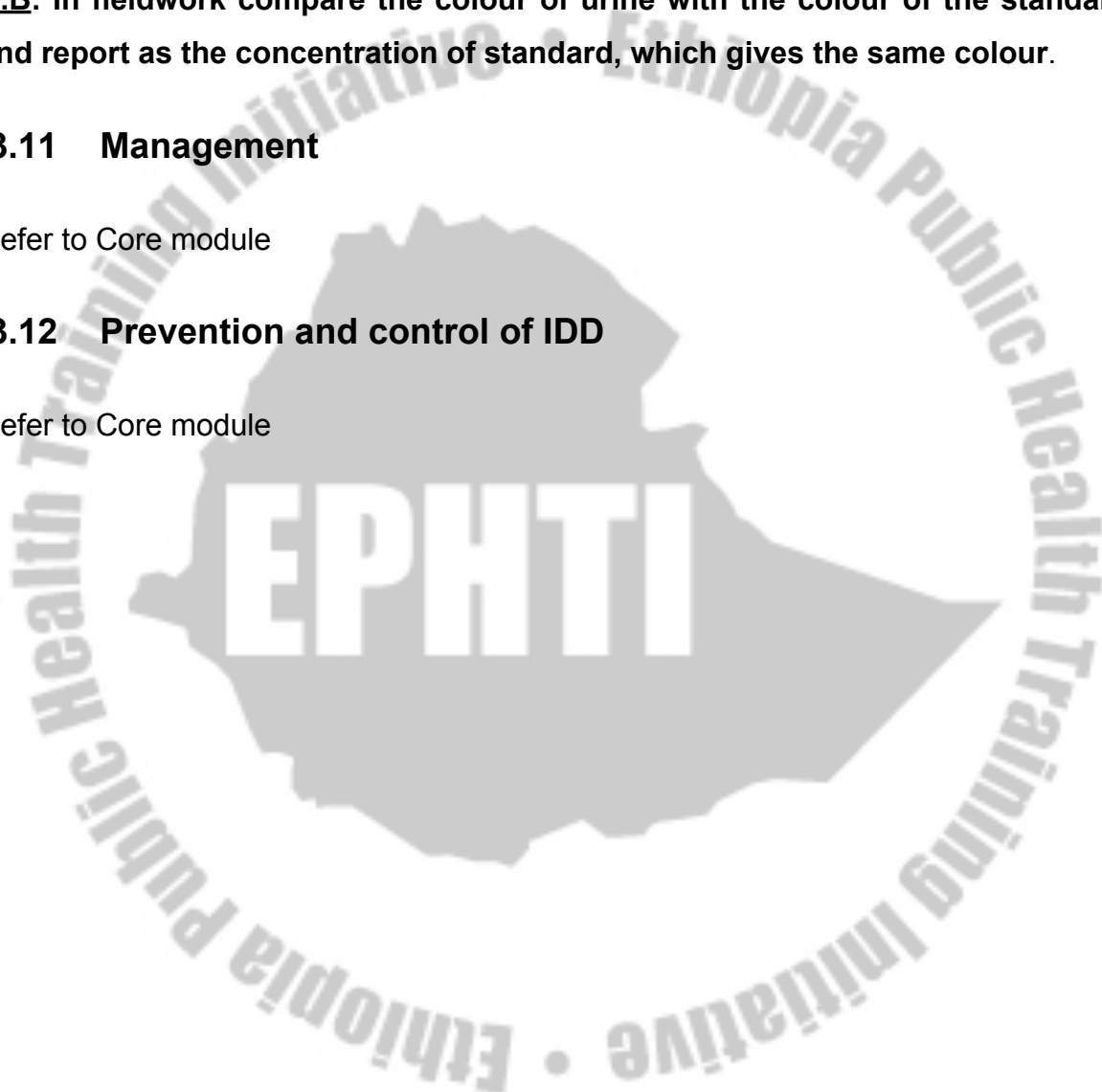
N.B: In fieldwork compare the colour of urine with the colour of the standard and report as the concentration of standard, which gives the same colour.

.3.11 Management

Refer to Core module

.3.12 Prevention and control of IDD

Refer to Core module



.4 Satellite Module for Environmental Health

.4.1 Purpose and use of the module

This satellite module could help environmental health professionals and any public health workers to have knowledge and skills in the prevention, control and monitoring strategies of iodine deficiency

The readers are advised to follow the following directions for better understanding of this module

- Do the pre-test in the core module
- Read the core module thoroughly
- Just after reading the core module and satellite module evaluate your self by doing posttest

.4.2 Pre test

Refer to the core module

.4.3 Significance and brief description of the Problem

Refer to the core module

.4.4 Learning objectives

Refer to the core module

.4.5 Epidemiology

Refer to core module

.4.6 Aetiology and pathogenesis

Refer to the core module

.4.7 Occurrence of IDD

Iodine is a chemical element. It occurs in variety of chemical forms the most important being: iodine (I^-), iodate (IO_3^-) elemental iodine (I_2). Which is found in trace amounts in function of the synthesis of thyroid hormones. Iodine that we need come from what we eat and drink. Unlike nutrients such as iron, calcium, or vitamins, iodine doesn't occur naturally in specific foods; rather it is present in the soil and water ingested through foods grown on that soil. Iodine deficiency results from an uneven distribution of iodine on the earth's crust. Ocean water contains adequate amounts of iodine, and thus persons living near the sea and those eating sea fish are more likely to be iodine sufficient but it is not accessible to every one. The breast concentrates iodine, and dairy products are usually considered as a good source only if they get enough iodine needed for the synthesis of thyroid hormone (Thyroxin).

.4.8 Effect of IDD

Iodine deficiency was once considered a minor problem, causing goiter, an unsightly but seemingly benign cosmetic blemish. However, it is now known that the effect on the developing brain is much more deadly, and constitute a threat to the social and economic development of many countries. In addition to these effects, iodine deficiency has adverse consequences for the community. Mental retardation can cover a wide range, from mild blunting of intellect to cretinism, and a large part of the population may have some intellectual impairment.

.4.9 Clinical features

Refer to the core module

.4.10 Diagnosis

Refer to the core module

.4.11 Management

Refer to the core module

.4.12 Prevention and control of IDD

The solution is relatively simple. A teaspoon of iodine is all a person requires in a lifetime, but because iodine cannot be stored for long periods by the body, tiny amounts are needed regularly. In areas of endemic iodine deficiency crops and grazing animals do not provide sufficient dietary iodine to the population. Therefore food fortification and supplementations have proven highly successful and sustainable interventions.

1. Universal salt iodization

Effective and affordable technology should be established to prevent iodine deficiency and its causes. The most important method is iodized salt and effective monitoring of consumption of iodized salt.

- Iodization of salt for both human and livestock consumption is required, recognizing that this is the most effective long range measure for correcting iodine deficiency.
- In some regions, iodization of salt may not be a practical option for the sustainable elimination of IDD, at least in the short term. This is particularly in remote areas where communications are poor or where there are numerous very small-scale salt producers.

In such areas, other options for correction of IDD may have to be considered,

Forms of iodine for salt fortification

Both potassium iodide (KI) and potassium iodate (KIO₃) extensively used for iodization of refined table salt. Most people in iodine deficient areas use unrefined salt that can be effectively supplemented with KIO₃ without added carrier agents or stabilizers. Iodate is more stable under adverse climatic conditions than iodide and

does not require stabilizers. It is also less soluble than iodide and less likely to migrate from the bag but is only sparingly soluble in water at low temperatures.

Ethiopia used KIO_3 for iodization of salt as a strategy for the prevention and control of IDD. Potassium iodate breaks down rapidly in the human body and effectively delivers iodide to the thyroid gland for the synthesis of thyroid hormone. It is not toxic, and has been approved and recommended by the Joint FAO/WHO Expert Committee on Food Additives as safe when used within the Provisional Maximum Tolerable Daily Intake (PMTDI) for iodine of 1 mg from all sources.

Recommended amount of iodine for salt iodization

WHO/UNICEF/ICCIDD recommended that, in typical circumstances, where:

- Iodine lost from salt is 20% from production site to household,
- Another 20% is lost during cooking before consumption, and
- Average salt intake is 10 g per person per day,

Hence iodine concentration in salt at the point of production should be within the range of 20-40 mg of iodine per kg of salt (i.e., 20-40 ppm of iodine) in order to provide 150 μ g of iodine per person per day.

The actual availability of iodine from iodized salt at the consumer level can Vary over a wide range as a result of:

- Variability in the amount of iodine added during the iodization process;
- Uneven distribution of iodine in the iodized salt within batches and individual bags;
- The extent of loss of iodine due to salt impurities, packaging, and environmental conditions during storage and distribution; and
- Loss of iodine due to food processing, and washing and cooking processes in the household.

Factors influencing salt iodization:

- Time
- Humidity

- Light
- Packaging material
- Quality of salt
- KIO_3 or KI

Main losses

- Refined salt retains iodine better than unrefined salt
- KIO_3 is better retained than KI in salt
- Polyethylene package retains iodine better than carton or jute package, and better than no package
- In high humidity iodine retention is lower
- In high temperature iodine retention is lower
- Light does not influence iodine retention
- Retention of KIO_3 in salt is 70-80% after 1 year in low humidity, polyethylene packages.

Advantage of salt iodization

- Every one consumes salt
- Salt production is generally centralized
- Salt iodization is easy to implement
- Salt iodization can be implemented at a reasonable cost
- color, taste and odor of salt are not affected by iodization
- Salt quality can be easily monitored at production, retail and household level

2. Food fortification

Fortification of foods with micronutrients is an effective means of long-term prevention and control of many micronutrient deficiencies, which has been shown to be cost-effective in many countries. For example, fortification of salt with iodine has effectively eliminated IDD in many countries, both industrialized and non-industrialized.

- Salt in the food industry should be adequately iodized with the required quantities to the population on a continuous and self- sustainable basis

- Administration of iodized oil capsules every 1 – 2 years most useful when iodine deficiency is severe and iodized salt unavailable

Advantage

- Given once a year
- Can target at risk group

Disadvantage

- Depends on logistics
- Foods like:
 - Bread
 - Milk
 - Sugar and oil can serve as a vehicle for iodine
- Other human exposures for iodine
 - Certain food colorings e.g.erythrosine
 - From disinfectant, such as providone iodine
 - In medicine, such as Amiodarone, used for heart failure
 - From farm animal for cleansing udder
 - Iodate used as a bread stabilizer in commercial baking

In areas with lack of transportation or where there are numerous very small-scale salt producers salt iodization may be difficult in such areas; other options for correction of IDD may have to be considered,

- Direct administration of iodine solutions, such as Lugol's iodine, at regular intervals (once a month is sufficient); or
- Oral iodine is available in various preparations, for example as Lugol lution (5% iodine, 10% potassium iodide), containing approximately 8mg iodide/drop; or as saturated solution of potassium iodide containing approximately 50mg iodide/drop.

Iodization of water supplies

Drinking water is another occasional vehicle for iodine nutrition. Some systems slowly release iodine from a porous basket (containing a concentrated iodine solution) into well water. Another approach adds an iodine solution to water in a well or flowing through a pipe. A simpler version merely adds a few drops of a concentrated solution manually to vessels containing drinking water in a school or home. If iodine (I_2) is added, it can also sterilize the water; this property is useful because many regions with iodine deficiency also have contaminated food and water.

2. Social mobilization

National level

A successful salt iodization program at the national level depends upon the implementation of a set of activities by various sectors

- Government ministries (legislation and its enforcement (justice), health, industry, agriculture, education, communication, and finance);
- Salt producers, salt importers and distributors, food manufacturers;
- Concerned civic groups; and
- Nutrition, food and medical scientists, and other key opinion makers.

Prepare channels of communication and maintain commitment and cooperation across these various groups. That is perhaps the greatest challenge to reaching the IDD elimination goal and sustaining it forever.

Salt producers and distributors are instrumental in ensuring that IDD is eliminated. Protecting consumers requires that a framework be established to ensure the distribution of adequately packaged, labeled, iodized salt. Ensuring a demand for the product and understanding the reason for insisting upon only iodized salt is a shared responsibility of the private salt marketing system, the government, and civic society. The establishment and maintenance of such an alliance and all of the associated program elements will determine the success and sustainability of the program.

Small-scale, private sector salt processors who crush and grind rock salt using manual labor and technology should be provided with technical skills and motivated to iodize their salt.

The demand creation campaign should be intensive

- Use of mass media such as television and radio.
- Made a positive image, emphasizing the healthy family, rather than the negative aspects of IDD.
- In addition to mass media, a range of other communications channels should be used to reach a variety of target audiences

Local level

Give health education with special emphasis for pregnant and lactating women's

- Women must be convinced of the importance of iodized salt for their health and the health of their fetus.
- Educate the public to understand the importance and contribution of iodized salt to eradicate iodine deficiency disorders.

Monitoring

IDD can only be eliminated once and for all if control programs are constantly maintained. In other words, iodine must be provided permanently to populations living in iodine deficient environments or where no iodized food is imported. Whether countries are deemed IDD-free, close to the goal of universal salt iodization, or still have some distance to go, the vital message is clear. All efforts must be maintained, and program must be sustained.

It is now considered that iodine deficiency is eliminated from one country when the access to iodized salt at household level is at least 90% together with a median urinary iodine of at least 100micro gram per liter and with less than 20% of the sample below 50micro gram per liter in that country.

Methods of measuring iodine in salt

Two techniques for measuring iodine levels in salt can be used:

i) Standard titration method - conducted in laboratories. A given amount of salt is treated with concentrated sulphuric acid, which liberates iodine. The free iodine is

titrated with sodium thiosulphate, using starch as indicator. The titration result provides an accurate quantitative estimate of the iodine level in the salt.

ii) Rapid-test kits/ Spot testing - These consist of bottles of starch solution (stabilized) of which one drop is placed on the salt. The intensity of the blue colour that develops indicates the approximate iodine level. It is proposed that this method be carried out routinely, for instance, at each district headquarters. This testing would normally fall under the responsibility of health inspectors whose duties include testing quality of food stuffs. Samples that are found to be sub-standard should be sent to the laboratory at a central level for checking. The test could also be carried out on salt as it is iodized and before it is packed. It could also be used to check sacks at the entry points of salt into a country.

Hence a regular system for salt monitoring must be instituted to periodically check salt-iodine levels from production to consumption. The overall responsibility for quality control within the country should be with the concerned Ministries (Ministries of Industry for production level and Ministry of Health for consumption level). The procedure for monitoring iodine levels in salt should be:

Area of monitoring

Factory level: The manufacturers' level is the most important level for monitoring. The manufacturer should conduct its own monitoring. External monitoring of production level quality control should be done by government officials (Ministry of Health or Standards Bureau) to substantiate the accuracy of the manufacturer's records.

Distributor and wholesale level: The major distributors should be sensitised and provided with rapid-test kits to check the presence of iodine in the salt before it is released for retail sale. Regular monitoring at three-monthly intervals is advisable. District or regional health departments should be notified of deficiencies.

Consumer level: The overall responsibility for quality control peripherally, inside the country, should be vested in the Ministry of Health through its Primary Health Care Department and regional/provincial and district health departments in particular, the public health inspectors at the district level. The aim is to verify that adequate concentrations of iodine are attained in salt, primarily at the consumer level; and if

the level is inadequate there, the concentration at higher levels of the distribution system (retail and wholesale) are to be verified in order to determine the level at which excessive losses are occurring.

Additional monitoring needs at intermediate levels

If the checks at the district level show consistently inadequate levels of iodization, spot checks should be made at successive higher levels to identify the level at which excessive losses occur.

Follow up

Where iodine levels are found to be consistently unsatisfactory, remedial measures must be identified and implemented, as follows:

Steps to reduce losses e.g. during transport (excessive exposure to weather)

- Reduce transport time
- Reduce exposure to light/moisture
- Better packaging

Social process model for a national IDD control program

1. **Assessment of the situation** requires baseline IDD prevalence surveys, including measurement of urinary iodine levels and an analysis of the salt situation.
2. **Dissemination of findings** implies **communication** to health professionals and the public, so that there is full understanding of the IDD problem and the potential benefits of elimination.
3. **Development of a plan of action** includes the establishment of an intersect oral task force on IDD and the formulation of a strategy document on achieving the elimination of IDD.
4. **Achieving political will** requires intensive education and lobbying of politicians and other opinion leaders.
5. **Implementation** needs the full involvement of the salt industry. Special measures, such as negotiations for monitoring and quality control of imported iodized salt, will be required. It will also be necessary to ensure that iodized salt delivery systems reach all affected populations, including the neediest. in

addition, the establishment of cooperatives for small producers, or restructuring to larger units of production, may be needed. Implementation will require training at all levels in management, salt technology, laboratory methods, and communication.

6. **Monitoring and evaluation** require the establishment of an efficient system for the collection of relevant scientific data on salt iodine content and urinary iodine levels.

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5. ACCRONYMES/ABBREVIATION

BSA	Body surface area
CNS	Central Nervous System
DHS	Demographic and Health Survey
HIV	Human immunodeficiency virus
ICCIDD	International Council for Control of IDD
IDD	Iodine Deficiency Disorders
IH	Iodine-induced hyperthyroidism
KI	Potassium Iodide
MOH	Ministry of Health
PMTDI	Provisional Maximum Tolerable Daily Intake
Ppm	Parts per million
RDA	Recommended Dietary Allowance
SSKI	Saturated Solution of Potassium iodide
T3	Triiodothyronine
T4	Thyroxine
Tg	Thyroglobulin
TGR	Total goitre rate
TSH	Thyroid Stimulating Hormone
UI	Urinary iodine
UN	United Nations

UNICEF	United Nations Children's Fund
USI	Universal Salt Iodization
WHO	World Health Organization
µg	Micrograms (millionths of a gram)

6.

Answer key

Q. No. 1. E

Q. No. 2. E

Q. No. 3. A

Q. No. 4. E

Q. No. 5. E

Q. No. 6. A

Q. No. 7. a. Distribute iodized oil capsules

b. Increase access and consumption by all families of iodized salt

Q. No. 8. D

Q. No. 9. E

Q. No. 10. E

Q. No. 11. B

Q. No. 12. a. Standard Titration Method

b. rapid test kits/spot testing

Q. No. 13. E

Q. No. 14. E

Q. No. 15. A

Q. No. 16. a. Hypothyroidism

b. Goiter

- c. Cretinism
- d. Mental retardation

- Q. No. 17.
- a. Children
 - b. Lactating mothers
 - c. Pregnant women
 - d. Adolescents

Q. No. 18. E

Q. No. 19. A

Q. No. 20. D

Q. No. 21. B

Q. No. 22. A

Q. No. 23. D

Q. No. 24. A

Q. No. 25. D

Q. No. 26.

- T3, T4 and TSH
- Serum thyroglobulin amount
- Urine iodine concentration
- Saliva/serum iodide ratio

Q. No. 27.

- It is not used to determine the exact amount of iodine.