

MODULE

Schistosomiasis

For the Ethiopian Health Center Team



Laikemariam Kassa; Anteneh Omer; Wutet Tafesse;
Tadele Taye; Fekadu Kebebew, M.D.; and Abdi Beker

Haramaya University

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Table of Contents

Acknowledgment	i
Table of contents	ii
UNIT ONE	1
Introduction	1
Direction for using the modules	2
UNIT TWO	3
Core module	3
Significance and brief description of the problem	6
Schistosomiasis	8
UNIT THREE	21
Satellite module for public health officers	21
UNIT FOUR	26
Satellite module for nurses	26
UNIT FIVE	33
Satellite module for medical laboratory technologists	33
UNIT SIX	53
Satellite module for environmental health officers	53
UNIT SEVEN	62
Satellite module for health extension workers.....	61
UNIT EIGHT	67
Take home message for care givers/self care	67
UNIT NINE	69
Role and task analysis	69
Annexes	74
References	80

UNIT ONE

INTRODUCTION

1.1. Purpose and Use of This Module

The scarcity of relevant teaching or learning materials in the higher training institutions of Ethiopia has been one of the major problems which hinder in effective and efficient task oriented and problem solving training. Preparation of such teaching materials that will fill the gap mentioned above is mandatory.

Therefore, this module is designed for the health professional students of the four disciplines all over the country to arm them with the basic knowledge, practical skill, and attitude through interactive and participatory learning.

This module will help the health center team comprised of Health Officers (HO), Public health Nurses (PHN) Medical Laboratory Technologists (MLT) and Environmental Health Officers (EHO) to correctly identify cases of Schistosomiasis and manage them effectively as team members. Thus separate satellite modules are prepared for each professional category of the health center team based on the tasks expected from them.

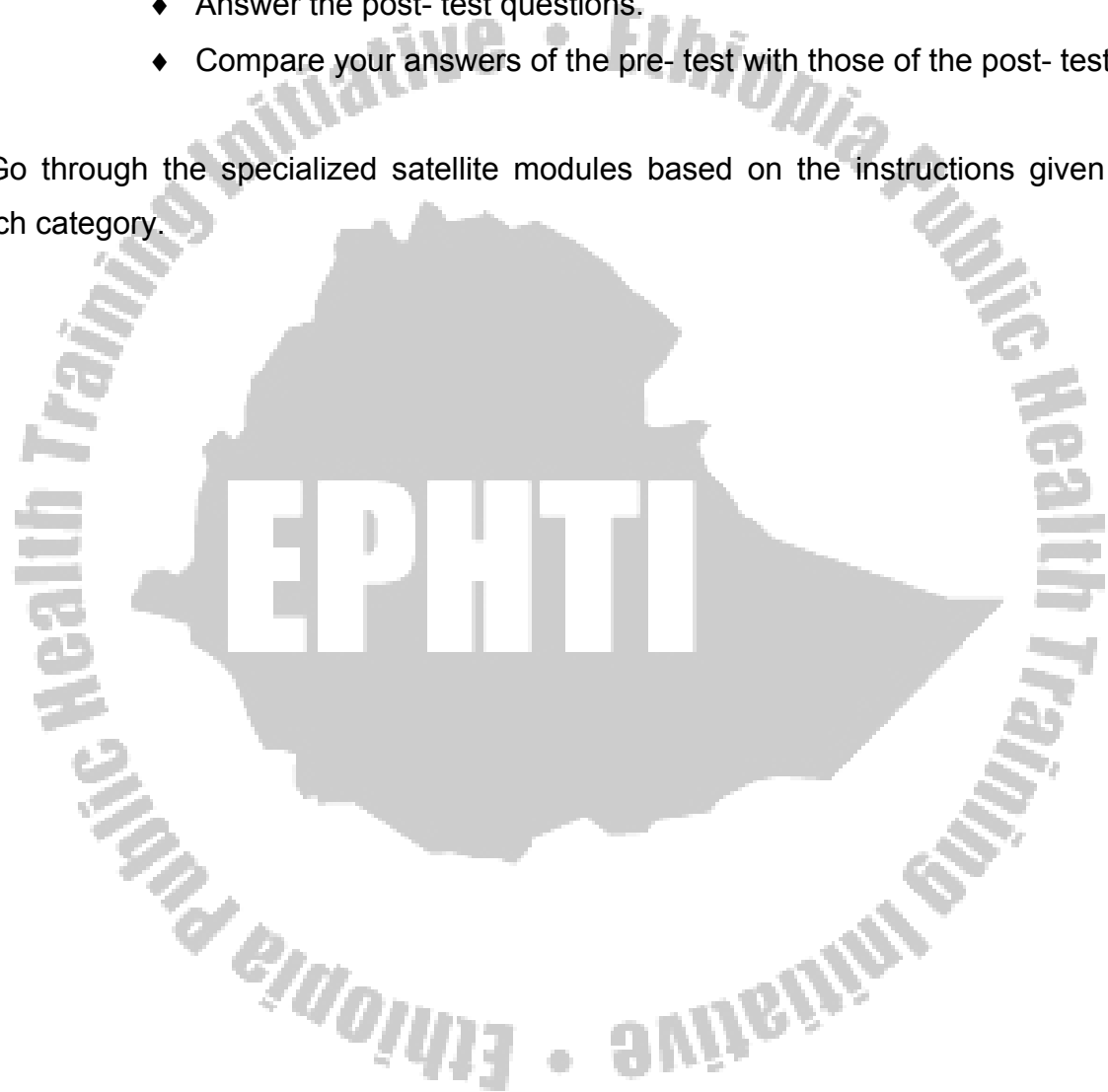
The module can also be used for in-service training of the health center team and for basic training of other health professionals, community health workers and caregivers. However, the module is not intended to replace standard textbooks or other reference materials.

1.2. Directions for Using Modules

The following steps will take you through the core module:

- ◆ Read the introduction
- ◆ Attempt to answer all pre- test questions.
- ◆ Read the core module and case study thoroughly
- ◆ Answer the post- test questions.
- ◆ Compare your answers of the pre- test with those of the post- test.

* Go through the specialized satellite modules based on the instructions given for each category.



UNIT TWO


CORE MODULE

2.1. Pretest

Choose the correct answer and write the letter of your choice on separate answer sheet

1. Which of the following are not features of intestinal schistosomiasis?
 - A. Bloody diarrhea
 - B. Ascites
 - C. Hematemesis
 - D. Hematuria
2. The most prevalent schistosoma species in Ethiopia include
 - A. *S.mansoni*
 - B. *S.haematobium*
 - C. *S.japonicum*
 - D. A and B
3. The intermediate host for *S. haematobium* belongs to the genus
 - A. *Biomphalaria*
 - B. *Bulinus*
 - C. *Oncomalaria*
 - D. All of the above
4. The infective stage of schistosoma species to human is
 - A. Egg
 - B. Miracidium
 - C. Cercaria
 - D. A and C
5. Select wrong combination
 - A. *S.mansoni* _Esophageal varices
 - B. *S. japonicum* _ Ascites
 - C. *S. haematobium* – Vesical calculi
 - D. *S. makongi* – Bladder cancer

6. Schistosomiasis is transmitted by
- A. Eating uncooked crayfish
 - B. Contact with urine of patients with schistosomiasis
 - C. Skin penetration by cercaria during swimming
 - D. Drinking un boiled water containing *Schistosoma* eggs
7. Which of the following symptoms may characterize acute schistosomiasis?
- A. Diarrhea
 - B. Abdominal cramps
 - C. Tensmus
 - D. Fever
 - E. All of the above
8. A unique characteristics of *S. mansoni* eggs on microscopic examination is the presence of a
- A. Lateral spine
 - B. Terminal spine
 - C. Operculum
 - D. Rudimentary spine
9. Which of the following methods are not important for the prevention of schistosomiasis?
- A. Proper disposal of human wastes
 - B. Snail eradication
 - C. Boiling drinking water
 - D. Treating patients early with antischistosomal drug
10. The drug of choice for *S. mansoni* is
- A. Praziquantel
 - B. Metrephonate
 - C. Oxaminoquine
 - D. A and C
11. Species of schistosoma associated with bladder stone and bladder carcinoma is
- A. *S.mansoni*

- B. *S. haematobium*
C. *S. japonicum*
D. *S. mekongi*
12. In *S. haematobium*, eggs can be recovered in the urine after infection in about
- A. 2 weeks
B. 12 weeks
C. 5 months
D. 1 year
13. The prevalence of *S. mansoni* in Ethiopia is about
- A. 5%
B. 25%
C. 50%
D. 80%
14. Schistosoma infection is more common in
- A. Rural
B. Urban
C. Displaced
D. A and C
15. In chronic Schistosomiasis diagnosis can be made by
- A. Serum antibody tests
B. Serum antigen tests
C. Rectal biopsy
D. All
- 

2.2. Significance and Brief Description of the Problem

Schistosomiasis is one of the most widely spread parasitic infections. It occurs in most countries of tropical Africa, Middle East, Central and South America, the Caribbean and the Far East. An estimated 200 million people in the world are infected with the parasite. The human schistosomes are distributed through some of the countries of the world at the lower end of the economic cycle or at least the parasites are found in relatively poor rural people. Many countries of tropic and sub-tropical Africa that already have severe economic problems are further handicapped by wide spread infection among their farmers. In some part of South America, 12% of the deaths in hospitals were due to the consequences of schistosomiasis. In Tanzania, 20% of persons in some areas have serious damage to the urinary system and can be expected to live only a few years. In Tanzania, Zanzibar, Nigeria and Egypt the pathological changes in children are likely to have their most serious effect in adolescence and early adulthood, just when these young people are likely to have completed schooling and are ready to become productive members of society. (10, 11)

Ethiopia is one of the endemic countries for both *S.mansoni* and *S.haematobium*. Human infection caused by *S.mansoni* has a wide geographical distribution in Ethiopia. The prevalence of schistosomiasis in Ethiopia, as in other developing tropical countries, is increasing due to water related projects and population movements. The transmission of the disease is closely linked with the personal habits and livelihood requiring daily and frequent contact with contaminated water. Increasing population movements in recent decades and deteriorating living conditions have increased the spread of schistosomiasis to areas where it was previously absent. Although the right snail hosts have been collected at higher altitudes, no transmission has been known to have occurred. It is believed that at this altitude the temperature is too low for development of schistosome larvae. Today, schistosomiasis causes greater morbidity and mortality than all other worm infestations. The disease is increasing in prevalence affecting about 10% of the world's population and ranking second to malaria as a cause of disabling disease and

death. Since schistosomiasis is a clearly socio-economic problem that has its roots in rural poverty, ignorance and the persistence of certain customs and habits, it is necessary that broadly based rural development program based on community participations should be integrated into the national control Programme.

2.3. Learning Objectives

After going through gthis core module, the learners will be able to:

- Describe *schistosomiasis* and identify the common etiologic agents
- Describe the epidemiology of *schistosomiasis*
- Describe the pathogenesis due to common species with their life cycle.
- Discuss the clinical features of the parasite.
- Diagnose and treat patients with *schistosomiasis*.
- Identify and manage complication of *schistosomiasis*.
- Explain the prevention and control measures for *schistosomiasis*.
- List the most common diagnostic methods of schistosomiasis.

2.4. Case Study-1

Abdi Oumer is an 18 year old young man originally from a rural village around Awash town, currently working as a daily laborer in the Lower Awash Agro-industry Plantation Farm. He visited a nearby Health Post for increasingly frequent burning sensation at the time of urination, hematuria, backache, and dull pain in the loins and suprapubic region for two months prior to presentation. He had occasional suprapubic colicky pain. He was a canal worker in the Plantation Farm for the past two years and usually takes bath and washes his clothes besides the canal.

At the Health Post, he was given pain relievers and advised to visit higher centers. He then visited Adama Health Center where he was seen by health officer. The patient gave similar history, but gave additional information that many of the workers in the Plantation Farm experience similar problem. On physical examination the health officer found only mild tenderness over the suprapubic region and in the right flank. Microscopic urinary examination was requested and revealed ova of *S. hematobium*.

The patient was sent home with four tablets of praziquantel and advised to him to inform the sick workers to seek medical follow up and to avoid contact with canal water. Later, a team of professionals was deployed from health center to visit the patient's village. The team was comprised of environmentalist, health officer and laboratory technicians.

After the team arrived in the village, members shared tasks among themselves. The public health officer tried to search for sick people and found many individuals with hematuria. He advised them to seek medical care at Adama Health Center. The Environmentalist observed that there is open field defecation & urination, no latrines or clean water supply in the village, and the villagers have the habit of regular washing after urination. On further investigation, he found snails close to the canal. The laboratory technician collected urine samples from the sick individuals and the team returned to the health center.

After returning to the health center, the team reported to the health center and medical director of Adama Hospital to arrange a meeting to discuss the findings. The team members agreed that the situation was serious and needs an immediate solution. Therefore, it was decided to deploy another team after a week for detailed investigation in the village.

Exercise

1. What are Abdi's health problems?
2. What conditions predisposes Abdi to this problem?
3. What measures should be taken by the community?

2.5. Schistosomiasis

The term schistosome or schistosoma means split body and refers to the fact that the males have a ventral groove called gynecophoric canal in which the cylindrical female resides in. They are members of the Platyhelminthes and are generally flat, flat leaf shaped worms. Members of the family show morphological and physiological

peculiarities, which distinguish them from all other trematodes. They are dioecious and live in the blood stream of warm-blooded hosts, typically in venules around the intestine or bladder, depending on the species. Although 18 species of the genus *Schistosoma* are currently recognized, the majority are parasites of animals other than humans. Most infections in humans can be accounted for by *Schistosoma haematobium*, *S.japomicum* and *S.mansoni*, together with a minor contribution from *S.intercalcatum* and *S.mekongi*. Ethiopia is one of the endemic countries for both *S.mansoni* and *S.haematobium*.

2.5.1. Schistosoma mansoni

S.mansoni causes intestinal schistosomiasis.

Epidemiology

S.mansoni is widely spread in many African countries including Sudan, Kenya, Madagascar, South America, Middle East, Brazil, and India. In Ethiopia, it is found at 2000m above sea level mainly in the south-west and western part of the country, but it was reported from all administrative regions. The major sites are small streams and fresh water lakes. The infection is more common in rural than urban communities and it is more important in developing countries, as are nearly all other parasitic diseases, not solely because of greater dependence on agricultural products produced mostly by irrigation and the fact that most people are engaged in agricultural practices. The survey on schistosomiasis carried by the Institute of Pathobiology, Addis Ababa University, in all 14 administrative regions between 1978 and 1982 indicates 15 % of the population were infected with *S .mansoni*. The national schistosomiasis survey of 1988-89 reported an overall prevalence of 25%. (1)

Life Cycle

S.mansoni is transmitted by cercariae penetrating the skin when a person is bathing, washing clothes, fishing, or engaged in agricultural work or other activities involving contact with water that has been fecally contaminated and contains the snail hosts of the parasite. The snail hosts of *S.mansoni* belong to the genus *Biomphalaria*.

Important snail intermediate hosts in Ethiopia are:

- *B.pfeifferi* –prefers a small streams and irrigation canals; the most common snail host.
- *B.sudanica*- prefers a small streams and irrigation canals

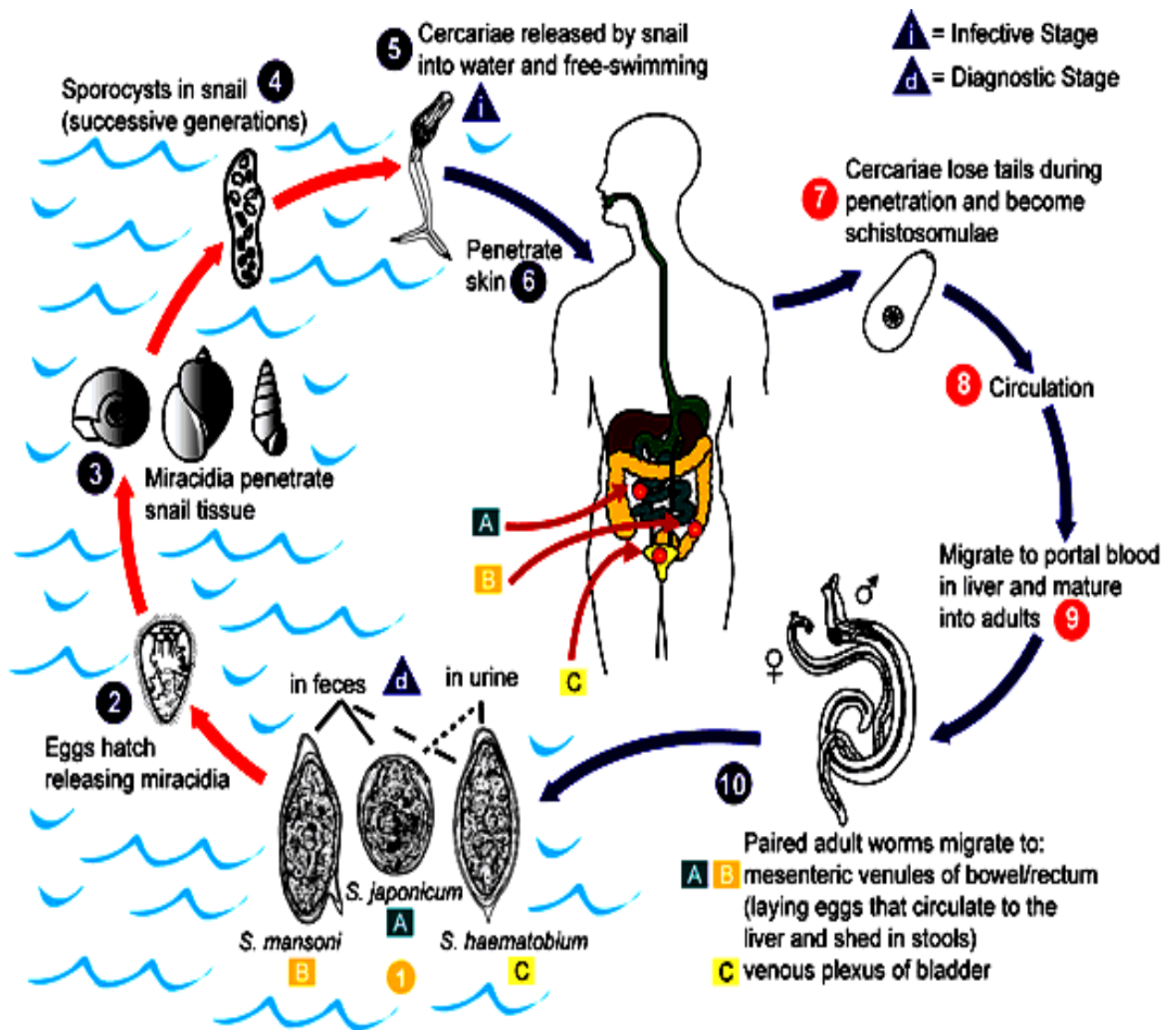


Fig.2.1 General life cycle of Schistosoma Species

Source: DPDx Laboratory Identification of Parasites of Public Health Concern, CDC, National Center

for Infectious Diseases Division of Parasitic Diseases, USA, 2003.

Eggs are eliminated with feces or urine (1). Under optimal conditions the eggs hatch and release miracidia (2), which swim and penetrate specific snail intermediate hosts (3). The stages in the snail include 2 generations of sporocysts (4) and the production of cercariae (5). Upon release from the snail, the infective cercariae swim, penetrate the skin of the human host (6), and shed their forked tail, becoming schistosomulae (7). The schistosomulae migrate through several tissues and stages to their residence in the veins (8,9). Adult worms in humans reside in the mesenteric venules in various locations, which at times seem to be specific for each species (10). For instance, *S. japonicum* is more frequently found in the superior mesenteric veins draining the small intestine (A), and *S. mansoni* occurs more often in the superior mesenteric veins draining the large intestine (B). However, both species can occupy either location, and they are capable of moving between sites, so it is not possible to state unequivocally that one species only occurs in one location. *S. haematobium* most often occurs in the venous plexus of bladder (C), but it can also be found in the rectal venules. The females (size 7 to 20 mm; males slightly smaller) deposit eggs in the small venules of the portal and perivesical systems. The eggs are moved progressively toward the lumen of the intestine (*S. mansoni* and *S. japonicum*) and of the bladder and ureters (*S. haematobium*), and are eliminated with feces or urine, respectively (1). (15)

Pathogenesis

The manifestation of schistosomiasis is dependent on the duration and intensity of infection, the location of egg deposition, and concurrent infection. In individuals from endemic areas, initial infection goes unnoticed. But in visitors to endemic areas, initial infection with schistosomes commonly results in acute febrile illness (Katayama fever or acute schistosomiasis), which is a manifestation of the immune response to the developing schistosomes and eggs. The majority of *S. mansoni* eggs penetrate through the intestinal wall and are excreted in the feces sometimes with blood and mucus (estimated egg output is 100-300 eggs per day). The eggs cause damage to the liver (granuloma formation), intestinal tract and other complications as a result of chronic inflammation caused by cellular reaction to the eggs in the tissue. Host reaction to

eggs lodged in the intestinal mucosa leads to the formation of granuloma, ulceration, and thickening of the bowel wall. Large granuloma cause colonic and rectal polyps. (2, 5)

Clinical Features

Clinical manifestations of schistosomiasis occur in three stages. During the first phase of cercarial invasion, a form of dermatitis, so called “*swimmer’s itch*” most often occurs 2 or 3 days after invasion as an itchy maculopapular rash on the affected area of the skin. Cercarial dermatitis is a self-limiting clinical entity. In the invasion stage of human schistosome cercariae dermatitis, fever, malaise, cough, and generalized allergic reactions may occur. The syndromes are induced by secretion, excretions, and breakdown products of cercariae and schistosomula. These manifestations frequently occur in tourists infected in endemic areas. In endemic communities these manifestations are rarely observed.

Acute schistosomiasis starts with worm maturation and the beginning of egg production. This stage is characterized by chills, fever, headache, dermatitis, eosinophilia, hepatosplenomegaly and generalized lymphadenopathy (known as Katayama fever). The syndrome is probably due to strong host immune response to large amounts of antigenic materials which are suddenly released from schistosome worms and eggs.

In the established stage, intense egg deposition and excretion takes place. Eggs are primarily responsible for the pathologic changes. Eggs of *S.mansoni* and *S.japonicum* break through the intestinal wall and cause bloody diarrhea.

The main clinical manifestations of chronic intestinal Schistosomiasis include intestinal and hepatosplenic disease as well as several manifestations associated with portal hypertension. During the intestinal phase, which may begin a few months after infection and may last for years, symptomatic patients characteristically have *colicky* abdominal pain and bloody diarrhea, fatigue and growth retardation in children.

The hepatosplenic phase of disease manifests early (during the first year of infection, particularly in children) with enlargement of liver due to parasite induced granulomatous lesion, which is seen in about 15-20 % of infected individuals. Moreover, portal hypertension may lead to esophageal varices, splenomegaly and ascites. Bleeding from esophageal varices may, however, be the first clinical manifestation of this phase. (5)

Diagnosis

Diagnosis of infection with members of the genus *Schistosoma* is based on the following:

1. Clinical signs and symptoms.
2. History of living in an endemic area.
3. Serological tests detecting anti-bodies or parasitic antigens.
4. Finding the characteristic eggs.

Serological tests are useful during acute phase of infection and in chronic cases in which eggs cannot be found. Serum antibody tests have a limited application because they do not differentiate between active and previous infection or re-infection. Active infection can be diagnosed by detecting circulating Schistosome antigen using a monoclonal antibody reagent.

The most common and conclusive means of diagnosing intestinal schistosomiasis is finding the characteristic eggs with lateral spine in the stool. For *S.mansoni*, fecal samples are examined by sedimentation methods designed to remove the greater portion of the fecal debris by sieving. In long standing infections, eggs may not be seen in the feces; the method then used is rectal biopsy. One or two snips of rectal mucosa are taken (the procedure is painless if properly done) and the tissue is examined microscopically while pressed between two slides. Testing viability of eggs is important in determining the stage of infection. In some long standing infections, dead eggs may be found in feces. Viability may be determined by direct examination of the eggs or inducing the eggs to hatch. (12)

2.5.2. Schistosoma haematobium (Urinary Schistosomiasis)

S.haematobium causes urinary/vesical schistosomiasis. The species contain several strains.

Epidemiology

S.haematobium is endemic in 54 countries, mainly in Africa, and eastern Mediterranean. It is also found in several Indian Ocean islands and small islands of the coast of east and West Africa. In some areas the distribution of *S.haematobium* overlaps with *S.mansoni* causing double infections.

The development of irrigation schemes and dams for hydroelectric power and flood control have greatly increased the prevalence of *S.haematobium* infections in several countries. In Ethiopia the distribution of *Schistosoma haematobium* is focal. It occurs in low land areas at altitude below 800 meters above sea level. *S.haematobium* is endemic in Awash valley, Kumruk (Western Wolega), and flood plains of Wabi Shebele (near Somali border). The prevalence varies from 5% -54% in Awash Valley, assuming infections below 5% are imported cases. In Kumruk most infections occur in the age group 5-24 years. In the age group 10-14 years, infection rate was 62.7%. The infection rate in males and females did not show statistically significant difference. Infection rate was higher in Muslims (39.9%) than Christians (18.1%). (19, 20, 21, 22, 23)

Life Cycle

S.haematobium is transmitted by cercaria (infective stage) penetrating the skin when bathing, washing clothes, fishing or engaged in agricultural work or other activities involving contact with contaminated water. The snail hosts of *S.haematobium* belong to the genus *Bulinus*.

Important snail hosts in Ethiopia

- *Bulinus abyssinicus*- in the Awash and Wabi Shebele valley
- *Bulinus africanus*- in the Sudan border

The life cycle of *S.haematobium* is similar to the life cycle of *S.mansoni* with few exceptions. *S.haematobium* flukes pair in the blood vessels of the liver and then migrate to the veins surrounding the bladder (vesical plexus). Mature flukes can also be found in the vein of the liver and rectum. The female adult worm lays eggs in the venules of the bladder. The estimated egg output of an individual infected with *S. haematobium* is 200 up to 2000 eggs per day.

Many of the eggs penetrate through the mucosa into the lumen of the bladder and are passed in the urine. Eggs can be found in the urine from about 12 weeks after infection. About 20% of the eggs remain in the wall of the bladder and become calcified. The eggs can also be found in the ureters, rectal mucosa, reproductive organs and liver.

Pathogenesis

Within 24 hours of infection an intense irritation and skin rash, referred to as "Swimmer's itch", may occur at the site of cercarial penetration. Acute schistosomiasis (Katayama fever), primarily an allergic response to developing schistosomes, rarely occurs with *S.haematobium*. When the eggs penetrate through the wall of the bladder, there will be bleeding which can be found in the urine (haematuria). Eggs trapped in the wall of the bladder and in surrounding tissues cause inflammatory reactions with the formation of granulomata. Many of the eggs die and become calcified eventually producing what are known as "Sandy patches" in the bladder. Following prolonged untreated infection and a marked cellular immune response, the ureter may become obstructed and the bladder wall thickened leading to abnormal bladder function, urinary tract infection and eventually obstructive renal disease with kidney damage. (2, 5)

Clinical Features

It is the eggs of *S.heamatobium* in the tissues not the adult flukes that stimulate host inflammatory response that result in damage to the bladder and ureters characterizing urinary schistosomiasis. *S.haematobium* infection is more commonly

seen in children than adults. Up to 80% of children infected with *S. haematobium* have dysuria, frequency of urination and haematuria. Along with the local effects of granuloma formation in the urinary bladder, obstruction of the lower end of the ureter results in hydrourether and hydronephrosis. This can be seen in 25-50% of infected children. As infection progresses, bladder granuloma undergoes fibrosis; the result is the presence of typical “Sandy patches” visible on cystoscopy. In many endemic areas, an association between squamous cell carcinoma of the bladder and *S. haematobium* infection can be observed. (2, 5)

Diagnosis

Diagnosis of *S. haematobium* infection is based on:

- A. Clinical signs and symptoms
- B. History of living in an endemic area
- C. Serological tests
- D. Finding the characteristic eggs.

During the prepatent period and in chronic cases in which eggs cannot be found serological tests are very useful. Serological tests that are applied for diagnosis of *S. mansoni* infection can be used for the diagnosis *S. haematobium*. The most common and conclusive means of diagnosis is microscopic finding of the characteristic eggs with terminal spine in urine and occasionally in feces. In long standing infections eggs may not be seen in the urine; the method then used is bladder mucosal biopsy.

Testing the viability of eggs is important in determining the stages of infection. Viability may be determined by direct examination of the eggs to look for flame cell action in the *miracidia*, inducing eggs to hatch or examining a preparation stained with *trypan blue*. (4, 12)

2.5.3. Schistosoma japonicum

S. japonicum is widely distributed in the Mainland China, part of the Philippines and Western Indonesia. The clinical features and pathology of *S. japonicum* infection are

similar to, but often more severe than, those of *S.mansoni* infection. The egg output off *S.japonicum* is higher compared to infections with other species (about 500-3500 eggs per day). Enlargement of liver and spleen is common in all age groups. *S.japonicum* infects a wide range of animals including water buffaloes, dogs, cats, cattle, pigs, sheep, goats and wild rodents. Laboratory diagnosis is based on finding characteristic eggs in the feces and rectal biopsy. The eggs are ovoid in shape and has one minute lateral spine.

2.5.4. Schistosoma intercalatum

S.intercalatum is the rarest and least pathogenic schistosome that matures in man. It causes intestinal schistosomiasis. It is found in the central and western Africa. The most common clinical symptoms are dysentery and lower abdominal pain.

The daily egg out put off *S. intercalatum* is about 300. The eggs trapped in the tissues appear to cause less post immune reaction and damage than the eggs of other Schistosomes. Highest prevalence and intensity of infection occur in the age group of 5-14 years. Laboratory diagnosis can be made by finding the characteristic egg with terminal spine.

2.5.5. Schistosoma mekongi

S.mekongi is found in Lao people's Democratic Republic, Cambodia and Thailand in the Mekong River Basin. The eggs are similar to *S.japonicum*, but slightly smaller and round. Dogs are important reservoir hosts in the transmission of *S.mekongi*.

Treatment

The treatment of schistosomiasis depends on the stage of infection and clinical presentation. Topical or systemic steroids can be for cercarial dermatitis & severe acute schistosomiasis respectively. The drug of choice for schistosomiasis is praziquantel. A single oral dose of 40 mg/Kg is generally sufficient to give cure rates of between 60-90% and reduction of 90-95% in the average number of eggs

excreted. Alternatives include oxaminoquine for *S.mansoni* & metrifonate for *S.haematobium*. However, metrifonate has been lately withdrawn from the market. (2)

Prevention and Control Methods

1. Avoiding contact with water known to contain cercariae by:
 - ◆ Providing safe water supply to the community.
 - ◆ Construct footbridges across infested rivers and streams.
 - ◆ Providing safe recreational bathing sites
2. Preventing water becoming contaminated with eggs by:
 - ◆ Health information on safe excreta disposal
 - ◆ Treating infected persons
 - ◆ Providing sanitary facilities
 - ◆ Protecting water supplies from fecal pollution by animal reservoir hosts (for *S. japonicum*)
3. Minimizing the risk of infection from new water conservation, irrigation schemes and hydroelectric development by:
 - ◆ Mass or selective treatment of labour migrants.
 - ◆ Setting settlements away from canal drains and irrigation canals and providing latrines and sufficient safe water for domestic use.
 - ◆ Lining canals with cement and keeping them free from silt and vegetation in which snails can breed
 - ◆ Filling in formerly used irrigation ditches with clean soil to bury snail hosts.
 - ◆ Varying the water levels in the system.
4. Destroying snail intermediate hosts, mainly by:
 - ◆ Using molluscides where this is affordable, feasible and will not harm important animal and plant life.
 - ◆ Removing vegetation from locally used water places, draining swamps and other measures to eradicate snail habitats.
 - ◆ Taking environmental measures to prevent seasonal flooding which results in an increase in snail numbers in transmission.

- ◆ Biological means by introducing predators like fish and insects that eat snails and *Marisa cornuarietis* snail that competes with *Biomphalaria glabrata*

5. Treating water supplies by:

- ◆ Using a chlorine disinfectant where possible
- ◆ Storing water for 48 hours to allow time for any cercariae to die.
- ◆ Using filter systems at water inputs to prevent cercariae from entering. (2,4).

6. Mass or Selective Chemotherapy

In areas with high morbidity and intensity of infection, chemotherapy can be given by health center staff in the community /school to reduce morbidity. The prevalence and intensity of infection is high in children and selective chemotherapy can be administered in schools. Prevalence and intensity of infection, drug tolerance, and impact of treatment should be monitored subsequently. Health extension workers can play key role in community mobilization and evaluation of treatment. With the introduction of new drugs such as praziquantel and existing metrifonate mass treatment has been possible in Ethiopia.

2.6. Learning Activity- 2

Mesfin Kebede is a 19-year-old freshman student at Alemaya University. A week after his arrival to the university, he visited the university clinic with complaints of colicky abdominal pain, bloody diarrhea and generalized body weakness. He was seen at the emergency outpatient department and the nurse on duty sent him with metronidazole and co-trimoxazole. He returned back to the clinic after a week with no improvement of his illness. He gave additional history that he had fever & skin rash two months back for which he visited Zeway Health Center where he was treated for malaria with three tablets with out blood examination and his fever subsided.

Family history revealed the following information: he is from Zeway town from a poor family who cannot support his schooling. Therefore, he had to engage in fishing

regularly after returning from school. He is the eldest in the family and is responsible for many activities at home including washing clothes of all family members. He usually washes clothes besides the lake.

Then the patient was examined and laboratory tests including blood, urine and stool examination were performed. White blood count was $5500/\mu\text{l}$; urine analysis was non-revealing but microscopic stool examination revealed ova of *S.mansoni*.

Exercise

Attempt the following questions

1. What is Mesfin's health problem?
2. What is the predisposing factor for the illness?
3. What should have been done to Mesfin at the first visit to the health center?
4. What public health problem exists in Zeway town & what measures should be taken?

2.7. Post-test

Do the pre test as posttest. Use a separate sheet of paper and compare your result

UNIT THREE

SATELLITE MOUDLE FOR PUBLIC HEALTH OFFICERS

3.1. Directions for Using This Module

- ◆ Before reading the satellite module try to answer all pretest questions.
- ◆ Read the satellite module
- ◆ Refer to core module when necessary
- ◆ Do the post- test questions
- ◆ Compare the results of the pretest & posttest questions with the answers at the end of the module.

3.2. Learning Objectives

After reading this satellite module the health officer will be able to:

- ◆ Identify the etiologies of schistosomiasis
- ◆ Describe the life cycle and pathogenesis of schistosomiasis
- ◆ Describe the clinical features of intestinal and urinary schistosomiasis
- ◆ Diagnose and treated patients with schistosomiasis
- ◆ Identify common complications of schistosomiasis
- ◆ Design and implement preventive and control measures of schistosomiasis
- ◆ Create public awareness about schistosomiasis through Health information.

3.3. Pre- test Questions

1. Compare and contrast the clinical features of intestinal and urinary schistosomiasis.
2. Briefly describe the pathogenesis of schistosomiasis.
3. Discuss the life cycle of schistosoma species.
4. Describe the control & preventive methods of schistosomiasis.
5. Briefly describe the complications of intestinal & urinary schistosomiasis.

3.4. Schistosoma mansoni

Pathogenesis

During the invasive stage, cercaria-associated dermatitis reflects both humoral and cell mediated dermal and subdermal inflammatory response. As the parasite approach sexual maturity and commencement of oviposition, acute schistosomiasis or Katayama fever may occur. In chronic schistosomiasis, most disease manifestations are due to cellular and humeral inflammatory response to eggs retained in the host tissue. This result in granuloma formation around parasite eggs. The granulomatous lesions may have a big size, thus inducing organomegally and obstruction. Subsequent to granulomatous response, fibrosis sets in, resulting in more permanent disease sequelae. Accumulation of antigen antibody complexes results in deposits in renal glomeruli and may cause significant kidney disease.

Ova that are carried by portal blood to the liver lodge at the presinusoidal sites where granulomas are formed, contributing to liver enlargement. After granuloma formation, periportal fibrosis (Symmers' clay pipe stem fibrosis) may occur. Presinusoidal portal blockage causes several hemodynamic changes, including portal hypertension, ascitis and esophageal varices which may result in hematemesis. (5)

Clinical Features

In general, disease manifestations of intestinal schistosomiasis occur in three stages: swimmers' itch, Katayama fever, and chronic schistosomiasis. Swimmers' itch is a form of dermatitis which starts manifesting 2 or 3 days after invasion with cercaria larvae. It appears as itchy maculopapular rash on the affected areas of the skin. It is a self-limiting clinical entity. Four to eight weeks after skin invasion acute schistosomiasis (Katayama fever) may develop. This is a serum sickness-like syndrome with fever, generalized lymphadenopathy, cough, colicky abdominal pain and diarrhea. Hepatosplenomegaly could also develop.

Chronic intestinal manifestations may manifest as colicky abdominal pain with bloody diarrhea, fatigue, and growth retardation in children. Other components of chronic intestinal schistosomiasis related to its complications are discussed below.

1. Portal hypertension

This occurs after about 10-15 years of exposure and infection. It is due to the development of periportal fibrosis. The liver may be enlarged, although in many cases it is small, firm, nodular, and the left lobe is characteristically prominent. It manifests with ascites, esophageal varices with or without bleeding, and an enlarged spleen. Patients may not have schistosoma eggs in the feces because of previous treatment and/ or attrition of adult worms without subsequent reinfection. (5)

2. Fissure, Fistula in ano and piles

Fissure in ano and piles due to *Schistosoma mansoni* infection and rectal and anal egg deposit have been observed. Fistulas frequently develop into the ischiorectal fossa, the perineum, the buttocks, or the urinary bladder.

3. Pulmonary hypertension

This is due to obliteration of pulmonary arterioles by granulomatous inflammation induced by embolized eggs lodged in the small arterioles. In the lungs, this may cause pulmonary hypertension and cor pulmonale. This clinical entity is an uncommon presentation in chronic schistosomiasis.

4. Glomerulonephritis

This may manifest with proteinuria and/or renal failure. (2, 5)

Diagnosis

Diagnosis of schistosomiasis is based on clinical signs and symptoms, history of living in or travel to endemic area, serologic tests & finding the characteristic eggs in stool. In chronic cases other diagnostic procedures can be used. Ultrasound of the liver can detect periportal fibrosis which is a very sensitive & specific diagnostic tool.

Ultrasound can also detect the presence of ascites & splenomegaly. Ascitic fluid analysis should also be made which has transudative feature in ascites secondary to portal hypertension.

3.5. Schistosoma haematobium

Pathogenesis

Similar processes that occur in intestinal schistosomiasis occur in urinary schistosomiasis. Granuloma formation in ureters obstructs urinary flow, with subsequent development of hydroureter, hydronephrosis and retrograde urinary tract infection. Similar lesions in the urinary bladder cause the protrusions of papillomatous structures in to its cavity; these may ulcerate and/or bleed. The chronic stage of infection is associated with scarring & depositions of calcium in the bladder wall. It can also predispose to squamous cell carcinoma of the bladder. (5)

Clinical Features

Clinical manifestations of *S.haematobium* include dysuria, urinary frequency and often terminal hematuria. Local effects of granuloma formation in the bladder result in obstruction in the lower end of the ureter resulting in hydroureter and hydronephrosis. Typical sandy patches and malignant lesions can be seen by cystoscopy. Symptoms of chronic cystitis may ensue due to retrograde urinary tract infection.

Diagnosis

Diagnosis of *S.haematobium* infection is based on clinical signs and symptoms, history of living in and traveling to an endemic area, serological tests, and finding the characteristic eggs with *terminal spine* in urine. Complications can be detected by cystoscopy and ultrasound.

Treatment

Treatment of schistosomiasis depends on the stage of infection and clinical presentation.

1. Cercarial dermatitis – topical steroid for relief of itching.

2. For severe acute schistosomiasis or Katayama fever systemic glucocorticosteroid can be considered.
3. Antischistosomal chemotherapy
 - ◆ Drug of choice: Praziquantel 40-60mg/kg as a single oral dose or divided in to two or three doses is sufficient.
 - ◆ Alternatives:
 - Oxaminoquine 15mg/kg single dose for *S.mansoni*
 - Metrifonet 5-15mg/kg, 3 doses given at two weeks interval for *S.haematobium*. (2, 5)
 - Artemisinin compounds used in malaria treatment are being evaluated for schistosomiasis.

Prevention and Control

1. Health education on:

- ◆ proper excreta disposal.
- ◆ avoiding contact with infected water bodies like lakes, rivers, ponds and canals.

2. Snail control:

- ◆ Physical methods
 - Periodic clearance of canals from vegetations
 - Manual removal of snails & their destruction
- ◆ Biological methods
 - Use of natural enemies to the snails as *Marisa*
- ◆ Chemical methods
 - Molluscides are applied in the canals to kill the snails. (2)

3.4. Post-test Questions

Do the pretest as a posttest. Use separate sheet of paper.

UNIT FOUR

SATELLITE MODULE FOR NURSES

4.1. Introduction

Schistosomiasis is one of the most common public health problems. It is also highly endemic parasitic disease in Ethiopia as well as many other African, Asian and South American countries. Nurses' responsibilities include prevention of the disease and promotion of health so that the community will lead a better and healthier life. It is therefore necessary that nursing students to be equipped with basic knowledge about schistosomiasis, its management and method of prevention and control. Nurses can effectively contribute in controlling schistosomiasis by utilizing various strategies of community mobilization techniques and diagnostic and management skills that their training can afford them.

4.1.1. Purpose and Use of This Module

This satellite module is an easy reference developed for nursing students and graduate nurses in the service sectors. It was developed with the aim of providing them with knowledge and skill specific to the profession regarding management, prevention, and control of schistosomiasis. This module should enable them to identify and tackle individual problems and those of the community at large. The module is also designed to provide a uniform and easy to understand reference that can help and solve the shortage of such reference materials in remote parts of this country.

4.1.2. Directions for Using the Module

- ◆ First complete the pre-test before reading this satellite module to check your existing knowledge
- ◆ Read the learning objectives
- ◆ Read the information on case management and prevention and control
- ◆ Refer to the core module when necessary

- ◆ Do the posttest to evaluate yourself and compare your answer with the key given at the end of the module.

4.2. Pretest

Choose the correct answer and write your choice on a separate answer sheet

1. All of the following are objective data of intestinal schistosomiasis **except**
 - A. Abdominal distention
 - B. Ascites
 - C. Edema of lower limbs
 - D. Haematuria
2. Which one of the following is **not** an actual nursing diagnosis?
 - A. Itching
 - B. Abdominal pain
 - C. Squamous cell carcinoma of the bladder
 - D. Fever
3. One of the following is **not** a preventive method of schistosomiasis.
 - A. Avoiding contact with water known to contain Cercariae
 - B. Prevention of water contamination with feces
 - C. Seeking treatment when infected
 - D. Providing safe water supply
 - E. None
4. All of the following are activities expected from nurses to do for a patient of schistosomiasis **except**
 - A. Collecting the specimen
 - B. Providing the ordered medications
 - C. Keeping in secret any information related with the disease and treatment (not told to the patient)
 - D. Giving information on its prevention.
5. At the time of evaluation of treatment outcomes in patients with Schistosomiasis, the nurse should expect the following **except**.
 - A. Relief of pain

- B. Normal bowel / bladder function
- C. Normal body weight
- D. Normal skin integrity
- E. None

4.3 Learning Objectives

After reading the satellite module the learner will be able to:

- ◆ Assess patients with schistosomiasis
- ◆ List at least four nursing diagnosis for patients with schistosomiasis.
- ◆ Describe five nursing interventions for a patient with schistosomiasis.
- ◆ Discusses the goals or outcome criteria of nursing intervention for patients with schistosomiasis.
- ◆ Manage patients with schistosomiasis
- ◆ Mention the preventive and control measures.

4.4. Case Management

4.4.1. Nursing Assessment

A. Subjective Data

The nurse should assess a patient with Schistosomiasis for:

1. Onset and characteristics of the disease
2. Recent travel to another geographical area
3. A history of living in an endemic area
4. Information about means of water supply and agricultural production.
5. Altered bowel elimination pattern
6. Stool for:
 - ◆ Frequency
 - ◆ Consistency
 - ◆ Colour
7. Urine for:
 - ◆ Dysuria

- ◆ Frequency
- ◆ Colour

8. Other Symptoms

- ◆ Fatigue
- ◆ Fever
- ◆ Itching sensation
- ◆ Abdominal pain (colicky abdominal cramp)
- ◆ Vomiting that contain blood
- ◆ Diarrhea associated with blood

B. Objective Data

1. Assess the skin for:

- ◆ Maculopapular rash
- ◆ Cercarial dermatitis
- ◆ Conjunctiva (pale or pink)

2. Assess the abdomen for:

- ◆ Hepatosplenomegally
- ◆ Abdominal distention
- ◆ Ascites
- ◆ Tenderness

3. Assess the general body parts for:

- ◆ Generalized Lymphadenopathy
- ◆ Emaciation of upper trunk and upper limbs.
- ◆ Edema of lower limbs

4.4.2. Nursing Diagnosis

Based on the assessment data the patient's major nursing diagnosis may include:

- ◆ Abdominal pain related to intestinal inflammatory process
- ◆ Alteration in comfort related to itching

- ◆ Diarrhea related to irritation of intestinal mucosa
- ◆ Potential for alteration of nutrition less than body requirement related to diarrhea; hepatic fibrosis
- ◆ Activity intolerance related to fatigue
- ◆ Altered body temperature related to disease process
- ◆ High risk for skin integrity related to edema
- ◆ High risk for squamous cell carcinoma of the bladder related to chronic infection of long duration.
- ◆ High risk for infection transmission related to contagious agents

4.4.3. Nursing Goal/ Plan

- ◆ Abdominal pain should be relieved
- ◆ Patient should feel comfortable
- ◆ Maintenance of skin integrity
- ◆ The patient should fully engage in his or her daily activity
- ◆ Patient's normal body temperature should be maintained
- ◆ Patient's nutritional status should return to normal
- ◆ Health Information about cause of the disease and its preventive methods should be given to the patient.
- ◆ The patient should regain normal bowel / bladder function

4.4.4. Implementing Interventions

- ◆ Assess vital sign
- ◆ Collect stool or/and urine specimen properly including the following information:
 - Type
 - Time of sample (for urine during early after noon)
 - Volume or amount
 - Sample number
- ◆ Inform patient regarding his/ her disease and treatment

- ◆ Administer medication as prescribed
- ◆ Monitor food and fluid intake
- ◆ Keep the skin clean and dry (Skin care)
- ◆ Monitor the patient's response to therapy
- ◆ Monitor for complications
- ◆ Monitor fecal and urine out put (frequency, amount and color)
- ◆ Give information for the patient about medications, their dosage and side effects
 - Some drugs cause occasional drowsiness and dizziness and
E.g. Oxamniquine
 - Some drugs cause mild gastrointestinal upsets, giddiness, and drowsiness. E.g. Praziquantel
 - Overdose causes organophosphate poisoning
E.g. Metrifonate
- ◆ Provide health information on prevention of schistosome infections such as
 - Seeking treatment when there is suspicion of infection
 - Mobilize the community so that people in the community understand and get motivated to act together and prevent the disease
 - Identify risk group of the community living in the endemic areas and eligible for stool/ urine examination.
 - Take time to discuss with the patients' living conditions and advise them accordingly
 - Make an appointment for a follow up visit
 - Using safe water supply
 - Avoiding contact with contaminated water
 - Prevention of water from contamination with feces

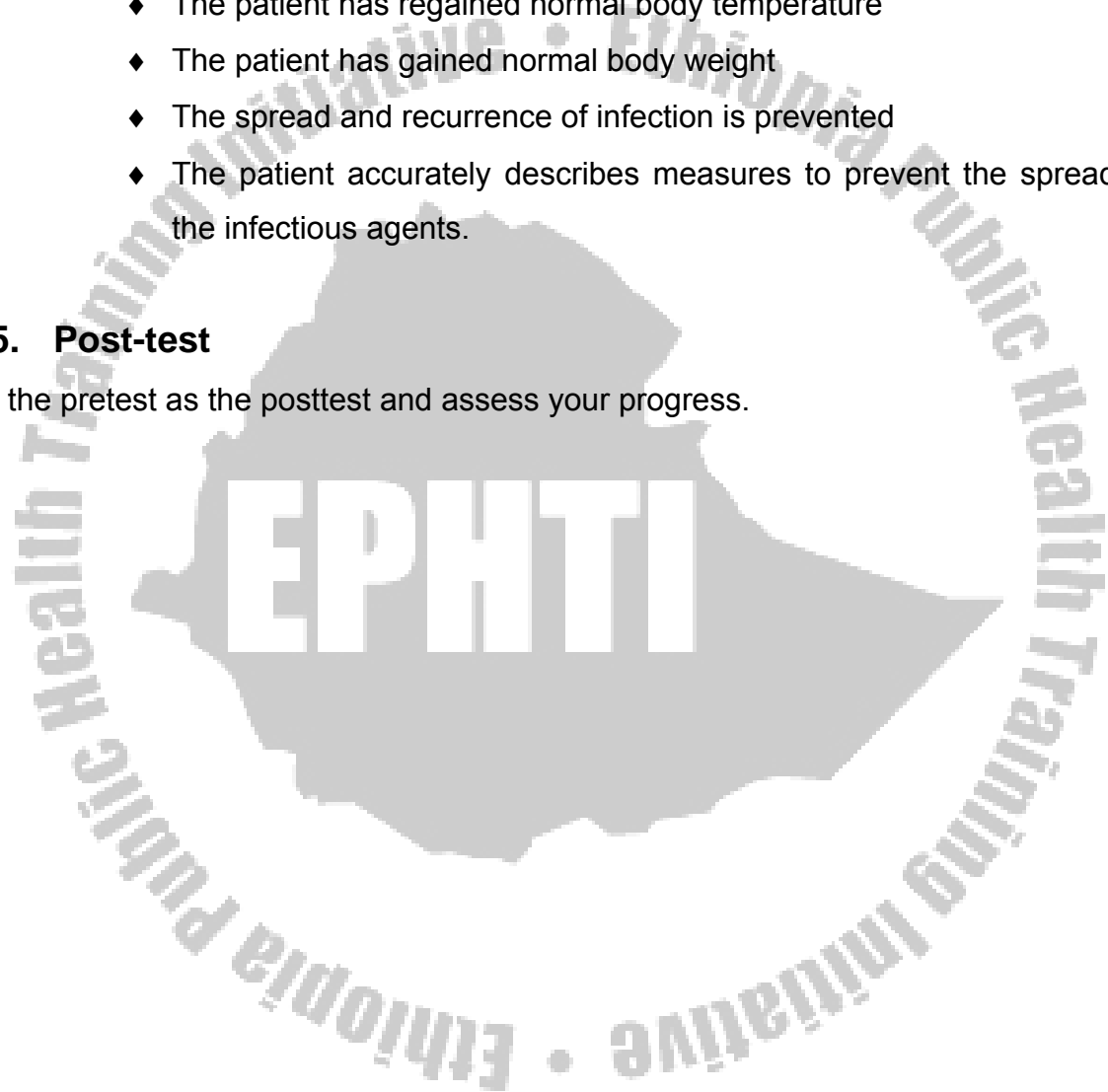
4.4.5. Evaluation

Use the following criteria to evaluate the achievement of nursing goals

- ◆ The patient has maintained normal bowel and urinary function
- ◆ Abdominal pain is relieved
- ◆ The patient verbalize that he/ she is comfortable
- ◆ The patient has regained normal body temperature
- ◆ The patient has gained normal body weight
- ◆ The spread and recurrence of infection is prevented
- ◆ The patient accurately describes measures to prevent the spread of the infectious agents.

4.5. Post-test

Do the pretest as the posttest and assess your progress.



UNIT FIVE

SATELLITE MODULE FOR MEDICAL LABORATORY TECHNOLOGISTS

5.1. Directions for Using This Module

- ◆ Complete the pre-test for the core module
- ◆ Read the core module thoroughly and do the post- test
- ◆ Complete the pre-test for the Medical Laboratory Technology Students' Satellite Module
- ◆ Read the satellite module thoroughly
- ◆ Do the post- test of the Satellite Module and evaluate your understanding by referring to the keys

5.2. Learning Objectives

After completing this module the student will be able to:

- ◆ Collect the appropriate specimen for detection of *S.mansoni* and *S.haematobium*.
- ◆ Explain the principles, application, advantages and disadvantages of the different laboratory techniques for the diagnosis of intestinal and urinary schistosomiasis
- ◆ Demonstrate laboratory procedures for different techniques of identifying infection with schistosomes.
- ◆ Collect different snail hosts of Schistoma species from different localities and examine if the snails are infected with human schistosome cercariae.

5.3. Pre-test

I. Choose the best answer from the alternatives given for each question and write your answers on a separate sheet of paper.

1. The following techniques are used to diagnose intestinal schistosomiasis except
 - A. Rectal biopsy examination
 - B. Zinc sulphate floatation technique
 - C. Formol ether concentration technique
 - D. Direct examination of feces
2. Laboratory findings in urinary schistosomiasis does not include
 - A. Glucosuria
 - B. Haematuria
 - C. Eosinophilia
 - D. Bacteriuria
3. Pick out the false statement about *S. haematobium*.
 - A. The eggs can be detected rarely in feces.
 - B. Rectal biopsy examination is used in case of chronic infections.
 - C. Collecting last few drops of urine is very important for diagnosis.
 - D. By examining a single urine specimen we cannot exclude *S. haematobium* infection.
4. What is the clearing reagent used in Kato-Katz thick smear?
 - A. Malachite green
 - B. Methylene blue
 - C. Trypan blue
 - D. Glycerine
5. Which of the following schistosoma species has lateral spine?
 - A. *S. haematobium*
 - B. *S. japonicum*
 - C. *S. intercalatum*
 - D. *S. mansoni*
6. All are true about Formol Ether concentration technique except
 - A. Risk of laboratory acquired infection from fecal pathogens is minimized.
 - B. The technique is rapid.
 - C. Fecal pathogens are killed by the formalin
 - D. None

II. Give short answers for the following questions.

1. What is the characteristic feature of *S.haematobium* eggs that differentiates them from eggs of *S.mansoni*?
2. What is the material that is used as a cover slip in Kato-Katz technique?
3. What is the appropriate time to collect urine specimen for diagnosis of *S.haematobium*? Why?
4. What are the two important schistosome antigens that are used to diagnose intestinal schistosomiasis?
5. What is the use of Ether in the Formol Ether Concentration Technique?

5.4. Techniques for Laboratory Diagnosis of Schistosomiasis

5.4.1. Laboratory diagnosis of *Schistosoma mansoni*

General Considerations

The eggs of *S.mansoni* can be detected in feces and rarely in urine. It is unsafe to assume a random distribution of eggs in feces, aliquots must be obtained from different parts of the specimen. Absence of eggs in a single fecal specimen does not necessarily imply absence of active infection; three to five tests on feces passed in different days may be needed. (7)

The laboratory diagnosis can be done by

- ◆ Finding
- ◆ for eggs when they cannot be found in faces
- ◆ Detecting antibodies or antigens using serological tests.

Other findings:

- ◆ There may be eosinophilia, raised erythrocyte sedimentation rate and low haemoglobin values (anaemia)
- ◆ In patients with hepatic disease, serum total protein is raised due to raised globulin, serum albumin is often low, and serum alkaline phosphatase and aspartate aminotransferase (AST) activities are usually raised. (4)

Collection of Faecal Specimen

- ◆ A fresh faecal specimen is required.
- ◆ The specimen should not be contaminated with urine.
- ◆ A large teaspoon amount of feces is adequate or about 10 ml of a fluid specimen.
- ◆ The container should be clean, dry, leak-proof, and free from traces of antiseptics and antibiotics and have suitable size.
- ◆ Avoid using containers made from leaves, papers, or cardboard (including match boxes) because these will not be leak-proof, may not be clean, and can result in the faecal contamination of hands and surfaces.
- ◆ Specimens must be labeled correctly and accompanied by a correctly completed request form. (4,7)

I. Direct Examination of Feces

Direct examination of feces involves:

- ◆ Reporting the appearance of the specimen (macroscopic examination)
- ◆ Examining the specimen microscopically for schistosome eggs.

Reporting the Appearance of Faecal Specimens

The following issues should be reported

- ◆ Color of the specimen.
- ◆ Consistency i.e. whether formed, semi-formed, unformed, watery
- ◆ Presence of blood, mucus, and/or pus
- ◆ Whether the specimen contains other parasitic worms, e.g. tape worm, thread worm etc.

Microscopic Examination

Materials and Solutions Needed

- ◆ Microscope
- ◆ Microscope slide
- ◆ Cover glass
- ◆ Wire loop or wooden applicator

- ◆ Dropping bottles containing physiological saline (0.85 %w/v)

Procedure

1. Place a drop of fresh physiological saline on a slide.
•Don't use too large a drop of saline in order to avoid contaminating the fingers and stage of the microscope.
2. Using a wire loop or piece of stick, mix a small amount of specimen, about 2 mg (Match stick head amount) with the saline. Make smooth thin preparations and cover it with a cover glass by holding the cover glass at an angle of 30° touching the edge of the suspension and gently lowering the cover glass on to the slide so that no air bubbles are introduced.
To make sure the preparation is thin (not too thick) place the slide on a newspaper. If you can see and not read the paper print, it is a good preparation.
If the specimen is dysenteric and unformed, no need of using physiological saline.
Just place a small amount of specimen including the blood and mucous using a wire loop or piece of stick. Cover with a cover glass and using a tissue, press gently on the cover glass to make a thin preparation.
3. Examine systematically the entire saline preparation for schistosome eggs. Use the 10x objective with the condenser iris closed sufficiently to give good contrast and use also the 40x objective to assist in the detection and identification of the eggs. The eggs are pale yellow-brown, large, and oval, measuring about 150x60µm. They have a characteristic lateral spine and fully developed miracidium.
4. Report the number of eggs found in the entire saline preparation as follows:
Scanty1-3 per preparation
Few4-10 per preparation
Moderate number11-20 per preparation
Many21-40 per preparation

Very manyOver 40 per preparation (7, 15)



Fig.5.1 Egg of *S.mansoni* with lateral spine (Arrow)

Source: DPDx Laboratory Identification of Parasites of Public Health Concern, CDC, National Center

for Infectious Diseases Division of Parasitic Diseases, USA, 2003.

II. Concentration Techniques

When eggs are not found in direct preparations concentration methods should be performed. Even in moderate to severe symptomatic infections concentration technique may be required to detect eggs.

A. Formol ether concentration technique

This technique is rapid and risk of laboratory-acquired infection from faecal pathogens is minimized because organisms are killed by the formalin solution. The technique, however, requires the use of highly flammable ether or less flammable ethyl acetate.

Principle:

Feces are emulsified in formal water; the suspension is strained to remove large faecal particles, ether or ethyl acetate is added, and the mixed suspension is centrifuged. The eggs are fixed and sedimented and the faecal debris is separated in a layer between the ether and the formal water. Faecal fat is dissolved in the ether.

Materials and solutions needed.

- Formol water, 10%v/v

- Diethylether or ethylacetate
- Sieve (strainer) with small holes or two layers of gauze
The small inexpensive nylon tea or coffee strainer available in most countries is suitable.
- Beaker
- Microscope slide
- Cover slip
- Conical (centrifuge tube)
- Stopper
- Applicator stick
- Centrifuge.
- Microscope

Procedure

1. Using a rod or stick, emulsify an estimated 1g (pea-size) of feces in about 4 ml of 10% formol water contained in a screw-cap bottle or tube.
2. Add a further 3-4 ml of 10% v/v formol water, cap the bottle, and mix well by shaking,
3. Sieve the emulsified feces, collecting the sieved suspension in a beaker.
4. Transfer the suspension to a conical (centrifuge) tube and add 3-4ml of diethyl ether or ethyl acetate.

Caution: *Ether is highly flammable and ethyl acetate is flammable, therefore use well away from an open flame. Ether vapour is anaesthetic, therefore make sure the laboratory is well-ventilated.*

5. Stopper* the tube and mix for 1 minute. If using a vortex mixer, leave the tube unstoppered and mix for about 15 seconds.

**Do not use a rubber bung or a cap with a rubber liner because ether attacks rubber.*

6. With a tissue or piece of cloth wrapped around the top of the tube, loosen the stopper (considerable pressure will have built up inside the tube).
7. Centrifuge immediately at 3000 rpm for 1 minute.

8. Using a stick or the stem of a plastic bulb pipette, loosen the layer of faecal debris from the side of the tube and invert the tube to discard the ether, faecal debris, and formol water. The sediment will remain.
9. Return the tube to its upright position and allow the fluid from the side of the tube to drain to the bottom. Tap the bottom of the tube to resuspend and mix the sediment.
Transfer the sediment to a slide, and cover with a cover glass.
10. Examine the preparation microscopically using the 10x objective with the condenser iris closed sufficiently to give good contrast. Use the 40x objective to examine the eggs.
11. Count the number of schistosome eggs in the entire preparation. This will give the approximate number per gram of feces.(4)

B. Kato-Katz technique

This technique is recommended by the World Health Organization (WHO) for the diagnosis of *S.mansoni*, *S.intercalatum* and *S.japonicum*.

Thousands of villages in Ethiopia have been screened for *S.mansoni* using this technique (by Institute of Pathobiology, Addis Ababa University). The technique is feasible for mass screening as the collected specimen can be examined at leisure time in the laboratory. It is a quantitative method and provides information on the intensity of infection. The technique has been used to evaluate mass chemotherapy in Jiga town. (18)

For community based surveys it is advisable to use the same technique in order to be able to compare prevalence and intensity of infection among villages/schools and select priority sites for selective chemotherapy. Until simpler techniques are developed it is advisable to use Kato-Katz technique for mass screening of *S.mansoni* in Ethiopia.

Principle:

It is based on the clearing of a thick faecal smear with glycerine in the presence of a background stain, usually malachite green. The eggs appear unstained although miracidia are not visible.

Materials and reagents needed

- Spatulas
- Filter paper or scrap paper
- Screen (stainless steel or plastic sieve)
- Template (stainless steel, plastic or cardboard)

Note: Templates of different sizes are known to exist.

A template with -9mm hole and 1mm thickness deliver 50 mg of feces

-6mm hole and 1.5mm thickness will deliver 41.7 mg of feces

-6.5mm hole and 1.5mm thickness will deliver 20 mg of feces.

- Water wettable (hydrophilic) cellophane strips, 25x30 or 25x35 mm in size.
- Microscope slide
- Flat bottom jar with lid
- Forceps
- Toilet paper or absorbent tissue
- Microscope
- Glycerol + malachite green or glycerol methylene blue solution.

[Add 1 ml of 3 % aqueous malachite green or 3% methylene blue to 100 ml glycerol and 100ml distilled water mixture. Mix well. Then pour this solution on to the cellophane strips in a jar and left for at least 24 hrs prior to use.]

Procedure

1. Mesh a portion of feces, either by pressing the sieve down on feces placed on filter paper or scrap paper, or by pushing the sample through the sieve with a spatula, to remove fiber and other coarse debris.
2. Scrap the flat-sided spatula across the upper surface of the screen to collect the sieved feces.

3. Place template in the middle of a clean microscope slide and fill with meshed feces from the spatula so that the hole is completely filled. Using the side of the spatula remove excess feces from the edge of the hole.
4. Carefully remove template and place a presoaked cellophane strip over the cylinder of feces left on the slide.
5. Invert the slide and press on an absorbent surface (e.g. toilet paper) on a bench top to spread the feces under the cellophane strip.
6. Position slide with smear uppermost to facilitate clearing of specimen and leave for 1-24 hours.
7. Examine the smear systematically within 24 hours and count and report the number of *S.mansoni* ova.
 - To calculate the total number of eggs per gram of feces, multiply the number of *S.mansoni* eggs in the smear by an appropriate factor. Selection of a factor depends on the template used. For example, if a 50mg template is used, the factor will be 20.

NOTE: Compare with other field technique for detecting and quantifying schistosome eggs in feces, the Kato-Katz technique is less sensitive, is unsuitable for fluid or hard specimens, can alter the morphological appearance of eggs, and the technique is less safe and hygienic. Alternative field techniques have been suggested such as formol detergent gravity technique described below. (4, 7)

C. Formol detergent field technique

It is reproducible, inexpensive, simple, safe and hygienic to perform (formalin kills faecal pathogens) and gives good preservation of schistosome eggs. It is more sensitive than the Kato-Katz technique because more feces is used.

Materials and reagents required

- Universal container with a conical base and measuring spoon.
- Sieve (strainer) with small holes. The small nylon tea strainer is suitable.
- Beaker
- Plastic bulb pipette or Pasteur pipette

- Microscope slide
- Microscope
- Formol detergent solution

[To make this solution add 10 ml of detergent solution (e.g. Lipsol, Decon, Teepol or other washing up detergents) to 480 ml of clean water. Then add 10 ml of concentrated formaldehyde solution to the mixture of detergent solution and water.]

Procedure

1. Dispense about 10 ml of the formol detergent solution in to a universal container.
2. Using the spoon attached to the cap of the containers, transfer a level spoonful of feces to the container (approx.300 mg feces), and mix well in the solution to break up the feces. Tighten the cap and shake for about 30 seconds.
3. Sieve the emulsified feces, collecting the sieved suspension in a beaker. Return the sieved suspension to the conical based Universal container.
4. Stand the container upright in a rack for 1 hour (do not centrifuge)
5. Using a plastic bulb pipette or Pasteur pipette, remove and discard the supernatant fluid, taking care not to disturb the sediment (containing schistosome eggs) which has formed in the base of the containers.
6. Add about 10ml of 10% formol detergent solution and mix well for a minimum of 30 seconds. Leave the sediment for a further 1-hour. Further clearing of the faecal debris will take place.

Note: *The schistosome eggs are fixed and will not be over cleared or become distorted.*

7. Using a plastic bulb pipette remove and discard the supernatant fluid, taking care not to remove the fine sediment that has collected in the conical base of the container.
8. Transfer the entire sediment to a slide and cover with a 22x40mm cover glass or with two smaller square cover glasses.

9. Systematically examine the entire sediment microscopically for schistosome eggs using the 10x objective with the condenser iris closed sufficiently to give good contrast. Count the number of eggs and multiply the number counted by 3 to give the appropriate number per gram of feces. (4)

III. Examination of Rectal Biopsy

Rectal biopsy examination is very important in chronic infections because schistosome eggs may not be found in feces. The eggs are often non-viable and calcified. A rectal biopsy depending on geographical area may contain the eggs of *S.mansoni*, *S.japonicum*, *S.intercalatum*, *S.mekongi*, and occasionally the eggs of *S.haematobium*. When the laboratory receives a biopsy for the diagnosis of schistosomiasis (It is taken by an experienced person) proceed as follows:

1. Immediately after removal, place the tissue in physiological saline and soak it for 30-60 min.
2. Transfer the tissue to a slide and cover with a cover glass. With care, press on the cover glass to spread out the tissue and make a sufficiently thin preparation.
3. Examine the entire preparation microscopically for eggs using the 10x objective with condenser iris closed sufficiently to give good contrast. Constant focusing is necessary to detect the eggs.

Note: *If the preparation is too thick to examine, add a drop of lactophenol solution and wait a few minutes for the tissue to clear sufficiently.*

4. Identify the eggs and estimate the number of uncalcified eggs in the biopsy and the proportion that are calcified (black). (4)

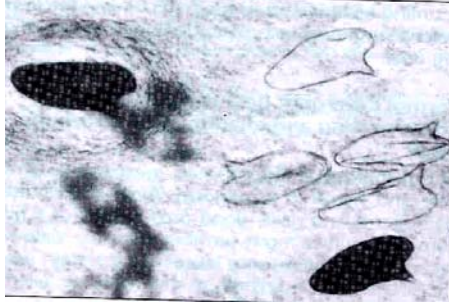


Fig.5.2. Uncalcified and calcified (black) eggs of *S.mansoni* in rectal biopsy.

Source: Cheesbrough M. District Laboratory Practice in Tropical Countries, Part 1, Cambridge University Press, 1998.

IV. Serological Diagnosis

This is based on the detection of antibodies produced against the schistosomes/eggs or antigens of the schistosomes/eggs.

- i. **Antibody detecting tests:** - do not differentiate present and past infection or reinfection because the antibodies persist in the serum for a long time after the infection has cleared. So, these tests have a limited application.
- ii. **Antigen detecting tests:** - are used to diagnose active infection by detecting circulating schistosome antigen using a monoclonal antibody reagent.

Nowadays Enzyme Immune Assays (Fast ELISA tests) are being used for screening urinary and intestinal schistosomiasis by detecting circulating proteoglycan schistosome antigens, i.e., circulating anodic antigen(CAA) and circulating cathodic antigen(CCA) in serum and urine. Western blot assay is also being used for confirmation and species identification. (4, 7)

5.4.2.Laboratory diagnosis of *Schistosoma haematobium*

General considerations

The clearest demonstration of an active infection is through the detection of living eggs in urine, although occasionally, eggs may be found in faeces. The excretion of *S.haematobium* eggs in urine is highest between 10.00h and 14.00h, with a peak around midday. It is preferable to obtain such a specimen but neither exercising

before passing urine nor collecting terminal urine (last few drops) increase the number of eggs present in the specimen (as once was thought). Examination of a single urine specimen is not reliable for excluding a schistosome infection, and up to four specimens, passed on different days, may be necessary because eggs may not be present in the urine all the time even when persons are heavily infected. (7)

The laboratory diagnosis can be done by

- ◆ finding the eggs or occasionally the miracidia in urine
- ◆ detecting the eggs in a rectal biopsy or bladder mucosal biopsy
- ◆ serological tests

Other findings

- ◆ Haematuria is a common finding.
- ◆ Proteinuria is frequently present.
- ◆ Eosinophils in urine and in blood
- ◆ Bacteriuria (4)

A. Urine Sedimentation or Centrifugation Technique

It gives a qualitative and quantitative result.

Materials and equipments needed

- Urine container
- Conical test tube
- Bench centrifuge
- Cover slip
- Microscope slides
- Urine dipsticks for blood and protein detection

Procedure

1. Collect 10-15 ml of urine in a clear dry container.

Note: *If unable to examine it within 30 minutes, keep the specimen in the dark to avoid miracidia hatching from the eggs.*

2. Report the appearance of the urine.

In urinary schistosomiasis the urine will usually contain blood and appear red or red-brown and cloudy. If blood is not seen, test the specimen chemically for blood and protein using dipsticks.

3. Transfer 10 ml of well-mixed urine to a conical tube and centrifuge at RCF 500-1000g to sediment the eggs. (Don't centrifuge at greater force because this can cause the eggs to hatch)

Note: If there is no bench centrifuge, allow the eggs to sediment by gravity for 1 hour.

4. Discard the supernatant fluid. Transfer all the sediment to a slide, cover with a cover glass, and examine the entire sediment microscopically using the 10x objective with the condenser iris closed sufficiently to give good contrast. The eggs are pale yellow-brown, large and oval in shape, measuring about 145x55µm. They have a characteristic small lateral spine at one end and contain a fully developed miracidium.
5. Count the number of eggs in the preparation and report the number/10ml of urine. If more than 50 eggs are present, there is no need to continue counting. Report the count as "More than 50 eggs/10ml". Such counts indicate a heavy infection. (4, 15)



Fig 5.3. Eggs of *S.haematobium* with terminal spine (Arrow)

Source: DPDx Laboratory Identification of Parasites of Public Health Concern, CDC, National Center

for Infectious Diseases Division of Parasitic Diseases, USA, 2003.

Miracidia in urine: - If the urine is dilute or has been left to stand for several hours in the light, the miracidia will hatch from the eggs. The ciliated miracidia are motile. (4)

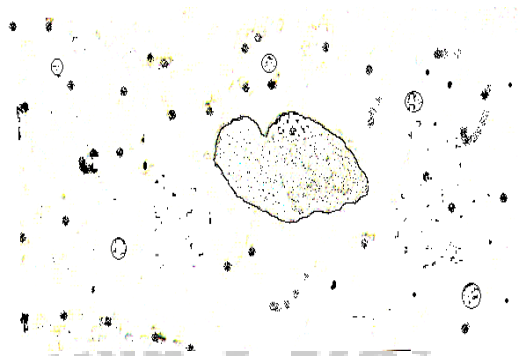


Fig.5.4. Ciliated miracidium of *S.haematobium* in urine.

Source: Cheesbrough M. District Laboratory Practice in Tropical Countries, Part 1, Cambridge University Press, 1998.

B. Filtration Technique

It is the most sensitive, rapid, and reproducible technique for detecting and quantifying *S.haematobium* eggs in urine. Polycarbonate membrane filters (Nucleopore filters), however, are expensive although with care they can be reused.

Materials required

- Syringe, 10ml or greater
- Filter holder, 13mm diameter
- Polycarbonate membrane filter of 13 mm diameter and 12-14 μ m pore size
- Cover slip
- Physiological saline
- Forceps
- Microscope

Procedure

1. Using blunt-ended forceps carefully place a polycarbonate filter on the filter support of the filter holder. Re-assemble the filter holder and attach it to the end of a 10 ml or greater syringe.
2. Remove the plunger from the syringe. Fill the syringe to the 10ml mark with well-mixed urine, and replace the plunger. Holding the syringe over a beaker or other suitable container, slowly pass the urine through the filter.
3. Remove the filter holder and unscrew it. Using blunt- ended forceps, carefully remove the filter and transfer it face upwards (eggs on surface) to a slide. Add a drop of physiological saline, and cover with a cover glass.
4. Using the 10-x objective with the condenser iris closed sufficiently to give good contrast, examine systematically the entire filter for *S.haematobium* eggs. Count the number of eggs and report the number per 10ml of urine.

Note: If more than 50 eggs are present (considered as a heavy infection) there is no need to continue counting. Report the count as “More than 50 eggs/10ml”. (4)



Fig.5.5. Filtration concentration technique for detection of *S.haematobium* eggs.

Source: Cheesbrough M. District Laboratory Practice in Tropical Countries, Part 1, Cambridge University Press, 1998.

Differentiating Non-Viable From Viable Schistosome Eggs on a Filter

In assessing active infection or in judging whether treatment has been successful, it is helpful to know whether the schistosome eggs detected are viable or non-viable.

Although it is often possible to see flame cell movement in viable eggs, a more reliable way of differentiating is to examine a preparation stained with 1 w/v trypan blue in physiological saline. A drop of stain is added and the preparation is left for 30 minutes at room temperature (in a damp chamber to prevent drying out).

Non-viable eggs..Stain blue

Viable eggs.. Unstained (4)

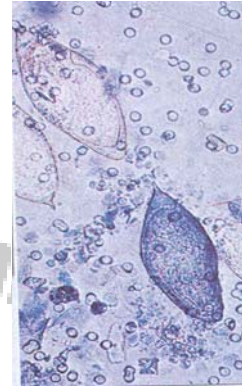
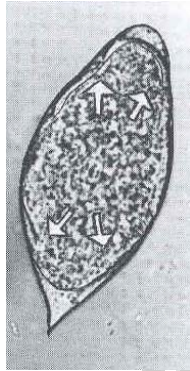


Fig.5.6. Position of flame cells stained

Fig.5.7. Trypan blue preparation showing

non viable *S.haematobium* egg and unstained living egg

Source: Cheesbrough M. District Laboratory Practice in Tropical Countries, Part 1, Cambridge University Press, 1998.

C. Examination of Total Volume of Urine Collected Between 10.00h and 14.00h

In light infections to increase the possibility of finding *S.haematobium* eggs, the total volume of urine excreted between 10.00h and 14.00h can be examined. The examination involves testing of the urine for protein and blood, preserving the eggs by adding 0.1ml of 10% formol saline to 50-100 ml of urine, allowing the eggs to sediment (for 2 hours), discarding all but the last approximate 15 ml of urine, centrifuging the last 15ml urine and examining the sediment for *S.haematobium* eggs. (4)

D. Examination of Biopsies

The laboratory examination of rectal and bladder mucosal biopsies is as described for intestinal schistosomiasis.

E. Serological Diagnosis

Serological tests for diagnosis of urinary schistosomiasis are similar with that of intestinal schistosomiasis.

5.4.3 Laboratory technique for examination of snails

Examination of Snails for Infection with Human Schistosome Cercariae

This is a technique to find cercariae, the infective stage of human schistosoma species

(*S.mansoni*, *S.haematobium*...) by examining snails.

1. Collect the major species of snails from their habitat.
2. Keep snails from each locality in different containers (bottles).
3. Label bottles carefully and document the following: name of the place, date, density of snails, habitat description where snails were found.
4. Bring the specimen to laboratory for examination or it can be done in the field.
5. Dissect snail by separating the shell from the soft parts.
6. Crush the soft part and overlay cover slide and examine for cercariae under microscope.

Swimming cercariae with bifurcated tail are seen.

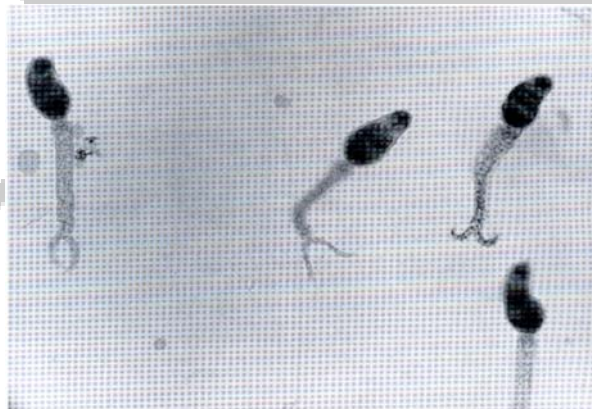


Fig 5.8. Cercaria of *S.mansoni*

Source: Marquardt W.C. et al. Parasitology and Vector Biology, 2nd edn, Harcourt Academic

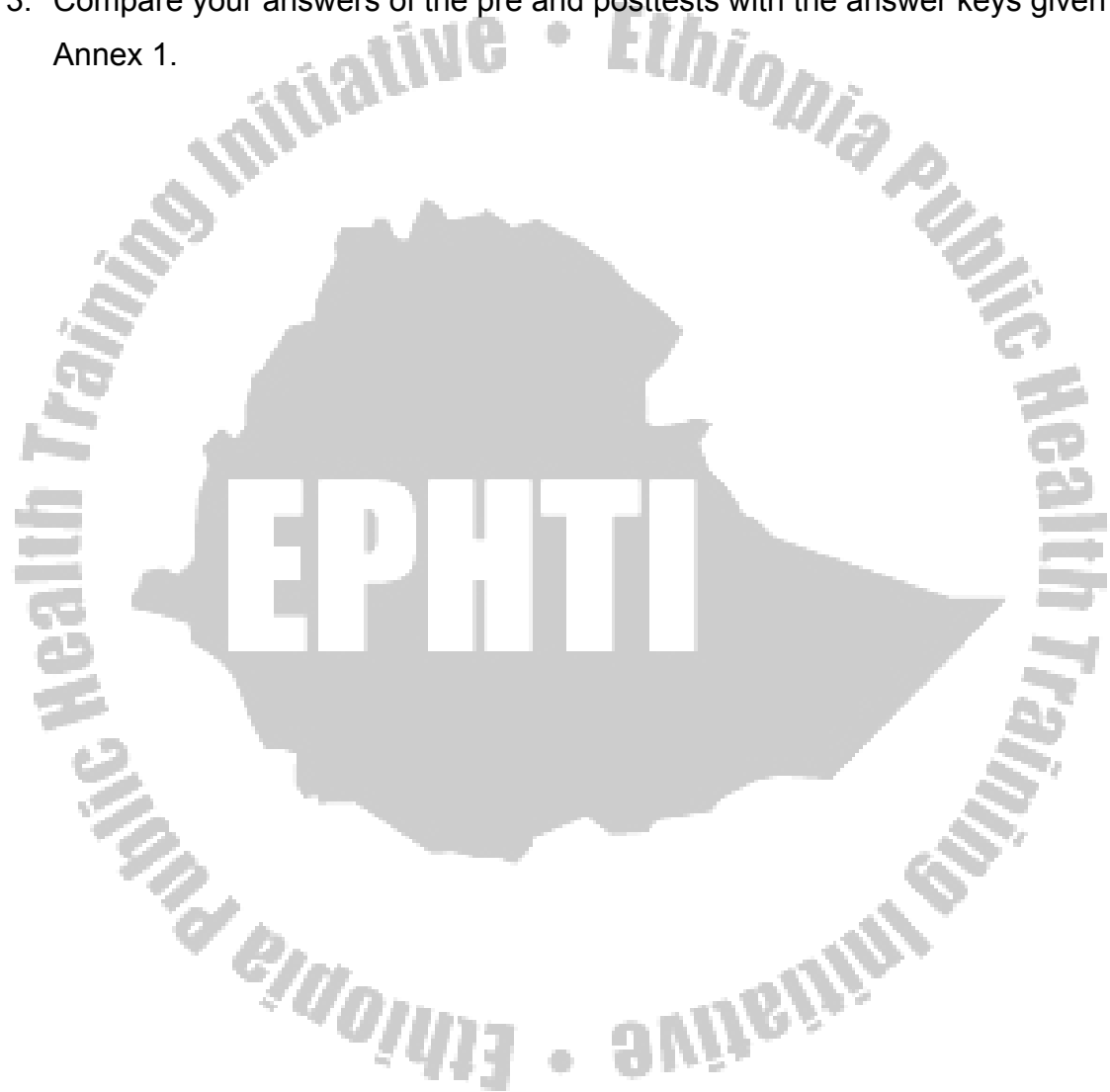
Press, 2000

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

1. Read the task analysis of the different categories of the health center team
2. Do the questions of pre-test as a post-test.

Note: Use a separate answer sheet.

3. Compare your answers of the pre and posttests with the answer keys given in Annex 1.



UNIT SIX

SATELLITE MODULE FOR ENVIRONMENTAL HEALTH OFFICERS

6.1 Introduction

6.1.1. Purpose and Brief Description of the Satellite Module

The purpose of this satellite module is to equip environmental health professionals with basic knowledge and skill about the preventive and control measures for schistosomiasis particularly those species prevalent in Ethiopia. The module also intends to help other health professionals by providing relevant information on schistosomiasis.

In Ethiopia the large majority of the rural population obtains water, for domestic uses, from unprotected sources like rivers wide and shallow ponds. Consequently, water based diseases such as, schistosomiasis, are one of the most significant public health problems in the nation. Since schistosomiasis is clearly a socio-economic problem that has its roots in rural poverty, ignorance and the persistence of certain customs and habits are increasing its prevalence. It is necessary that the prevention and control methods based on community participation should be integrated into the national poverty relegation program. Schistosomiasis can be prevented and controlled mainly by eradication and control of intermediate host snails. This can be achieved by using chemical, biological, ecological measures as well as by changing the behavior of the community. Thus, the role of the environmental Health officer should be broadly based up on primary prevention activities.

Four species of the genus *Schistosoma* are important human parasites. Of these *S. mansoni*, *S. haematobiu*, *S. intercalatum* and *S. japonicum* have widespread distribution. The adult male and female worms live in the blood veins and intestine of the host (human) for many years. As an adaptation for these unusual microhabitats, the worms are thread like in shape. Cylindrical and elongated females live

permanently in the ventral groove (gynecophoric canal) of the shorter, stouter males. The eggs which do leave an infected person in urine or feces hatch on contact with fresh water and the emergent miracidia infect a range of aquatic and amphibious snails in which infective cercariae are produced.

6.1.2. Directions for Using the Satellite Module

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

6. 2. Pretest

Choose the best answer and write the letter of your choice on the separate sheet

1. Schistosomiasis is mainly prevented and controlled by
 - A. Treating all patients.
 - B. Giving health information.
 - C. Eradicating or control of intermediate host snails
 - D. None
2. Humans are being infected by
 - A. Miracidium
 - B. Cercariae
 - C. Egg of schistosoma
 - D. The larvae of snail species
3. Which factors are favorable for snails to survive?
 - A. Fast flowing water
 - B. Muddy channels
 - C. 40⁰c temperature of the environment
 - D. During rainy season
4. The predators of the intermediate host snails are
 - A. Fishes
 - B. Other large snails
 - C. Ducks
 - D. A and C

5. Which chemical is more important in the control of snails?
- A. DDT
 - B. CuSO_4
 - C. NaCO_3
 - D. Malathion
6. How many species of schistosoma are important human parasites?
- A. One
 - B. Four
 - C. Two
 - D. Unknown
7. Which type of species of human schistosoma has widespread distribution in Ethiopia?
- A. *S. intercalatum*
 - B. *S. monsoni*
 - C. *S. haematobium*
 - D. B and C

Write 'true' if the statement is correct and 'false' if the statement is incorrect

8. Schistosoma infection has great association with population migration.
9. Adults are more affected than children.
10. Social and religious practices do not take part in the infectiousness of schistosomiasis
11. The rate of cercariae out put is uniform through out the day.
12. Destroying aquatic vegetation around fresh water bodies/snail habitat is one aspect of prevention.
13. Reducing the rate of flow of water enhances the breeding of the intermediate snails.

Give Short answer

14. Explain the mode of transmission of schistosomiasis.
15. What are the factors associated with the transmission of schistosomiasis.
16. Mention the major snail control measures which in turn controls the transmission of schistosomiasis.

6.3. Learning Objectives.

After going through this satellite module the student will be able to:

- ◆ Describe the mode of transmission and life cycle of schistosomiasis
- ◆ Identify the host and environmental factors that are associated with the transmission of schistosomiasis
- ◆ Plan and implement prevention and control measures, specifically pertinent to environmental health Sciences.
- ◆ Evaluate the effects of intervention program to ensure its sustainability

6.4. Schistosomiasis

6.4.1. Mode of Transmission and Life Cycle

The mode of transmission is water-based route which involves parasites that require a snail host, fish or other aquatic animal in which to develop. Humans become infected by the infective forms penetrating the skin. Schistosoma species are transmitted by cercariae penetrating the skin when a person is bathing, washing clothes, fishing, or engaged in agricultural work or other activity involving contact with water that has been fecally contaminated and contains the snail host of the parasites. In its snail host the parasite multiplies and develops to its infective cercarial stage.

There are a number of reservoir hosts capable of carrying schistosoma species. Snails are intermediate hosts in which the asexual stage (larval stage) develops. Snails are more likely found in stagnant water than rapidly flowing. The snails are more likely found in stagnant than rapidly flowing water. The snail species are specific to each species of schistosoma. i.e. *Biomphalaria* for *S. mansoni* *Bulinus* for *S. heamatbium* and *Onchomelania* for *S. Japonicum*. *S. mansoni* and *S.heamatobium* are endemic in Ethiopia. Areas with irrigation have the highest risk of infection.

Humans are the most significant definitive hosts of *S.mansoni* and *S.intercalatum*. Intermediate hosts of *S.mansoni* are aquatic snails, (*Biomphalaria* species for

S.mansoni and *Bulinus* species for *S.intercalatum*). They are found on vegetation in ponds, streams, rivers, lakes and dams, irrigation channels. The indirect life cycle of schistosoma species indicate that cercariae develop in to schistosomula which migrate via the lungs to the liver. In the portal venous system the schistosomula become mature flukes and pair. The paired flukes migrate to the mesenteric veins which drain the large intestine. The venules of the rectum and lower large intestine are the main sites involved. The female flukes lay eggs in the capillary venules. Some of the eggs become lodged in the tissues infection to eggs laying normally takes 4-8 weeks. In their human host; schistosomes live for up to 5 years, some times longer.

6.4.2. Epidemiological Factors

The epidemiological factors of schistosomiasis are basically described in the following manner.

1. The release of egg-via- urine and feces, then contamination of the fresh water.
2. The presence of intermediate host snail in the fresh water.
 - ◆ Capable of infection by miracidiae
 - ◆ Capable of producing cercariae.
3. The suitability of the fresh water; with respect to temperature, rate of flow, acidity or alkalinity and the availability of organic matter conducive for snail.
4. Human contact with water, such as, bathing and washing. Here some points should be taken into consideration
 - ◆ Children excrete large number of schistosoma eggs.
 - ◆ There is high prevalence in dense rural community.
 - ◆ Infection has high association with population migration/settlement.
 - ◆ Infection is high in irrigation areas.
 - ◆ It affects young children more than adults and affects more males than females.
 - ◆ It has great association with social and religious practices.

6.5. Transmission Factors

There are basically two types of factors that determine its transmission. These are

1. Factors with respect to the intermediate host snails
2. Factors related to cercariae and infection of susceptible host

A. Factors with respect to the intermediate host snails

1. *Composition of the fresh water*

- ◆ There should be fresh water
- ◆ There must be abundant aquatic vegetation in the water to feed on and to deposit eggs. Algae are the main food.
- ◆ There must be calcium for their eggs
- ◆ Alkaline environment is conducive for the snails

2. *Temperature*

- ◆ 22-23^o is conducive; if the temperature reaches 39^oc the snail will die.
- ◆ Fast flowing water and heavily shaded are unfavorable for snails.

3. *Habitat*

- ◆ Muddy canals and slow flowing water is favorable for snails
- ◆ Drains leading from main canal create good condition for snails.

4. *Season*

- ◆ The season that is favorable for snails is during the month after rainfall.

5. *Predators*

- ◆ Ducks and large snails (non-vectors eat intermediate host snail)

6. *Feet of birds*

- ◆ Some water birds feet carry the egg mass of the snail and infect the water bodies.

B. Factors with respect to cercariae and infection of susceptible host

1. Age of snail- Young snail is more liable than adult to be infected by miracidia. Therefore, they should be targeted during eradication of snails.

2. Infection –Snail can release $1.5 - 2 \times 10^3$ cercariae per day for 200 days but more susceptible to unfavorable conditions.

3. Season - Acute transmission occurs in the 4th–5th month after the rainy season. Seasonality in snail population density and cercarial infection appears to be mainly influenced by rainfall. Snail population declines in the rainy season. High turbidity and siltation caused by flooding and increased water velocity during the rainy season are the indirect effects of rainfall while splashing out of snails in a flood are a direct effect of rainfall. Both of these factors appeared to affect the intermediate host snail population density and cercarial infection negatively.

4. Time of the Day –Peak cercariae output is at 4:00-8:00 O'clock local time. And hence avoiding water contact at this time is crucial in preventing the spread of infection.

5. Velocity of flow-The optimum velocity of water that favors the breeding of snails is 30cm/sec. And hence making the flow velocity faster than 30cm/sec especially in irrigation canals is one of the most applicable and feasible method of prevention of schistosomiasis.

6.4.3. Measures to Prevent and Control Schistosomiasis

The basic measure in the prevention and control of schistosomiasis lies on eradication and control of intermediate host snails.

Snail control can be achieved by using:

- ◆ Chemical
- ◆ Biological
- ◆ Ecological methods etc.

Chemical control: This approach is recommended only when other options can not be used, because most molluscides are highly toxic and, therefore, dangerous to other aquatic life as well as to humans. Some of the chemicals are non-biodegradable and persist for a long time in the environment. They are expensive and

unavailable locally. Application of these chemicals requires skill. It consists of introducing chemicals such as CuSO_4 , Sodiumpentachlorophenate or niclosamide in the breeding places of snails. Therefore, selection and application of molluscides should be based upon toxicity level, environmental persistence, and cost. Some recommended molluscicides are Niclosamide (Baylucide, Mallutox), 10mg/lit at room temperature and Endod (*Phytolecca dedocandra* or Lemma toxin) dose similar to Niclosamide.

Biological control: Introducing other snail species that compete for food and other resources or introducing predators of mollusks are ways of decreasing the longevity and density of the intermediate host snail species. For example, *Marisa Cornuarietis* (competitive snail species) eliminates the snail genera *Biomphalaria* (intermediate host for *Schistosoma mansoni*) *Bulinus* (intermediate host for *Schistosoma haematobium*) and snail family lymnaea (intermediate host for *F.hepatica*). Biological control usually utilizes disease agents and predators of snails like birds that may eat snail. In practice, this has not worked very well.

Ecological methods: It entails making the habitat unsuitable for reproduction or survival of the mollusks. Since the vectors of schistosomiasis are aquatic and prefer to attach to plants in water where the flow velocity is fairly slow, removal of aquatic plants and altering streambeds and canal contours to increase water velocity reduces suitable snail habitat.

In general, at present snail control is best accomplished with chemical means; despite the disadvantages of environmental contaminations i.e. by applying topical anticercaria such as niclosamide to the skin which acts as an impenetrable barrier. Boots and gloves can also be used to prevent water contact.

6.5. Post-test

So far we have been discussing about schistosomiasis, now do the pre-test of the core module as the post-test and assess your progress.

UNIT SEVEN

SATELLITE MODULE FOR HEALTH EXTENSION WORKERS

7.1. Introduction

7.1.1. Purpose and use of this module

This satellite module on schistosomiasis is prepared for community health workers. It emphasizes on the role of community health workers in the detection and early referral of schistosomiasis cases and prevention and control of the disease. Moreover, it will help in their active participation and dissemination of information about schistosomiasis to the public. However, in order to be easily understandable this module should be translated to the local language. Meanwhile, the Community health worker should take the responsibility of conveying the message of the module.

7.1.2. Direction for using the module

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

7.2. Pre-test

Choose the correct answer and write your choice on a separate sheet.

1. Which of the following is the most important factor for schistosomiasis infection?
 - A. Ingesting water and food contaminated with schistosoma eggs.
 - B. Insect bite
 - C. Swimming in water containing cercariae
 - D. Ingesting fish infected with cercariae
2. What is an intermediate host for the transmission of schistosomiasis?

- A. House fly
B. Mosquito
C. Fresh water fish
D. Snails
3. Which of the following is an important symptom in patients with schistosomiasis?
- A. Itching of the skin
B. Bloody diarrhea
C. Bloody urine
D. Fever
E. All of the above
4. Which of the following is wrong about the preventive and control aspect of schistosomiasis?
- A. Proper construction and use of latrine.
B. Boiling water for drinking.
C. Cleaning the canal where snails breed
D. Educating the public to avoid contact with water bodies that have cercariae and to use latrine.

7.3. Learning Objectives

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

- Define schistosomiasis
- List causes of schistosomiasis
- Identify probable cases of schistosomiasis
- Describe the mode of transmission of schistosomiasis
- Describe the management of schistosomiasis
- Discuss the prevention and control methods of schistosomiasis

7.4. Significance and Brief Description of the Problem

Ethiopia is one of the endemic countries for both *S.mansoni* and *S.haematobium*. The human infection caused by *S.mansoni* has a wide geographical distribution in Ethiopia. The severity of schistosomiasis in Ethiopia is increasing due to water related

projects and population movements. Today, schistosomiasis causes greater morbidity and mortality than all other worm infestations. The disease is increasing in prevalence affecting about 10% of the world's population and ranking second to malaria as a cause of disability and death.

Since schistosomiasis is a socio-economic problem, the control and prevention program should be integrated with the rural development programs, particularly in small scale agricultural and water development activities.

7.5. Definition, Life Cycle, Disease Development, and Patient Presentation

Definition

Schistosomiasis is a trematode disease caused by several species of schistosoma. There are two types of schistosomiasis of public health importance in Ethiopia. Intestinal schistosomiasis caused by *S. mansoni* affects the intestine and liver while urinary schistosomiasis caused by *S. haematium* affects bladder, ureters and kidneys.

Life cycle

Human infection is by skin penetration of the cercariae stage while swimming or washing in fresh water body containing the cercariae stages. Cercariae migrate from skin to blood vessels (veins) around the intestine and bladder where they develop into adult stages. The adult worms, mate and the female worm produces eggs. The eggs penetrate into the intestinal vessels of humans and excreted in feces. The eggs develop into a stage called miracidium. The miracidium penetrates an intermediate host snail where it develops into cercariae and is released into the water. The cercariae again infect man while swimming or contact with water.

Disease development

The disease is produced as a result of damage of tissues caused by reaction of the body to schistosomula, adult worms, and mainly deposited eggs in the intestinal or

bladder wall. The tissue damage is caused by host's immunological response and mechanical damage to tissues caused by eggs wherever they are deposited, i.e. intestinal or bladder wall, liver, brain, spinal cord, etc.

Patient Presentation

Patients with schistosomiasis may present with the following signs and symptoms:

- Itching of the skin at the point of cercariae penetration
- Fever and chills
- Diarrhea, abdominal cramps and tenderness
- Burning urination, bloody urine and frequent urination
- In the long run may develop abdominal swelling.

Patients are either in endemic area or travel to areas known for schistosoma and have contact with water bodies suspected to have infected snails.

7.6. Management

Early treatment is essential in patients with schistosomiasis before it damages vital body organs like the liver & kidney. Once there is damage to these organs, it is difficult to cure the patient. Therefore, community health workers should encourage patients to visit health units as early as possible.

7.7. Prevention and Control Methods

A. Proper Excreta disposal and safe water supply

When infected feces get into the bodies of water that harbor the proper snails, the life cycle of the worms can be completed and infection is transmitted. This also indicates that the life cycle of the parasite can be interrupted here, because they cannot develop without a body of water containing the proper snail host. The most basic preventive measure is to construct and use latrines. Elimination of open defecation/urination and the proper construction of latrines to prevent contamination of water is the most important preventive and control measures expected from health extension workers.

B. Information / Education /Communication

The community must be educated on the mode of transmission of schistosomiasis in order to be able to change the behavior and take a leadership role in the prevention and control of schistosomiasis. Appropriate messages must be developed for each endemic locality and the messages must be transferred to the target population. This approach aims at provision of information and to educate the public on the cause, mode of transmission and prevention of the infection. It is also used to promote proper excreta disposal to stop the transmission.

C. Eliminating or reducing breeding site

This includes the management of bodies of water so as to minimize the breeding conditions of the snails. The snails are known to inhabit and breed in relatively stagnant and deep water. Thus, making the bodies of water shallow, exposed to the sun or making the water run faster will make the snail's environment unfavorable. The process of environmental management for the prevention of infections requires community participation. Mobilizing the community is an important issue in the prevention and control of the disease. This can be undertaken by community health workers.

7.7. Post-test questions for community health workers

Choose the correct answer and write your choice on a separate answer sheet.

1. Which of the following is the most important factor for the infection of schistosomiasis?
 - A. Ingesting water and food contaminated with schistosome eggs.
 - B. Insect bite
 - C. Swimming in water containing cercariae
 - D. Ingesting fish infected with cercariae
2. What is an intermediate host for the transmission of schistosomiasis?
 - A. House flies
 - B. Mosquito
 - C. Fresh water fish

- D. Snails
3. Which of the following is an important symptom in patients with schistosomiasis?
- A. Itching of the skin
 - B. Bloody diarrhea
 - C. Bloody urine
 - D. Fever
 - F. All of the above
4. Which of the following is wrong concerning the preventive and control aspect of schistosomiasis?
- A. Proper construction and use of latrine.
 - B. Boiling water for drinking.
 - C. Cleaning the canal where snails breed
 - D. Educating the public to avoid contact with water bodies that have cercariae and to use latrine.

Task Analysis for health extension workers

The community health worker is expected to under take the following activities:

1. Establish the presence of schistosomiasis in the community.
2. Conduct home visit to monitor drug reaction and advise defaulters.
3. Giving health information to the community about the causes, treatment and prevention methods.
4. Mobilizing the community to construct and use latrines.
5. Reporting to the nearest health institution about all activities done on this disease.
6. Mobilizing the community to protect springs and wells.

UNIT EIGHT

TAKE HOME MESSAGES FOR CARE GIVERS/SELF CARE

So far, we have discussed in detail about schistosomiasis.

What do you know about scistosomiasis?

Schistosomiasis is a disease caused by blood and intestinal flukes which are generally flat, flashy flat leaf shaped worms in which the adult worms are adapted to life with in blood vessels of intestinal wall and bladder. The male is actually flat, but its sides of the body rolled ventrally forms a gynecophoric canal bearing the long flat body of the female.

Causes of Schistosomiasis

The common species of flukes that cause the disease schistosomiasis are:

- ◆ *S. mansoni*
- ◆ *S. haematobium* and
- ◆ *S. japonicum*

Who are affected by schistosomiasis?

- ◆ People who are close and have repeated contact with infected water bodies; closely linked with the personal habits and livelihood requiring daily and frequent contact with contaminated water.
- ◆ It affects children as well as adults.

Signs and symptoms of schistosomiasis

- ◆ Itching sensation at the site of penetration of cercariae
- ◆ Fever
- ◆ Fatigue
- ◆ Abdominal cramping/painful urination

- ◆ Bloody diarrhea/bloody urine
- ◆ Paleness of inner eye lids, palms and finger nail beds because of blood loss.

Management of schistosomiasis

Any person showing the above signs and symptoms should go to a health institution for examination and appropriate treatment

Prevention of schistosomiasis

Infection of schistosomiasis can be prevented by:

- ◆ Construction of foot bridges across infected rivers
- ◆ Prevention of water contamination by providing health information and sanitary facilities
- ◆ Early treatment of infected persons
- ◆ Providing health information to use latrines, and sufficient and safe water supply
- ◆ Protecting water supplies from fecal pollution by animal reservoir hosts
- ◆ Minimizing the risk of infection from new water conservation, irrigation schemes and hydroelectric development
- ◆ Destroying snail intermediate hosts by removing vegetation from locally used water places and draining swamps.

UNIT NINE

ROLE AND TASK ANALYSIS

N.B: The scope and level of involvement in the different tasks may vary on the basis of level of training of health professionals.

9.1 Knowledge, Objective and Learning Activities

No	Learning objectives	Learning activities			
		HO	Nurse/PHN	ENHS/EHT	MLT
1	To define schistosomiasis	Define schistosomiasis	Define schistosomiasis	Define schistosomiasis	Define schistosomiasis
2	To identify the etiology and pathogenesis of schistosomiasis	-Identify the etiologies of schistosomiasis -Study the pathogenesis of schistosomiasis	-Identify the etiologies of schistosomiasis -Study the pathogenesis of schistosomiasis	-Identify the etiologies of schistosomiasis -Study the pathogenesis of schistosomiasis	-Identify the etiologies of schistosomiasis -Study the pathogenesis of schistosomiasis
3	To describe the epidemiology of schistosomiasis	Study the prevalence of <i>S.mansoni</i> and <i>S. haematobium</i>	Study the prevalence of <i>S.mansoni</i> and <i>S. haematobium</i>	Study the prevalence of <i>S.mansoni</i> and <i>S. haematobium</i>	Study the prevalence of <i>S.mansoni</i> and <i>S. haematobium</i>
4	Explain the public health significance of schistosomiasis	Recognize the morbidity and mortality of schistosomiasis	Recognize the morbidity and mortality of schistosomiasis	Recognize the morbidity and mortality of schistosomiasis	Recognize the morbidity and mortality of schistosomiasis
5	To identify the clinical features of schistosomiasis	Describe the sign and symptoms of schistosomiasis	Describe the subjective and objective features manifested by schistosomiasis	Learn the signs and symptoms of schistosomiasis	Learn the signs and symptoms of schistosomiasis
6	To enumerate the methods of diagnosing schistosomiasis	-Know the techniques of history taking and physical	-Recognize the subjective and objective features for the diagnosis of	-Recognize the different approaches to detect	-Study the steps in diagnosing schistosomiasis -Study the

		examination to diagnose schistosomiasis -Know the laboratory techniques used to diagnose schistosomiasis	schistosomiasis - Be familiar with the basic diagnostic methods	schistosomiasis	different laboratory techniques to detect schistosomiasis
7	To describe the management of schistosomiasis	-Understand the need for early detection and treatment of schistosomiasis -Study the management of complications of schistosomiasis Enumerate the drugs used and complications	-Understand the pharmacological management of schistosomiasis -Identify the possible nursing interventions for the complications of schistosomiasis	-Understand the need for early detection and treatment of schistosomiasis	-Understand the need for early detection and treatment of schistosomiasis
8	To explain the preventive and control measures of schistosomiasis	-Study the preventive and control measures of schistosomiasis	-Recognize the control and preventive methods of schistosomiasis	- Study the preventive and control measures of schistosomiasis -Study the various environmental health actions to prevent the predisposing factors of schistosomiasis	- Study the preventive and control measures of schistosomiasis
9	To recognize the interdisciplinary roles of the different health center team members in the	-Recognize the roles of other team members.	-Recognize the roles of other team members.	-Recognize the roles of other team members.	-Recognize the roles of other team members.

	management, prevention and control of Study the preventive and control measures of schistosomiasis				
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9.2 Attitude, objectives and learning activities

No.	Learning objectives	Learning activities			
		HO	Nurse/PHN	ENHS/EHT	MLT
1	To recognize schistosomiasis is a significant public health problem in Ethiopia	Realize that schistosomiasis is a major health problem of Ethiopia	Realize that schistosomiasis is a major health problem of Ethiopia	Realize that schistosomiasis is a major health problem of Ethiopia	Realize that schistosomiasis is a major health problem of Ethiopia
2	To appreciate the different etiologies of schistosomiasis	Give emphasis to <i>S.mansoni</i> and <i>S.haematobium</i> species.	Give emphasis to <i>S.mansoni</i> and <i>S.haematobium</i> species.	Give emphasis to <i>S.mansoni</i> and <i>S.haematobium</i> species.	Give emphasis to <i>S.mansoni</i> and <i>S.haematobium</i> species.
3	To appreciate the life cycle of schistosomiasis	Recognize the need of intermediate host and fresh water bodies for the life cycle of schistosomiasis.	Recognize the need of intermediate host and fresh water bodies for the life cycle of schistosomiasis.	Recognize the need of intermediate host and fresh water bodies for the life cycle of schistosomiasis.	Recognize the need of intermediate host and fresh water bodies for the life cycle of schistosomiasis.

4	To recognize the signs and symptoms of schistosomiasis.	-Appreciate the need to detecting schistosomiasis early. -Focus on the important clinical features and complications.	-Focus on the important clinical features. -Give due attention to patients with schistosomiasis.	-Give emphasis to educate about the signs and symptoms of schistosomiasis,	-Recognize the signs and symptoms of schistosomiasis.
5	To give value to the diagnostic approaches of schistosomiasis	Appreciate the importance of history taking and physical examination in the diagnosis of schistosomiasis.	-Give respect and show concern to the patient during the whole diagnostic procedure.	-Believe on the need for advocacy to increase the public awareness that schistosomiasis can be easily diagnosed in health institutions.	-Recognize the different laboratory techniques and procedures to detect and interpret schistosoma species.
6	To give emphasis to appropriate management of schistosomiasis.	-Give importance to appropriate treatment of acute schistosomiasis. -Give value to appropriate management of complications of schistosomiasis.	-Give value about the curability of schistosomiasis through proper medical and nursing management.	-Realize the value for the need of appropriate management of schistosomiasis.	-Realize the value for need of appropriate management to treat schistosomiasis. - Believe that schistosomiasis can be treated.
7	To give emphasis to prevention and control measures of schistosomiasis.	-Believe on importance of health information to prevent schistosomiasis.	-Give more emphasis to health information as main preventive and control measures.	-Believe that there are specific measures to prevent and control schistosomiasis. - Give attention to health information. -Recognize the environmental control measures.	-Believe that health information is the most important measure to prevent schistosomiasis.

9.3 Practice, Objectives and Learning Activities

No	Learning Objectives	Learning Activities			
		HO	NURSE/PHN	ENHS/EHT	MLT
1	To perform appropriate diagnostic measures of schistosomiasis	Take appropriate history, perform proper physical examination.	Apply the nursing process to diagnose the patients' illness	Give health information on the sign and symptoms.	Conduct appropriate laboratory investigations.
2	To detect the different etiologic agents of schistosomiasis	Take appropriate history, perform proper physical examination.	Asses the patient properly for the possible causative agents.	Give health information on the root causes and the need for medical check up.	-Carry out the different laboratory investigations to identify etiologic agents/species. -Record and report the result
3	To apply proper management of schistosomiasis	-Prescribe appropriate anti-schistosomal chemotherapy. -Refer severe/ complicated cases.	Carry out the appropriate nursing management and patient support principles.	Teach on personal and environmental management	- Play an active role in laboratory confirmation of cure.
4	To conduct appropriate prevention and control measures of schistosomiasis	-Prescribe proper anti- schistosomal chemotherapy. - Give health information to individuals, family and community on the prevention and control -Ensure community involvement in the prevention of schistosomiasis.	-Give health information to individuals, family and community on the prevention and control.	Give health information on:- -the need of early detection and treatment -environmental causes and management -the need for the use of sanitary toilets -prevention of pollutions of water sources.	-Give health information to the community about prevention and control.

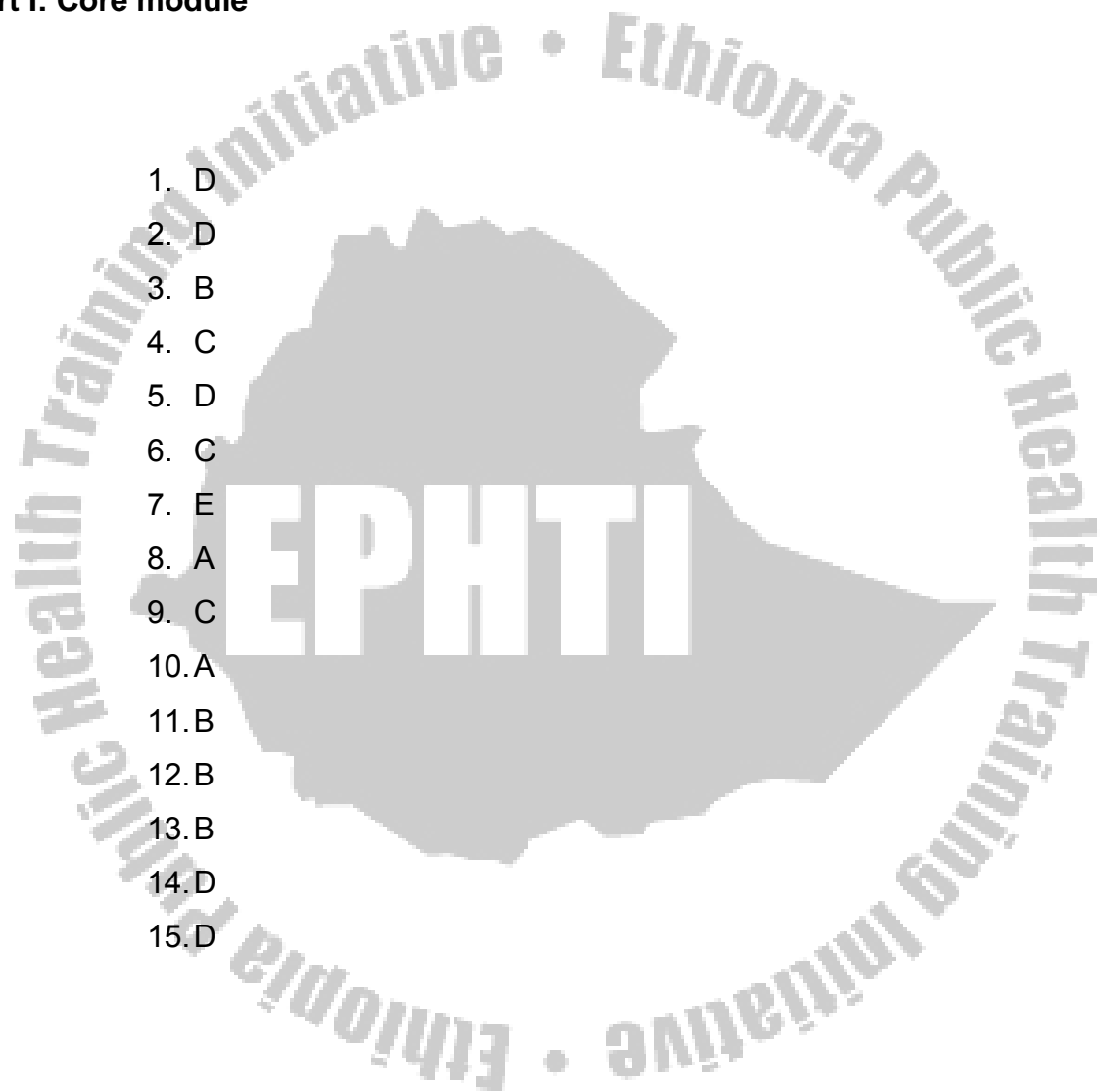
ANNEXES

Annex-1

Answer keys to pre and post tests

Part I: Core module

1. D
2. D
3. B
4. C
5. D
6. C
7. E
8. A
9. C
10. A
11. B
12. B
13. B
14. D
15. D



Part II

A. For Health officers

1.

No.	<i>Intestinal Schistosomiasis</i>	<i>Urinary schistosomiasis</i>
1	Cercarial dermatitis, so called “ <i>swimmer’s itch</i> ” most often occurs	Cercarial dermatitis, so called “ <i>swimmer’s itch</i> ” occurs but less commonly
2	<i>Colicky</i> abdominal pain, bloody diarrhea, fatigue and growth retardation in children	Burning sensation on urination, bloody urine, and frequency of urination
3	Portal hypertension which may lead to ascites, splenomegaly, and esophageal varices	Obstruction of the lower end of the ureter which may result in hydroureter and hydronephrosis
4	Presence of periportal fibrosis on ultrasound	Presence of typical <i>sandy patches</i> visible on cystoscopy
5	No association with malignancy	An association with squamous cell carcinoma of the bladder

2.

The basis for pathogenesis of schistosomiasis is an inflammatory response both humoral and cell mediated against cercaria in early infection and more importantly to eggs deposited in several tissues. The granulomatous response around these ova is cell mediated and is regulated both negatively and positively by a cascade of cytokines, cellular and humoral response.

3.

Eggs are eliminated with feces or urine. Under optimal conditions the eggs hatch and release miracidia, which swim and penetrate specific snail intermediate hosts. Miracidia develop into cercariae in the snail. Upon release from the snail, the infective cercariae swim; penetrate the skin of the human host which migrates through several tissues and stages to their residence in the veins. Adult worms in humans reside in

the mesenteric venules in various locations; mesenteric veins for *S. mansoni* and venous plexus of bladder for *S. haematobium*. The females deposit eggs in the small venules of the portal and perivesical systems; the eggs are moved progressively toward the lumen of the intestine (*S. mansoni* and *S. japonicum*) and of the bladder and ureters (*S. haematobium*), and are eliminated with feces or urine, respectively.

4.

- ◆ Avoiding contact with water known to contain cercariae by providing safe water supply to the community for washing and bathing sites and Health information for the community
- ◆ Preventing water from contamination with eggs by providing sanitation facilities, health information and treating infected persons.
- ◆ Minimizing the risk of infection from new water conservation, irrigation schemes and hydroelectric development by treating workers when necessary and making settlements away from canal drains and irrigation canals
- ◆ Destroying snail intermediate hosts by removing vegetation from canals and using molluscicides

5.

- ◆ Complications of intestinal schistosomiasis.
 1. **Portal hypertension:** is due to the development of periportal fibrosis due to granulomatous inflammation induced by embolized eggs to the liver that are lodged in the presinusoidal sites. It manifests with ascites, esophageal varices with or without bleeding, and an enlarged spleen.
 2. **Glomerulonephritis:** is due to antigen-antibody complexes deposited in the renal glomeruli. This may manifest with proteinuria and/or renal failure.
 3. **Fissure in ano, Fistula in ano and piles**

Fissure in ano and piles due to schistosoma mansoni infection have been observed. Fistulas frequently develop into the ischioanal fossa, the perineum, the buttocks, or the urinary bladder.

◆ **Complications of urinary schistosomiasis**

1. **Hydroureter and hydronephrosis:** occur due to granuloma formation in the ureters obstructing urinary flow.
2. **Bladder stone:** may form due to scarring and depositions of calcium around the eggs as nuclei in chronic stages of infection.

B. For Nurses

1. D
2. C
3. C
4. C
5. E

C. For Medical Laboratory Technologists

Multiple-choice items

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

Short answer items

1. *S.haematobium* eggs have terminal spine where as that of *S.mansoni* have lateral spine.
2. Cellophane strips soaked in glycerine/malachite green or glycerine/methylene blue solution.
3. The appropriate time is between 10.00h and 14.00h because the excretion of *S.haematobium* eggs in urine is highest at this time.
4. Circulating anodic antigen (CAA) and circulating cathodic antigen (CCA)

5. The use of ether in Formol Ether concentration technique is to dissolve the fat in the feces

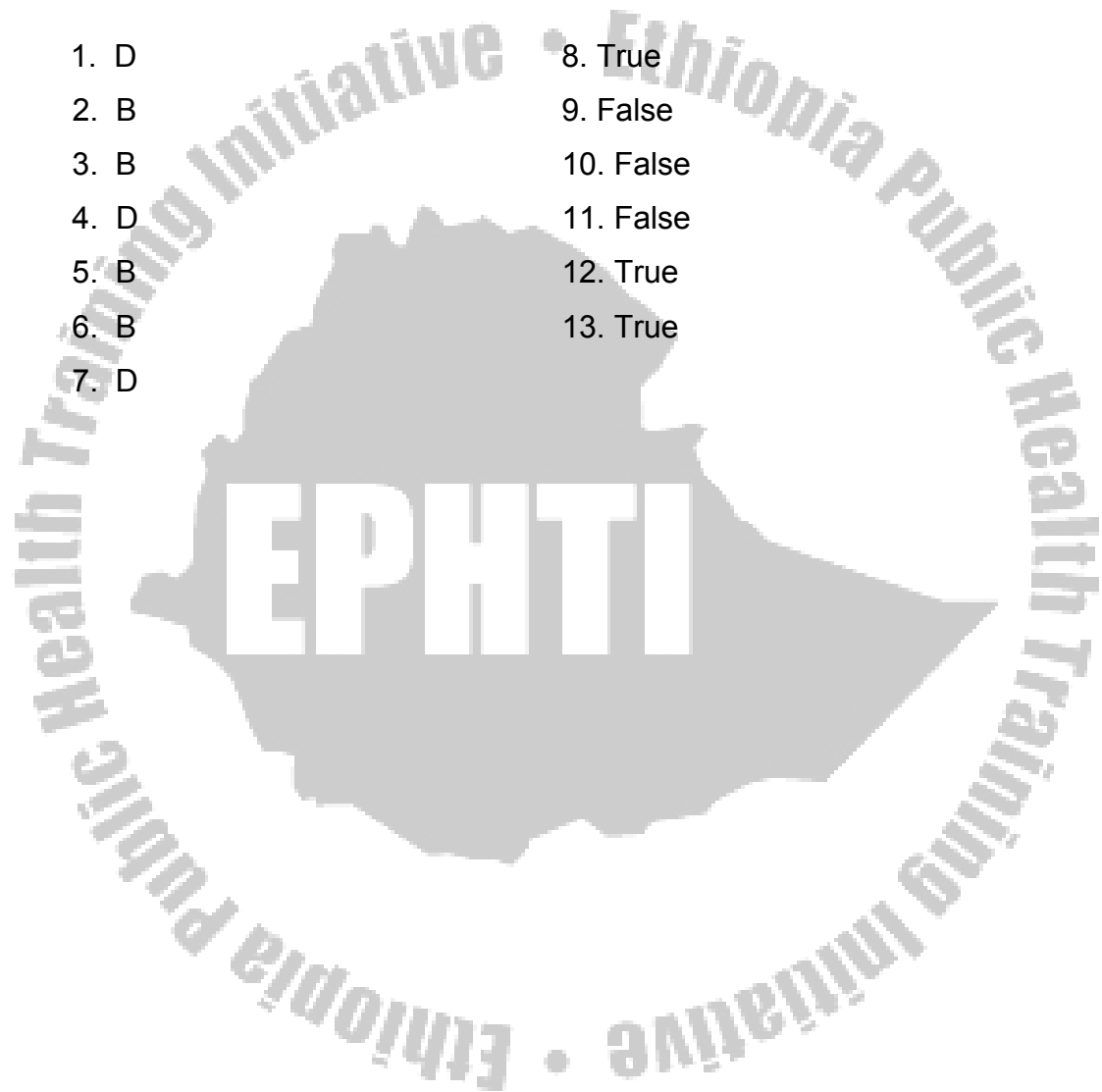
D. For Environmental Health Officers

Choose the best answer

True or false

1. D
2. B
3. B
4. D
5. B
6. B
7. D

8. True
9. False
10. False
11. False
12. True
13. True



Annex- 2

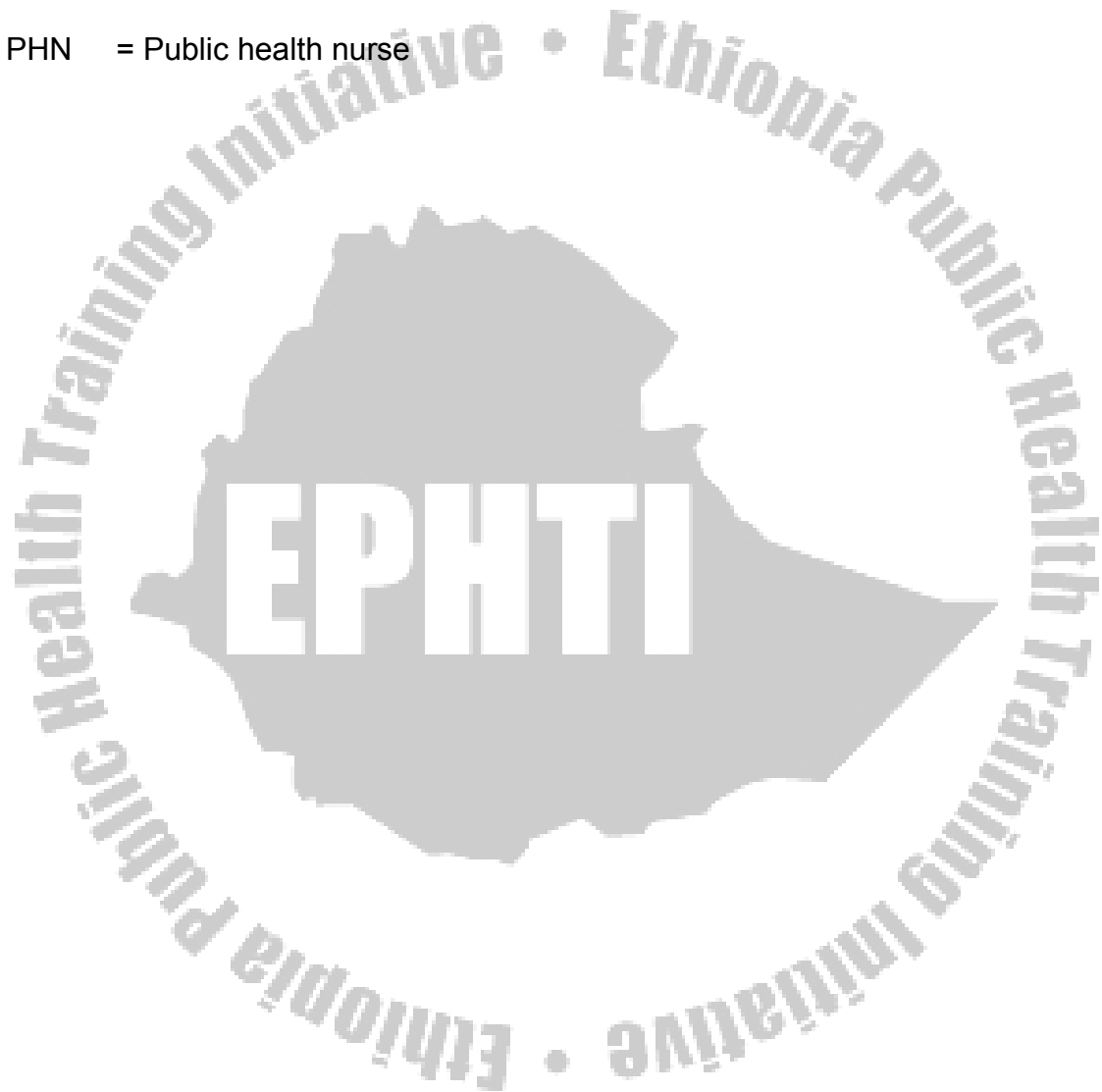
Abbreviations

HO = Health Officer

ENHO = Environmental Health Officer

MLT = Medical Laboratory Technologist

PHN = Public health nurse



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GLOSSARY

Ascites: an abnormal pooling of fluid in the abdominal cavity; the fluid contains large amounts of protein and other cells. Ascites is usually noticed when more than 1 pint (500 ml) of fluid has collected.

Bacteriuria: the presence of bacteria in the urine. More than 100,000 bacteria per ml of urine usually mean urinary tract infection is present.

Biopsy: 1. Removing a small piece of living tissue from an organ or other part of the body for microscopic examination to establish a diagnosis or follow the course of a disease.

2. The tissue removed for examination.

3. (*Informal*) to remove *tissue* for examination. Kinds of biopsy include aspiration biopsy, needle biopsy, punch biopsy, surface biopsy.

Cercaria: (*pl. cercariae*) a tiny, wormlike form of the class Trematoda. It develops in a freshwater snail. It is released into the water and swims toward the sun, rising to the surface of the water in the warmest part of the day.

Cystoscopy: the direct examination of the urinary tract with a special device (cystoscope) placed in the urethra. Before the test, the patient either is given a tranquilizer or is put to sleep. For the test, the bladder is filled with air or water and the cystoscope is put into place. In addition to testing, cystoscopy is used for taking samples of tumors or other growths and for removing growths (polyps).

Dermatitis: an inflammation of the skin marked by redness, pain, or itching. The condition may be long-term or sudden.

Dysuria: painful urination, usually the result of a bacterial infection or blockage in the urinary tract. Dysuria is a symptom of such conditions as inflammation of the urinary bladder (cystitis), swelling of the urethra (urethritis), swelling of the prostate (prostatitis), urinary tract tumors, and some gynecological disorders.

Esophageal varices: a network of twisted veins at the lower end of the esophagus, which is enlarged and swollen as the result of high blood pressure within

the portal vein in the abdomen. These vessels often form open sores and bleed. This is often a complication of cirrhosis of the liver.

Fissure: 1. A crack like break in the skin, as an anal fissure.

2. A split or a groove on the surface of an organ. It often marks the division of the organ into parts, as the lobes of the lung. A fissure is usually deeper than a sulcus, but *fissure* and *sulcus* are often used as if they were the same thing.

Fistula: an abnormal passage from an internal organ to the body surface or between two internal organs. Fistulas may occur in many sites from the mouth to the anus and may be made for treatment follow the course of a disease.

Fossa (pl. fossae): a hollow or pouch, especially on the surface of the end of a bone

Hematemesis: vomiting of bright red blood, indicating rapid bleeding of the upper digestive tract. It is often linked to enlarged veins in the esophagus or peptic ulcer.

Hematuria: abnormal presence of blood in the urine. Many kidney diseases and disorders of the genital and urinary systems can cause hematuria.

Hydronephrosis, swelling of the pelvis by urine that cannot flow past a blockage in a ureter.

Ureteral obstruction may be caused by a tumor, a stone lodged in the ureter, inflammation of the prostate gland, or a urinary-tract infection. The person may have pain in the flank. Surgery to remove the blockage may be needed. Prolonged hydronephrosis will result in eventual loss of kidney function.

Hydroureter: swelling of the ureter by urine that cannot flow past a blockage in the lower ureter, bladder or urethra.

Miracidium: the larval stages of aquatic invertebrates (e.g. Flukes) that lead sedentary, or attached, lives in the adult stage are typically motile and free-swimming. Such larvae are found in sponges, sessile mollusks, and many rotifers and worms. These larvae serve to increase the distribution of the adults.

Proteinuria: also called albuminuria, having large amounts of protein in the urine, as albumin proteinuria is often a sign of kidney disease or kidney problems brought on by another disease. However, proteinuria can also be caused by heavy exercise or fever.

Pyuria: white blood cells in the urine. It is a sign of infection of the urinary tract. Pyuria occurs in inflammation of the bladder, kidney, or urethra, and tuberculosis of the kidney. Pyuria may be caused by an infection from viruses. Miliary pyuria causes blood, pus, and tissue cells, as well as bacteria, in the urine.

