APPLIED PARASITOLOGY (ZOO 401)

*Guinea worm Disease

*Also known as Guinea Worm Disease

*Caused by nematode parasite *Dracunculus medinensis*

*Vector borne parasitic disease (as it is transmitted by the water fleas Daphnia sp.)

*Involves subcutaneous tissues(leg and foot)

*Its not lethal but disable its victim temporarily

*Transmitted exclusively when people drink stagnant water contaminated with parasite infected water fleas.

*It affects people in rural, deprived and isolated communities who depend mainly on open surface water sources such as ponds and wells.

*EPIDEMIOLOGY

*The disease can occur in any age group but frequently presents in young adults between 15 to 45 years.

*Men and women are equally affected. Transmission of the disease depends on seasonal variation and usually occurs during the rainy season or dry season

*Recent World Health Organization (WHO) reports from October 2018 state that only a few cases have been reports in Chad, South Sudan, and Angola.

*The goal was to eradicate this disease from the world by the year 2020. Status??

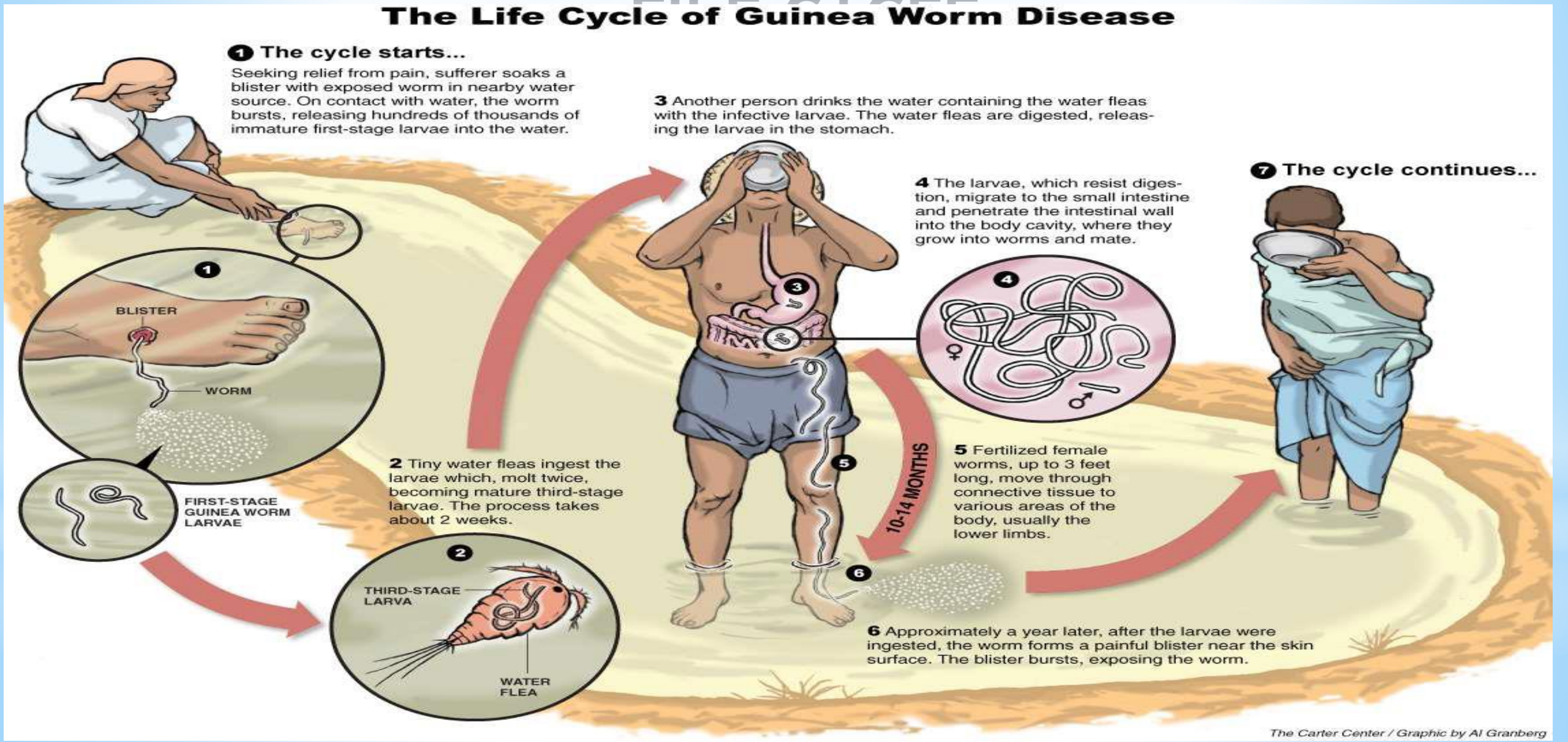
*HABITAT

*It is a round worm threadlike in nature

*Adult parasite inhabits subcutaneous tissue mainly of legs but other parts are also included like head and neck

*Female worm which is 55 to 120cm long resides in the subcutaneous tissues and intermusular connective tissues the of the lower extremities; especially around the ankle whle the male 2 to 3cm long resides in the resides in the retroperitoneal connective tissues and dies shortly after copulation

*LIFE CYCLE


The Life Cycle of Guinea Worm Disease
1 The cycle starts...
Seeking relief from pain, sufferer soaks a blister with exposed worm in nearby water source. On contact with water, the worm bursts, releasing hundreds of thousands of immature first-stage larvae into the water.
BLISTER
WORM
FIRST-STAGE GUINEA WORM LARVAE
2 Tiny water fleas ingest the larvae which, molt twice, becoming mature third-stage larvae. The process takes about 2 weeks.
THIRD-STAGE LARVA
WATER FLEA
3 Another person drinks the water containing the water fleas with the infective larvae. The water fleas are digested, releasing the larvae in the stomach.
4 The larvae, which resist digestion, migrate to the small intestine and penetrate the intestinal wall into the body cavity, where they grow into worms and mate.
10-14 MONTHS
5 Fertilized female worms, up to 3 feet long, move through connective tissue to various areas of the body, usually the lower limbs.
6 Approximately a year later, after the larvae were ingested, the worm forms a painful blister near the skin surface. The blister bursts, exposing the worm.
7 The cycle continues...
The Carter Center / Graphic by Al Granberg

Pathology and pathogenesis

* After ingestion of the Cyclops, there is no specific pathology associate with the mucosal penetration and larval maturation in the deep connective tissues.
* Erythema and tenderness can be associated with blister formation.

* **FACTORS THAT ENHANCE TRANSMISSION OF DRACUCUNLIASIS**
* **SEASON**: Where the step-wells are the source of water supply, peak transmission occurs during the dry season(March-May) when the contact between open cases of guniea-worm disease and the drinking water is the greatest. Secondly, where ponds are used, transmission occurs when ponds are full.

* **TEMPERATURE**: Larvae develop best between 25 and 30 deg C and will not develop below 19 deg C. Note that the disease is limited to tropical and subtropical regions.

*Laboratory diagnosis

Diagnosis is mainly by clinical presentation.

Peripheral eosinophilia can be present in the blood work. Immunoglobulin G4 levels might be elevated.

Gravid female worm appears at the surface of skin.

If the worms die before they emerge from the skin, they may calcify and can be visible on x-ray

*SIGNS or SYMPTOMS

*Intense burning pain localized to path of travel of worm

*Fever

*Nausea

*Vomiting

*Allergic reaction

*Arthritis and paralysis (due to death of adult worm in joint).

*Skin blisters, which when rupture form ulcers.

*Adult worms protrude from these ulcers.

*Prevention and Control

1. Prevent people from drinking contaminated water containing the cyclops which can be seen in clear water as swimming white specks. This can be done by using:

Piped water

Water from borehole

Boiled water

Treating water sources with larvicides to kill the water fleas.

2. Prevent people with emerging Guinea worms from wading into water sources used for drinking.

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TREATMENT AND MANAGEMENT

No medication is effective against guinea worm disease.

Surgical extraction of the worm is the therapy in areas where facilities are available.

Anti-inflammatory agents like aspirin and ibuprofen can help decrease pain and swelling. Diphenhydramine can treat the itching.

Topical antibiotic cream or ointment is an option to prevent secondary bacterial infection at the site where the worm emerges. Systemic antibiotics may be required if cellulitis, sepsis, or abscess develops. Wound care is important.

*ONCHOCERCIASIS

*__Onchocerciasis__ also known as **RIVER BLINDNESS**

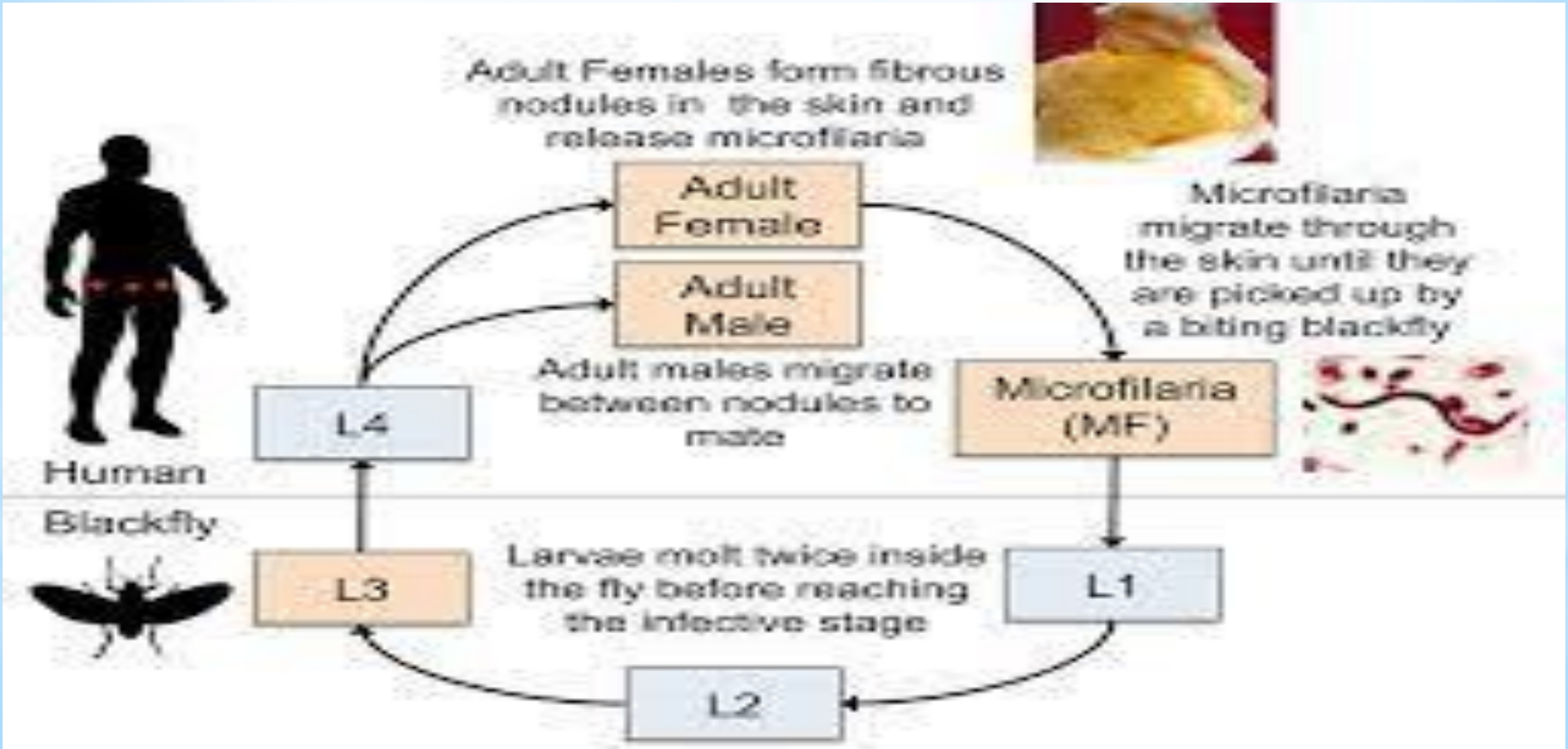
*It is a parasitic disease caused by infection by *Onchocerca volvulus*, a nematode (roundworm).

*it is the world's second-leading infectious cause of blindness

*The parasite is transmitted to humans through the bite of a **black fly** of the genus ***Simulium***.

*The larval nematodes spread throughout the body.

*LIFE CYCLE


Adult Females form fibrous nodules in the skin and release microfilaria
Adult Female
Adult Male
Adult males migrate between nodules to mate
Microfilaria migrate through the skin until they are picked up by a biting blackfly
Microfilaria (MF)
L4
L3
L2
L1
Larvae molt twice inside the fly before reaching the infective stage
Human
Blackfly

*DIAGNOSIS

*The gold standard test for the diagnosis of onchocerciasis remains the skin snip biopsy. The sites for the skin snip are usually over the iliac crest, the scapula, and the lower extremities. Six snips provide the most diagnostic sensitivity.

*Performing polymerase chain reaction (PCR) of the skin snip can increase the sensitivity and specificity in these two situations.

If a patient has skin nodules caused by *Onchocerca* infection, nodulectomy allows for the identification of macrofilariae (adult worms) in the tissue.

Slit lamp eye exam can be used to visualize microfilariae, or the lesions they cause, in individuals with eye disease.

Serology tests

*SIGNS AND SYMPTOMS

- *Skin involvement typically consists of intense itching, swelling, and inflammation
- *Skin atrophy - loss of elasticity, the skin resembles tissue paper, 'lizard skin' appearance
- *Depigmentation may involve any part of the eye from conjunctiva and cornea to uvea and posterior segment, including the retina and optic nerve cornea.

Fig. 5: Eye lesions in Onchocerciasis
Source: Google images.

*TREATMENT

Ivermectin is the drug administered.

Ivermectin treatment is particularly effective because it only needs to be taken once or twice a year. Although ivermectin does not kill the macrofilariae, it does sterilize the adult female worms.

Treatment for a patient who will not be returning to live in an endemic area should be given every six months (and dosing as frequent as every three months could be considered) for as long as there is evidence of continued infection.

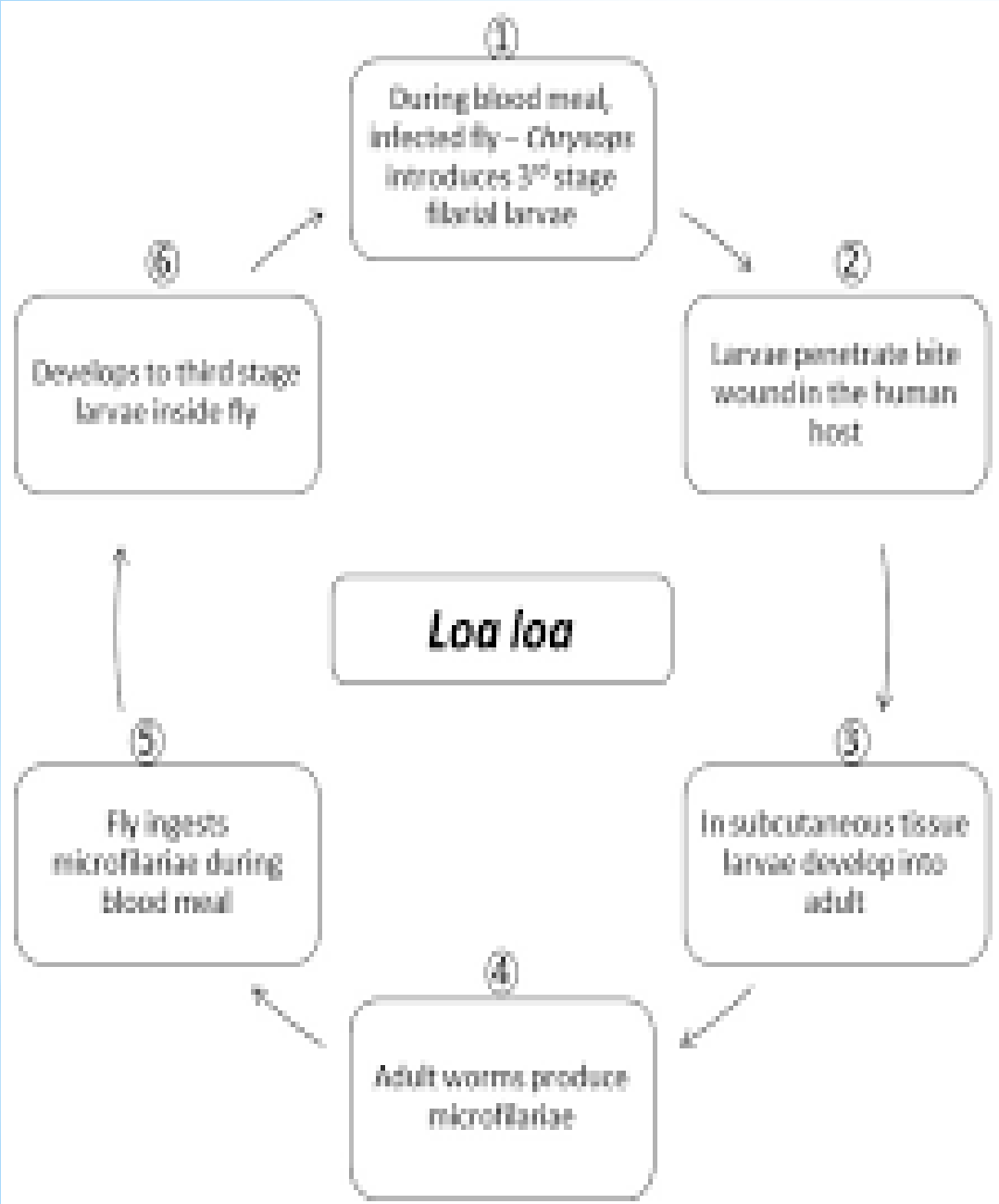
Treatment with ivermectin should be given one week prior to treatment with doxycycline in order to provide symptom relief to the patient.

*LOIASIS

*Loiasis, called African eye worm by most people, is caused by the parasitic worm *Loa loa*.

*It is passed on to humans through the repeated bites of deerflies (also known as mango flies or mangrove flies) of the genus Chrysops.

*Infection with the parasite can also cause repeated episodes of itchy swellings of the body known as Calabar swellings.


1
During blood meal, infected fly – Chrysops introduces 3rd stage filarial larvae
2
Larvae penetrate bite wound in the human host
3
In subcutaneous tissue larvae develop into adult
4
Adult worms produce microfilariae
5
Fly ingests microfilariae during blood meal
6
Develops to third stage larvae inside fly
Loa loa

*DIAGNOSIS AND SYMPTOMS

- dentification of the adult worm by a microbiologist or pathologist after its removal from under the skin or eye
- Identification of an adult worm in the eye by a health care provider
- Identification of the microfilariae on a blood smear made from blood taken from the patient between 10AM and 2PM
- Identification of antibodies against *L. loa* on specialized blood test

A positive antibody blood test in someone with no symptoms means only that the person was infected sometime in his/her life. It does not mean that the person still has living parasites in his/her body.

The most common manifestations of the disease are Calabar swellings and eye worm. Calabar swellings are localized, non-tender swellings usually found on the arms and legs and near joints. Itching can occur around the area of swelling or can occur all over the body.

Eye worm is the visible movement of the adult worm across the surface of the eye. Eye worm can cause eye congestion, itching, pain, and light sensitivity. Although eye worm can be scary, it lasts less than one week (often just hours) and usually causes very little damage to the eye.

People with loiasis can have itching all over the body (even when they do not have Calabar swellings), hives, muscle pains, joint pains, and tiredness. Sometimes adult worms can be seen moving under the skin.

*TREATMENT

Although surgical removal of adult worms moving under the skin or across the eye can be done to relieve anxiety, loiasis is not cured by surgery alone.

There are two medications that can be used to treat the infection and manage the symptoms. The treatment of choice is diethylcarbamazine (DEC), which kills the microfilariae and adult worms. Albendazole is sometimes used in patients who are not cured with multiple DEC treatments

It is thought to kill adult worms. Certain people with heavy infections are at risk of brain inflammation when treated with DEC. This can cause coma or sometimes death. People with heavy infections need to be treated by experienced specialists.

Sometimes, other medical conditions need to be addressed first in order to make it safer to use DEC. Sometimes treatment is not recommended.

*PREVENTION AND CONTROL

There are no vaccines that protect you from loiasis. If you are going to be in an area with loiasis for a long period of time, diethylcarbamazine (DEC)—300mg taken once a week—can reduce your risk of infection.

Avoiding areas where the deerflies are found, such as muddy, shaded areas along rivers or around wood fires, may also reduce your risk of infection.

You may reduce your risk of bites by using insect repellants that contain DEET (N,N-Diethyl-meta-toluamide) and wearing long sleeves and long pants during the day, which is when deerflies bite.

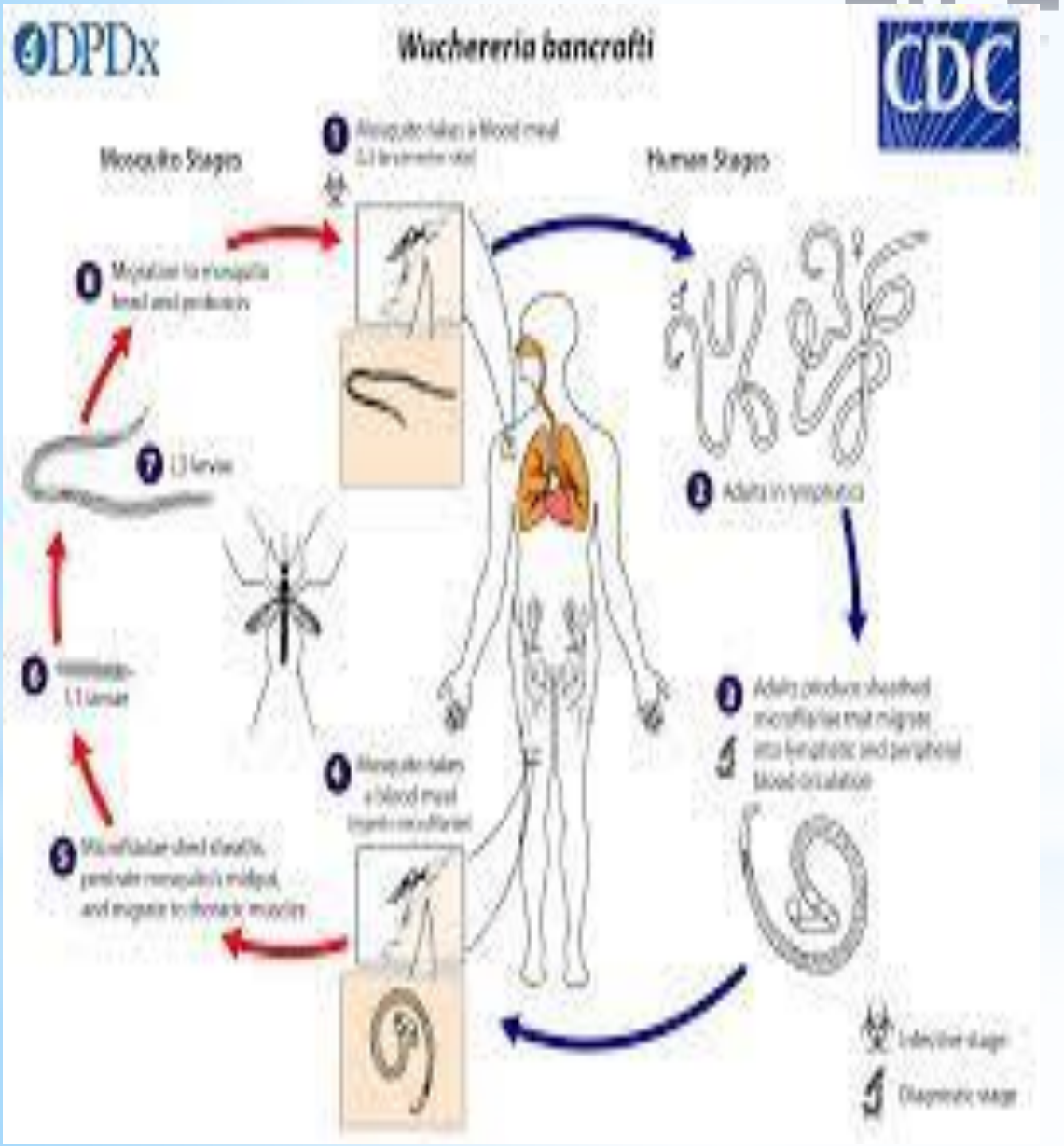
Treating your clothes with permethrin may also help.

*WUCHERERIASIS

* Wuchereriasis or Lymphatic filariasis, considered globally as a neglected tropical disease (NTD), is a parasitic disease caused by microscopic, thread-like worms called *Wuchereria bancrofti* .
* The adult worms only live in the human lymph system. The lymph system maintains the body's fluid balance and fights infections.
* Lymphatic filariasis is spread from person to person by mosquitoes

* It is a **digenetic parasite** completing its life cycle in 2 hosts. The final host is man harboring the adult worms, while the intermediate host is blood-sucking insects, the female mosquitoes of genus Culex, Aedes or Anopheles.
* Adult worms live coiled up in the lymph glands and lymph passage of man, where they often obstruct the flow of lymph.
* The larvae i.e. microfilariae are found in the peripheral blood, occasionally they are also found in chylous urine or in hydrocele fluid.

*LIFE CYCLE



* **Definitive host**: Man. No animal host or reservoir is known for *W. bancrofti*
* **Intermediate host**: Female mosquitoes, belonging to genus Culex, Aedes, and Anopheles.
* **Infective form:** Actively motile third-stage filariform larva is infective to man.
* **Mode of transmission**: Humans get the infection by the bite of a mosquito carrying a filariform larva.

* Copulation takes place when individuals of both sexes are present in the same lymph gland

*DIAGNOSIS

* A blood smear is a simple and fairly accurate diagnostic tool, provided the blood sample is taken during the period in the day when the juveniles are in the peripheral circulation.
* A polymerase chain reaction test can also be performed to detect a minute fraction, as little as 1 pg, of filarial DNA.
* Some infected people do not have microfilariae in their blood. As a result, tests aimed to detect antigens from adult worms can be used.
* Ultrasonography can also be used to detect the movements and noises caused by the movement of adult worms.
* Dead, calcified worms can be detected by X-ray examinations.

*SYMPTOMS

*There are asymptomatic, acute and chronic conditions of the disease.

*Most people who are infected are asymptomatic meaning they show no signs outside the body of being infected.

*The asymptomatic infections will damage the lymphatic system, kidneys and immune system.

*For the acute infections there is local inflammation in lymph nodes, lymphatic vessels this will then lead to lymphoedema.

*The lymphoedema is caused as a response by the body to the parasite. This causes bacterial infections on the skin. In chronic conditions tissues start to swell skin/tissue thicken, and there is scrotal swelling. This leaves people deformed and valuable to infections.

*PREVENTION

Prevention focuses on protecting against mosquito bites in endemic regions.

Insect repellents and mosquito nets are useful to protect against mosquito bites.

Public education efforts must also be made within the endemic areas of the world to successfully lower the prevalence of *W. bancrofti* infections.

Encourage early detection and treatment of suspected infected persons.

Participate in mass treatment programmes for filariasis.