Chapter 1

Introduction
1. Introduction:

1.1 Introduction of lymphatic filariasis

Lymphatic filariasis infection and disease Lymphatic filariasis (LF) also known as elephantiasis, is a mosquito-transmitted disease that can lead to a chronic swelling of arms, legs, breasts or genitals. LF is a major cause of clinical morbidity and is an impediment to socioeconomic development. It is the world's second leading cause of permanent long-term disability (after mental illness) and its prevalence is increasing. Approximately 120 million people in 80 endemic countries worldwide are estimated to be infected with parasites that cause the disease. *Wuchereria bancrofti* is the most widespread filarial parasite and is estimated to affect 107 million people in tropical and subtropical areas of Africa, India, and Asia, the Pacific islands, and South and Central America.

In spite of the magnitude of the problem, in the last decade there has been a great sense of optimism about effective control of the disease. The International Task Force for Disease Eradication has identified it as one of the world's six 'eradicable' or 'potentially eradicable' infectious disease. As a result, the World Health Assembly, at its 50th general assembly in May 1997, passed a resolution to eliminate the disease as a public health problem worldwide. The major challenges to the implementation of this resolution include a good knowledge of the geographical distribution of the disease, effective drug treatment, an efficient drug delivery system and political commitment by national governments and the international community.

1.1.1 Brief history of filariasis

Patrick Manson, known internationally as “the father of tropical medicine”, while working in the remote Chinese port city of Amoy in 1877, first identified that
mosquitoes were responsible for the transmission of lymphatic filariasis. Following the introduction in 1947 of the drug diethylcarbamazine (DEC) for the treatment of the disease, a number of countries (Japan, China, Malaysia, Korea and some islands in the Pacific) made significant improvement in treatment of lymphatic filariasis. In 1993, an independent International Task Force for Disease Eradication identified LF as one of only six eliminable infectious diseases. LF was selected because of advances in treatment methods, both for controlling transmission and for managing the disease. The World Health Assembly (1997) adopted a resolution calling for the elimination of LF as a public health problem worldwide. The principal strategies for interrupting transmission of infection is to identify areas in which LF is endemic and then implement community wide programs to treat the entire at-risk population. The goal of such treatment is to break the cycle of transmission between mosquitoes and humans.

1.1.2 Human parasite & vectors

Several species of filarial nematodes are known to infect humans. Not all cause disease but they include the causative agents of elephantiasis a (Brugia, Wuchereria) and river blindness (Onchocerca). The various parasites are Wuchereria bancrofti, Brugia malayi, Onchocerca volvulus, Loa loa, Brugia timori, Drunculus medinesis, Mansonella ozzardi, Mansonella perstans, and Mansonella streptocerca.

The vector found in Amravati region is Wuchereria bancrofti.
**Wuchereria bancrofti**

**Scientific classification**

- Kingdom: Animalia
- Phylum: Nematoda
- Class: Secernentea
- Order: Spirurida
- Suborder: Spirurina
- Family: Filarioidea
- Genus: *Wuchereria*

*Wuchereria bancrofti* is a parasitic filarial nematode worm spread by a mosquito vector. It is one of the three parasites that cause lymphatic filariasis. Named for Otto Wucherer and Joseph Bancroft, it affects over 120 million people, primarily in Africa, South America, and other tropical and sub-tropical countries. Elephantiasis can result if the infection is left untreated. Limited treatment modalities exist and no vaccines have been developed.\(^{10,11}\)

### 1.1.3 Life cycle of *Wuchereria bancrofti*

*Wuchereria bancrofti* carry out their life cycle in two hosts. Human beings serve as the definitive host and mosquitoes as their intermediate hosts. The adult parasites reside in the lymphatics. They are viviparous. The first stage larvae are known as microfilariae. The microfilarias are present in the circulation. The microfilaria migrates between the deep and the peripheral circulation. During the day they are present in the deep veins and during the night they migrate to the peripheral circulation. Next, the worm is transferred into a vector; the most common vectors are the mosquito species: *Culex, Anopheles, Aedes,* and *Manson.* Inside their second host, it matures into...
motile larvae. When it’s current host feeds, and it is egested into the blood stream of its new human host. The larvae move to the lymph nodes, predominantly in the legs and genital area, and develops into adult worm over the course of a year. By this time, an adult female can produce microfilariae itself.

*Wuchereria bancrofti* displays a large size gap between the male and female a difference known as sexual dimorphism. The adult male worm is long and slender, between four and five centimeters in length, a tenth of a centimeter in diameter, and features a curved tail. The female, in contrast, is six to ten centimeters long, and three times larger in diameter than the male. This size deviation can be attributed to the vast numbers of microfilariae that the female produces each day.

1.1.4 Bionomics of the Vectors:

There are over 2500 different species of mosquitoes throughout the world of which 150 species occur in the United States. 52 species occur in California, and 19 species occur in Alameda County. In the course of the District’s operation about 10 species are commonly found in the County. Eight of the species account for over 99% of complaints from the public. Each of the species has a scientific name that is latin, such as *Culex tarsalis*. These names are used in a descriptive manner so that the name tells something about this particular mosquito. Some species have what is called “common names” as well as scientific names, such as *Anopheles freeborni*.

All mosquitoes must have water in which to complete their life cycle. This water can range in quality from melted snow water to sewage effluent and it can be in any container imaginable. The type of water in which the mosquito larvae is found can be an aid to the identification of which species it may be. Also, the adult mosquitoes show a very distinct preference for the types of sources in which to lay their eggs. They lay their eggs in such places such as tree holes that periodically hold water, tide
water pools in salt marshes, sewage effluent ponds, irrigated pastures, rain water ponds, etc. Each species therefore has unique environmental requirements for the maintenance of its life cycle.

The feeding habits of mosquitoes are quite unique in that it is only the adult females that bite man and other animals. The male mosquitoes feed only on plant juices. Some female mosquitoes prefer to feed on only one type of animal or they can feed on a variety of animals. Female mosquitoes feed on man, domesticated animals, such as cattle, horses, goats, etc; all types of birds including chickens; all types of wild animals including deer, rabbits; and they also feed on snakes, lizards, frogs, and toads.

Most female mosquitoes have to feed on an animal and get a sufficient blood meal before she can develop eggs. If they do not get this blood meal, then they will die without laying viable eggs. However, some species of mosquitoes have developed the means to lay viable eggs without getting a blood meal.

The flight habits of mosquitoes depend again on the species with which we are dealing. Most domestic species remain fairly close to their point of origin while some species known for their migration habits are often an annoyance far from their breeding place. The flight range for females is usually longer than that of males. Many times wind is a factor in the dispersal or migration of mosquitoes. Most mosquitoes stay within a mile or two of their source. However, some have been recorded as far as 75 miles from their breeding source.

The length of life of the adult mosquito usually depends on several factors: temperature, humidity, sex of the mosquito and time of year. Most males live a very short time, about a week; and females live about a month depending on the above factors.
Mosquito Life Cycle

The mosquito goes through four separate and distinct stages of its life cycle and they are as follows: Egg, Larva, pupa, and adult. Each of these stages can be easily recognized by their special appearance. There are four common groups of mosquitoes living in the Bay Area. They are *Aedes*, *Anopheles*, *Culex*, and *Culiseta*.

**Egg:** Eggs are laid one at a time and they float on the surface of the water. In the case of *Culex* and *Culiseta* species, the eggs are stuck together in rafts of a hundred or more eggs. *Anopheles* and *Aedes* species do not make egg rafts but lay their eggs separately. *Culex*, *Culiseta*, and *Anopheles* lay their eggs on water while *Aedes* lay their eggs on damp soil that will be flooded by water. Most eggs hatch into larvae within 48 hours.

**Larva:** The larva (larvae - plural) live in the water and come to the surface to breathe. They shed their skin four times growing larger after each molting. Most larvae have siphon tubes for breathing and hang from the water surface. *Anopheles* larvae do not have a siphon and they lay parallel to the water surface. The larva feed on micro-organisms and organic matter in the water. On the fourth molt the larva changes into a pupa.

**Pupa:** The pupal stage is a resting, non-feeding stage. This is the time the mosquito turns into an adult. It takes about two days before the adult is fully developed. When development is complete, the pupal skin splits and the mosquito emerges as an adult.

**Adult:** The newly emerged adult rests on the surface of the water for a short time to allow itself to dry and all its parts to harden. Also, the wings have to spread out and dry properly before it can fly.

The egg, larva, and pupae stages depend on temperature and species characteristics as to how long it takes for development. For instance, *Culex tarsalis* might go through its life cycle in 14 days at 70°F and take only 10 days at 80°F. Also, some
species have naturally adapted to go through their entire life cycle in as little as four days or as long as one month.

Culex mosquitoes lay their eggs on the surface of fresh or stagnant water. The water may be in tin cans, barrels, horse troughs, ornamental ponds, swimming pools, puddles, creeks, ditches, or marshy areas. Mosquitoes prefer water sheltered from the wind by grass and weeds. Culex mosquitoes usually lay their eggs at night. A mosquito may lay a raft of eggs every third night during its life span.

*Mosquito Egg Raft*

*Culex* mosquitoes lay their eggs one at a time, sticking them together to form a raft of from 200-300 eggs. A raft of eggs looks like a speck of soot floating on the water and is about 1/4 inch long and 1/8 inch wide. Tiny mosquito larvac emerge from the eggs within 24 hours. *Anopheles* mosquitoes lay their eggs singly on the water, not in rafts. *Aedes* mosquitoes lay their eggs singly on damp soil. *Aedes* eggs hatch only when flooded with water (salt water high tides, irrigated pastures, treeholes, flooded stream bottoms).

*Mosquito Larva*

Mosquito larvae, commonly called “wigglers”, must live in water from 7 to 14 days depending on water temperature. Larvae must come to the surface at frequent intervals to obtain oxygen through a breathing tube called a siphon. The larva eats algae and small organisms which live in the water. During growth, the larva molts (sheds its skin) four times. The stages between molts are called instars. At the 4th instar, the larva reaches a length of almost 1/2 inch. When the 4th instar larva molts it becomes a pupa.
Anopheles are unlike Culex and Aedes larvae since they do not have a breathing tube, they must lie parallel to the water surface in order to get a supply of oxygen through a breathing opening.

**Mosquito Pupa**

Mosquito pupae, commonly called “tumblers”, must live in water from 1 to 4 days, depending upon species and temperature. The pupa is lighter than water and therefore floats at the surface. It takes oxygen through two breathing tubes called “trumpets”. When it is disturbed it dives in a jerking, tumbling motion and then floats back to the surface. The pupa does not eat. The metamorphosis of the mosquito into an adult is completed within the pupal case. The adult mosquito splits the pupal case and emerges to the surface of the water where it rests until its body can dry and harden.

**Mosquito Adult**

Only female mosquitoes bite animals and drink blood. Male mosquitoes do not bite, but feed on the nectar of flowers. Aedes mosquitoes are painful and persistent biters, attacking during daylight hours (not at night). They do not enter dwellings, and they prefer to bite mammals like humans. Aedes mosquitoes are strong fliers and are known to fly many miles from their breeding sources. Culex mosquitoes are painful and persistent biters also, but prefer to attack at dusk and after dark, and readily enter dwellings for blood meals. Domestic and wild birds are preferred over man, cows, and horses. Culex tarsalis is known to transmit encephalitis (sleeping sickness) to man and horses. Culex are generally weak fliers and do not move far from home, although they have been known to fly up to two miles. Culex usually live only a few weeks during the warm summer months. Those females which emerge in late summer search for sheltered areas where they “hibernate” until spring. Warm weather brings her out in search of water on which to lay her eggs. Culiseta mosquitoes are moderately aggressive biters, attacking in the evening hours or in shade during the day.
The various vectors for transmission of these parasites are, Culex
(C. annulirostris, C. bitaeniorhynchus, C. quinquefasciatus and C. pipiens); Anopheles
and A. wellcomei); Aedes (A. aegypti, A. aquasalis, A. bellator, A. cooki, A. darlingi, A. kochi,
A. plynnesiensis, A. pseudoscutellaris, A. rotumae, A. scapularis, A. vigilax);
Mansonoi (M. pseudotitillans, M. uniformis);
Coquillettidida
(C. juxtamansonia)

Though a large variety of mosquitoes have been stated to be actual or potential vectors
of human filariasis, only three of them play an important role in the epidemiology of
Wuchereria infections, vis a) Culex quinquefasciatus, which transmits the nocturnally
periodic Wuchereria bancrofti. b) Aedes plynnesiensis incriminated in the transmis-
sion of the non-periodic, Wuchereria bancrofti var. Pacifica. c) Mansonioide spp.
eM. annulzfera, M. unzformis, M. indiana and M. tongpalianis) will carry the mf of
B. malayi. \brief account of the habits of these vectors is given below.

C. quinquefasciatus, commonly called, as Southern house mosquito is one of the most
common mosquitoes found in human habitations in the tropics and subtropics of the
world. Females are intensely anthropophilic and feed actively only at night. Even in
the laboratory females’ bite only at night except when they have undergone a period of
starvation. In Mrica they are attracted to natives rather than to Europeans. Females lay
from 2-4 rafts of eggs, usually at night but rarely in broad daylight. Larvae are never
found far from human habitations. They live in flooded, open cement drains, cess-
pools, latrines, shallow wells, ditches, ground pools, and in household storage water.
In the lower Congo river Valley larvae are commonly found in poorly drained land
surrounding villages. In India they commonly inhabit rice fields near villages.
Immature stages can adapt to a high degree of salinity and can easily survive in water with a pH of 5-10.

1.1.5 Lymphatic filariasis, transmission

In 1866, the German Doctor Otto Wucherer discovered numerous microfilariae in patients with haematuria and chyluria in Bahia, Brazil. In 1870 the Briton, Lewis, in Calcutta discovered that patients with elephantiasis were infected with filariae. Because microfilariae were periodically detectable in the blood, the Scottish doctor Patrick Manson suspected that night-biting mosquitoes might be responsible for transmission. He is regarded by many as the father of tropical medicine. He initially worked as a doctor in Kaohsiung, in the south of Formosa, the present-day Taiwan. In subsequent years he carried out various experiments in Anoy (Xiamen), China. He allowed mosquitoes to bite his filaria-infected gardener, afterwards dissecting the insects and detecting microfilariae. He was able to follow the metamorphosis of the parasites in the insects. Manson, however, thought that mosquitoes only sucked blood once in their lifetime. So, there was a problem in explaining transmission. He assumed that drinking water was contaminated by dead mosquitoes and that transmission occurred in this way. It later became clear that the parasites are transmitted via the bite of infected mosquitoes, primarily by the night-biting Culex and Anopheles mosquitoes. This biting behavior is important as the numbers of microfilariae in the peripheral blood systematically fluctuate over a 24-hour period reaching their highest levels at night. There is a remarkable periodicity of the microfilariae. The density of parasites is greatest at the time when the chance of transmission is greatest (at night). In the Pacific Islands, transmission occurs via the daytime-biting Aedes mosquitoes so there is no or less diurnal variation.

The most important species of vector is Culex quinquefasciatus. This mos-
quito, together with *Anopheles gambiae* and *Anopheles funestus*, is the most important vector in sub-Saharan Africa. In Egypt, *Culex pipiens* is the principal vector. *Culex* mosquitoes lay their eggs in small groups on the water surface. *Mansonialia* mosquitoes (subgenus *Mansonioides*) are also vectors and are found in association with certain water plants. Transmission via mosquitoes means that there is very marked geographical heterogeneity. There can be limited transmission at one particular place, whereas 2 kilometers further on transmission might be 100 times more intense. *Wuchereria bancrofti* is fairly poorly transmitted by mosquitoes. On average a dozen bites are necessary before an infection becomes patent 19.

After being sucked up by the mosquito, microfilariae reach the abdominal stomach via the proboscis, pharynx and thoracic oesophagus. Chitinous teeth in the foregut can mechanically damage aspirated microfilariae. These teeth are particularly pronounced in *Anopheles* females. In the stomach, the parasites shed their sheath, penetrate the gastric wall and migrate via the haemocoel to the insect’s thoracic muscles. After maturation, the immature worms migrate through the insect’s head to the labium (“lower lip”) of the proboscis. This stage is reached approximately 10 days after the blood meal. When the mosquito again sucks blood, the 1.2-1.6 mm long infective larvae break through the labella of the labium and then creep onto the skin (the labium is not inserted into the skin, in contrast to other mouthparts). If the parasite, now known as an infective larva, finds a portal of entry (e.g. the bite wound), it enters and is transported via the lymphatics. The insect’s salivary glands play no direct role in transmission, in contrast to malaria.

*Wuchereria bancrofti* becomes adult in human lymphatics and lymph nodes. The worms are 0.2 mm wide and can be up to 10 cm long. They survive for up to 10 years. Approximately 6 to 12 months after infection, microfilariae appear in the circulation. Every day, the female produces numerous microfilariae (250 to 300 ).
They are surrounded by an egg membrane (sheath). The membrane is sometimes very difficult to see in a microscopic preparation.

There is no multiplication of adult parasites in humans so that the worm load and the degree of illness is proportional to the number of infective larvae transmitted by infected insects. The number of insect bites is directly proportional to the duration and intensity of exposure in a filariasis region. In most cases, severe disease is only seen in humans who have lived for a long time in an endemic area. The patient’s individual immunological response has a significant role in the development of the various symptoms.

1.1.6 Life history
During blood meal when an infected mosquito introduces the third stage-filarial larvae into the skin of human host, where they get penetrated through the wound. They develop in adults that commonly reside in lymphatic. The adults produce microfilaria, which are sheathed and have nocturnal periodicity. The microfilaria migrates into lymph and blood channels moving actively through lymph and blood. A mosquito ingests the microfilariae lose their sheath and some of them work their way through the wall of the proventriculus and cardiac portion of the mosquito’s midgut and reach the thoracic muscles. There the microfilaria develop into first, second, and third stage larvae (infective stage) these third stage larvae migrate through the haemocoel to the mosquito proboscis and can infect another human host where mosquito take the blood meal.

1.2 Pathogenesis and pathology
The pathology associated with lymphatic filariasis results from a complex interplay of the pathogenic potential of the parasite, the immune response of the host, and external (‘complicating’) bacterial and fungal infections. Immune-mediated pathology in
lymphatic filariasis most commonly derives from the lymphatic obstructive consequences of the responses to dead or dying worms in the lymphatics. While genital damage (particularly hydrocoele) and lymphoedema / elephantiasis are the most recognizable clinical entities associated with lymphatic filarial infections, there are much earlier stages of lymphatic.

In addition to this ‘non-inflammatory pathway’ to lymphatic pathology, there is another pathological process that is mediated by host inflammatory responses. These responses can be initiated by immune reactivity (clinically expressed as the characteristic adenitis and retrograde lymphangitis earlier described as ‘filarial fevers’) or by bacterial and fungal superinfections of tissues with compromised lymphatic function originating from filarial infection. Recognition of the importance of these secondary infections in causing much of the progression and physical destruction associated with elephantiasis has had a major impact on improving the care, management and prospects for affected patients \(^{19,20}\)

### 1.3 Lymphatic filariasis, clinical features

At first, most people do not show any symptoms. But as adult worm starts to die the symptoms arises. The disease usually is not life threatening, but it can permanently damage the system does not work right, fluid collects and cause swelling in arms, breasts, legs and for men, the genital areas. The entire leg, arms, or genital area may swells several times its normal size. Because of swelling and decrease function of the lymph system there is difficulty for the body to fight with germs and infections. There is bacterial infection on the skin and lymph system. This results the hardening and thickening of the skin, which is called elephantiasis. Other sympoms like pulmonary tropical eosinophilia syndrome, with nocturnal cough and sneezing, fever, eosinophilia, chronic low grade fever, the presence of chyle (a fluid composed a combination of
fat and lymph created by lacteals during digestion) in the urine, chronic interstitial lung disease with nocturnal asthma, orchitis, pneumonitis, and abscess formation. 

**Signs of inflammation**

**Adenolymphangitis:** Acute pain and inflammation in one or more lymph nodes (groin, axilla, elbow, neck). This is associated with fever and general malaise. Retrograde lymphangitis often occurs after 4 to 8 hours. There is centrifugal redness, pain and heat over the course of the lymph vessels. Pyogenic lymphangitis proceeds centripetal, not centrifugal. In most cases, the symptoms last 3-4 days. Each episode results in several days of incapacity for work.

**Inflammation of testis and spermatic cord:** acute pain, swelling and fever. Repeated funiculitis (inflammation of the spermatic cord) results in thickening of this structure.

**Filaria fever:** Irregular fever often occurs without external lymph node inflammation, as a result of inflammation of the deeper lymphatics and lymph nodes. The fever may recur irregularly for months or years after the patient leaves an endemic region (observed in 20,000 American military personnel who fought in the South Pacific during the Second World War, an area endemic for *W bancrofti*.)

**Signs of chronic obstruction:**

**Hydrocele:** accumulation of fluid in the tunica vaginalis. Hydrocele often occurs in orchitis (inflammation of the testis). This is very common in an endemic region. Microfilariae are often found in hydrocele fluid. Large hydroceles can be very inconvenient. Sexual incapacity associated with genital filariasis is a major concern for those infected. Shame, anxiety, sexual problems in marriage and social stigmatisation are widespread. Note: lymph from the scrotum and the greater part of the penis drains towards the superficial inguinal lymph nodes, that from the glans goes principally to the deep inguinal nodes while from the testis it flows to the pre-aortic and retroperito-
neal lumbar lymph nodes.  

**Lymphoedema and elephantiasis:** Chronic lymphostasis can lead to lymphoedema. This is most striking in the legs, scrotum, breasts and arms. The labia and penis are somewhat less frequently affected. If the lymphoedema persists for a long time, elephantiasis can occur. The skin is then markedly thickened and can become wart-like. The oedema is “non-pitting” because there is also a proliferation of connective tissue. The tissue is fibrotic and hard. Recurrent erysipelas (bacterial superinfection) can cause the elephantiasis to increase still further. *Bmgia* infections mostly cause elephantiasis confined to the genitalia, lower legs and lower arms.

**Lymph leakage:** The rupture of swollen lymphatics into the renal pelvis can cause chyluria (milk-like pale pink urine). This sort of fistula can follow a very chronic course. Rupture of lymphatics in the abdominal cavity or thorax results in chylous ascites and chyllothorax (chyle = lymph). A protein-rich white fluid is obtained on aspiration. Lymph leakage into the area of the tunica vaginalis results in chylocele. Clumping of lymph proteins in the ureters can cause obstruction. Long-term extensive chyluria results in hypoproteinaemia. The rupture of numerous small skin lymphatics in the scrotum can lead to a constantly wet, sticky scrotum which is particularly unpleasant.

**Tropical pulmonary eosinophilia. Weingarten’s syndrome.**

Tropical pulmonary eosinophilia is particularly common in India, but also in Southeast Asia. Pulmonary symptoms are predominant: cough, dyspnoea, “asthmatic syndrome”. Chest X-rays very consistently show patchy infiltrates, in contrast to Loeffler’s syndrome in which they are more fleeting. Sometimes the lymph nodes swell and splenomegaly occurs. The erythrocyte sedimentation rate increases and there is marked eosinophilia. There are no microfilariae in the peripheral blood. Serological tests for filariae are strongly positive. This condition responds very well to therapy with DEC (in contrast to Loeffler’s syndrome). Steroids can be given if other diagnoses
(e.g. strongyloidosis) can be excluded.

**Endomyocardial fibrosis**

Chronic hypereosinophilia can cause cardiac lesions such as or fibroplastic endocarditis. The contents of the eosinophilic granules (including major basic protein) are toxic to the endocardium and the adjacent myocardium. A restrictive cardiomyopathy can follow.  

**1.4 Immunity**

After inoculation, the worms migrate through the bloodstream and into the lymphatic. Thus their ultimate destinations are the lymph node of the infected individual. When in the lymph node, the worms mature into the adult, begin to mate and produce offspring, a process which require several month time period. The adult themselves are not very immunogenic and normally will not elicit strong local inflammatory response. Recent studies show that the L3 (stages 3 larvae) and other stages of worm (L1 and L2), in contrast to the adult worm, are important immunogenic targets. Thus larvae remain in blood circulation and show periodicities in such a way that they are present in the peripheral blood system during the evening hours when nectors become active and begin to feed. The larvae also are not responsible for the serious condition that results from the infection. Though the adult worm live in the afferent lymphatic of the lymph nodes, they do not normally result in disease symptoms while they are alive while alive the adult cause dilation of the lymphatic and a thickening of the vessel wall, as well as an infiltration including plasma cells eosinophills and macrophages in and around the vessel. They cause damage to lymph valves and cause the skin over lymph node to experience lymphoedema, though most infection are asymptomatic. The actual problem of the disease then result upon the death of the adult worm. Once the adult dies, necrosis around the worm occurs. The necrosis is followed by fibrosis, obstructing
the lymphatic and severely compromising the lymph flow.

Now, because of lymph blockage, the infected individual may become more susceptible to bacterial and fungal super infections of affected limbs and may experience adenolymphangitis which may further blocks the lymph flow. The person may also experience severe lymphedema and elephantiasis, especially of the lower appendage and male may be suffer from hydrocele and scrotal elephantiasis. The extent of some of the lymphedema and elephantiasis can be also serve, especially in the case of hydrocele and scrotal elephantiasis in males that the affected region can swell through most appendages will swell to 2 to 3 times their original size. Because of the serve swelling the individual get isolated from their community and family. The individual may become unable to work or provide a living.

For example in chandrapur where there are so many people suffered from lymphatic filariasis in savali taluka, where there are so many lymphatic individual, one individual of named vrushi marotrao ninode age 35 years suffer from lymphatic filariasis since 12 year helpless himself and he also can’t do any work for himself and his family also. Through the mechanisms are not fully known the infection in Asia may also result Ill a condition know as pulmonary tropical eosinophilia. It is believed that condition arises from larvae the get stuck in the lungs on their way to the lymphatics. The accumulation of the larvae in the lungs causes an eosinophilic response by the host, resulting in damage to the lungs in an attempt to kill the larvae.

People that are at the risk of this disfiguring infection are those that spend long period of time in endemic areas. In order for the infection to take hold, the individual must be inoculated with the parasite multiple time our several month. This means that short-term travelers and tourists in endemic areas are at a reduce risk. Also, people can not transmit this infection person to person the vector mosquito is required.
Prevention of the infection should also be promoted because of these reasons, including sleeping under a mosquito net so that the inoculation of the L3 larvae cannot take place and by using the mosquito repellent.

It has been also reported that children of infected mother had the three to fourfold infected risk of filarial infection, as ascertained by circulating filarial antigen, relative to children of uninfected mother. Paternal infection did not correlate with childhood infection status, including a specific maternal effect. Peripheral blood mononuclear cells from children of filarial - infected mothers had higher level of constitutive interleukin 5(IL-5) and IL-10, increased microfilaria antigen - specific IL-5 production, and diminished microfilaria antigen-driven lymphocyte proliferation than cell from children of uninfected mother. In contrast, there were no difference between the two groups in adult worm antigen-driven gamma interferon, IL-2, IL-4, IL-5 and IL-10 production and lymphocyte proliferation. This data indicate that maternal filarial infection increase childhood susceptibility to *Wuchereria bancrofti*; and skews filarial- specific immunity toward TH-2 type cytokine response, childhood susceptibility to *Wuchereria bancrofti* and skews filarial- specific immunity toward TH-2 type cytokine response.

1.4.1 Genetic variation in immune function and susceptibility to human filariasis

The generation of a draft sequence of a the human genome has provided the opportunity to characterize human diversity, even as it pertains to differences in host response to parasitic infection with organisms that cause lymphatic filariasis, malaria and schistosomiasis. Worldwide, human infection with filarial pathogens represents a significant cause of morbidity throughout the tropics. In particular, epidemiologic evidence suggests that a genetic component contributes to susceptibility and possibly the out-
comes of filarial infection. Different approaches can be applied in population-based studies in areas where filarial infection is endemic, such as genome linkage scans and candidate gene analysis for the purpose of identifying genetic risk factors. This review summarizes recent advances in our understanding of genetic contributions to human lymphatic filariasis and addresses the immediate questions facing the field. It is anticipated that the identification of susceptibility genes in filarial infection could provide new insights into therapeutic strategies, including pharmacological intervention and vaccine development, and influence public health measures to control or avert infection.

1.5 Socio-economic burden

The social impacts of the disease in terms of physical disfigurement, loss of self-esteem, lowered employment opportunity, interference in sexual activity and family discord. Poor marriage prospects, stigma within the community, poor job opportunities is common. The degree of stigma is associated with the severity and visibility of the disease. There is a considerable psychosocial stress on the individual and families including sexual disabilities of men afflicted with hydrocele or genital abnormalities and of women with lymphoedema of breasts or genital and [manly the poor quality of life of individuals with the disease is obvious.]

Lymphatic Filariasis reduces the economic productivity of individuals. Economic losses result from the disability associated with acute attacks and chronic manifestations of the disease. An acute attack can result in several lost workdays and suffers often experience multiple attacks each year. Persons with the 2 most common chronic disease manifestations-hydrocele and lymphoedema-generally experience lifelong decreases in productivity. Because of its prevalence, hydrocele appears to have the greater impact. During the 1970s, it was reported that 90% of men
along the Tanzanian coast and 60% in the Coast Province of Kenya were affected by
the age of 70 years. In India, 45% of men in Pondicherry have hydrocoele by the age
of 60 years. In India, it is estimated that Lymphatic Filariasis causes almost US $1
billion a year in lost productivity in some communities, 7-8% of male labour is lost.
In Africa, Lymphatic Filariasis may cause almost US $1 billion in losses each year
of this loss is due to disability in men with hydrocoele. Lymphatic Filariasis has
changed the economic activities of entire communities. In Tanzania, some villages have
switched from fishing to farming to adapt to decreased male labour productivity.
Since the middle of the past century, there have been documented reports on impact of Fi-
lariasis on major industries, including the productivity of rubber tappers in Malaysia,
agricultural workers in then British Guiana, and, more recently, in farmers in Ghana,
and weavers in India. Industry has long recognized the debilitating effects of Lymph-
atic Filariasis and, in some localities, has attempted to mitigate the problem. Im-
provements in housing, water and sanitation facilities on sugar plantations in then British
Guiana were followed by a decrease in the prevalence of infection. Currently, efforts
to eliminate. Lymphatic Filariasis in several western Pacific nations are being led by
the mining industry.

The prevalence of Lymphatic Filariasis and the associated debilitating manifestations and costs are affected by local socioeconomic conditions most frequently by activities that provide mosquito breeding sites. For example, coco-fibre in
Sri Lanka associated with Filariasis endemicity because the ponds used for the processing also support breeding sites. In Haiti, disposal of byproducts of village rum production results in pools of standing sugary water throughout the community. Sometimes, attempts to improve the local economic situation have resulted in the spread of the disease. In Ghana, the spread of Lymphatic Filariasis may be associated with the development of a large irrigation project.
1.5.1 Impact of Filariasis on health care systems

The economic burden of lymphatic filariasis can be categorized as direct disease-related costs to individuals and households, costs to government-funded health care systems, lost productivity of infected individuals, and reduced productivity from structural changes in the economies of endemic villages. Data on individual’s expenses for medical care related to lymphatic filariasis are limited but some exist. In India, where one-third of the cases of lymphatic filariasis can be found, over 10 million people each year seek treatment for the disease. The total annual treatment costs borne by individuals including medicines, doctor’s fees and travel, companion costs and accommodation, exceed US $30 million. This total does not include the costs borne by the government for medical care. Data from other regions on the costs to individuals and households are generally not available. However, evidence from Tanzania and Tahiti show that it is fairly common to seek treatment for acute attacks, although the nature and cost of treatment were not specified. Direct expenditures by individuals and households may be low or nonexistent because either medical care is not affordable or no safe and effective treatment is available.

Lymphatic Filariasis also imposes a burden on the health care infrastructure in endemic areas. Again, data are limited. However, 2 reports provide insight. In 1975, a district hospital in Tanzania reported that 15% of major surgeries were for hydrocele repair. More recently, in 1998, Dr J. Gyapong estimated that in a hospital in northern Ghana as much as 25% of all surgery is for hydrocele.
1.5.2 Control measures

Since most clinically asymptomatic infected individuals have lymphatic abnormalities, they may be at risk of developing disease. Diethylcarbamazine or ivermectin or coadministration of both or DEC/ivermectin with albendazole administration in these cases is expected to clear the infection and make them free from infection, so that it is expected that the pathology will not progress to overt disease. Prevention of repeated episodic attacks of ADL will be important not only to prevent sufferings of the patients (thus reduce burden of disease) but also for the prevention of progression of existing chronic disease. Regular foot hygiene prevents incidence of episodic ADL attacks. The current basis of medical management of lymphoedema lies in limb care, exercise, physiotherapy including manual massage and possibly use of drugs. Coadministration of Daflon with DEC or DEC alone can result in significant reduction of filarial lymphoedema. Surgical management of lymphoedema is indicated in certain specific cases and prevention of acute attacks after surgery is important for sustaining the benefit of surgery. Surgery is the method of choice for hydropcele management 43. However, currently passive case detection and patient seeking treatment do it. The inclusion of this as a public health measure will require not only developing and using rapid assessment techniques, methods for line listing, setting up of facilities at different levels for case detection and surgery and referral system.

There is no consensus on the management modalities of different urogenital manifestations and there is an urgent need for developing consensus by review and expert group discussion. India has not only the problem but also a large body of experienced clinicians and scientists, who have a responsibility of producing the lead document on the management of genitourinary manifestations of filariasis 44.
1.5.3 Impact of filariasis on health care systems

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Lymphatic filariasis reduces the economic productivity of individuals. Economic losses result from the disability associated with acute attacks and chronic manifestations of the disease. An acute attack can result in several lost workdays and sufferers often experience multiple attacks each year. Persons with the 2 most common chronic disease manifestations-hydrocoele and lymphoedema—generally experi-
ence lifelong decreases in productivity. Because of its prevalence, hydrocoele appears to have the greater impact. During the 1970s, it was reported that 90% of men along the Tanzanian coast and 60% in the Coast Province of Kenya were affected by the age of 70 years. In India, 45% of men in Pondicherry have hydrocoele by the age of 60 years. In Africa, lymphatic filariasis may cause almost US $1 billion in losses each year. 83% of this loss is due to disability in men with hydrocoele. Lymphatic filariasis has changed the economic activities of entire communities. In Tanzania, some villages have switched from fishing to farming to adapt to decreased male labor productivity. Since the middle of the past century, there have been documented reports on impact of filariasis on major industries, including the productivity of rubber tappers in Malaysia, agricultural workers in then British Guiana and, more recently, on fanners in Ghana and weavers in India. Industry has long recognized the debilitating effects of lymphatic filariasis and, in some localities, has attempted to mitigate the problem. Improvements in housing, water and sanitation facilities on sugar plantations in then British Guiana were followed by a decrease in the prevalence of infection. Currently, efforts to eliminate lymphatic filariasis in several western Pacific nations are being led by the mining industry.

1.5.4 Socioeconomic factors and disease prevalence of filariasis

The prevalence of lymphatic filariasis and the associated debilitating manifestations and costs are affected by local socioeconomic conditions most frequently by activities that provide mosquito-breeding sites. For example, cocofibre in Sri lankais associated with filariasis endemicity because the ponds used for the processing also support breeding sites. In Haiti, disposal of byproducts of village rum production results in pools of standing sugary water throughout the community. Sometimes, attempts to improve the local economic situation have resulted in the spread of the
disease. In Ghana, the spread of lymphatic filariasis may be associated with the development of a large irrigation project.

1.6 Bioinformatics aspect 47,48,49,50,51,52,53,54

Bioinformatics and computational biology involve the use of techniques from applied mathematics, informatics, statistics, and computer science, and chemistry, especially biochemistry to solve biological problems usually on the molecular level. Research in computational biology often overlaps with systems biology. Major research efforts in the field include sequence alignment, gene finding, genome assembly, protein structure alignment, protein structure prediction, prediction of gene expression and protein-protein interactions, and the modeling of evolution.

The DNA sequences of hundreds of organisms have been decoded and stored in databases. This data is analyzed to determine genes that code for proteins, as well as regulatory sequences. A comparison of genes within a species or between different species can show similarities between protein functions, or relations between species (the use of molecular systematics to construct phylogenetic trees). With the growing amount of data, it long ago became impractical to analyze DNA sequences manually. Today, computer programs are used to search the genome of thousands of organisms, containing billions of nucleotides. These programs can compensate for mutations (exchanged, deleted or inserted bases) in the DNA sequence, in order to identify sequences that are related, but not identical. A variant of this sequence alignment is used in the sequencing process itself.

The computational biology tool best-known among biologists is probably BLAST, an algorithm for searching large databases of protein or DNA sequences. NCBI provides a popular implementation that searches their massive sequence databases. Bioinformatic meta search engines (Entrez, Bioinformatic Harvester) help find-
ing relevant information from several databases.

In the present study, the phylogeny is selected for study perpose.

1.6.1 Phylogenetic study

Phylogenies, or phylogenetic relationships, are in general patterns of shared common history between biological replicators. Instances of such replicators are for example species or genes. Thus, molecular phylogenetics is the study of evolutionary relationships among taxa or genes by a combination of molecular biology and statistical techniques.

Phylogenetic analyses are useful in many different contexts, either directly (e.g., to infer evolutionary history of the molecule used, to infer temporal order of other events mapped on the phylogeny such as gene transfers, to study epidemiology) or indirectly. The indirect use stems from the fact that since all species and/or genes share more or less of a common history, these are not independent observations. Comparative studies that ignore the historical pattern thus will be more or less biased and misleading. There are a number of methods developed to indirectly use a phylogeny and “correct” for the shared history in comparative (e.g., ecological or physiological) studies.

There are several reasons why molecular data, particularly DNA sequence data, are more versatile for phylogenetic studies than morphological or physiological data. Firstly, sequences are more easily modelled; one particular position in a sequence can take the same states (e.g., A, C, G, T) as the others, whereas for example comparisons between bones in a limb and colour of an appendage is less obvious how to model. Secondly, molecular data are more easily generalized to other taxa; e.g., comparing a bacterium and a plant morphologically may be difficult using gene sequence data makes this feasible. This is especially useful when studying microorganisms, in
which only a limited number of morphological or physiological characters are available.

In phylogenetic studies, the evolutionary relationships are modelled as a phylogenetic tree. This is composed of nodes (vertices) and branches (edges). The nodes represent the taxonomic units, and the branches describe the relationships among the units in terms of shared history. The branching pattern of a tree is called the topology.

When referring to the nodes of a tree, we distinguish between terminal nodes and internal nodes. Terminal nodes represent the extant taxonomic units under comparison and are frequently referred to as operational taxonomic units (OTUs). These may correspond to gene A from species X, Y and Z etc. The internal nodes represent inferred historical splitting events, and may be interpreted as ancestral species or ancestral instances of genes. The branches can be classified as internal or external (peripheral) branches.

A phylogenetic tree can be drawn in different ways. The branches can either be scaled, that is, their lengths are proportional to the evolutionary change. Or, the branches can be unscaled, that is, their lengths convey no particular information. In a representation of a historical relationship, there is an element of time - the branches have a direction. However, methods used to infer phylogenetic relationships are indifferent to direction and the directionality must be introduced by some external
criterion. In a rooted tree, a particular node is designated root. The root is the origin of all shared histories described by the tree. An unrooted tree is a tree that only describes the relationships among the OTUs but does not provide any information about their common history. The most common way to infer a root is to use an outgroup: this is a taxon that (based on other studies) is assumed to be further away from (less related to) all of the study taxa (the ingroup). If this assumption is met, the root (for the ingroup) will be on the branch between the out-group and the ingroup.

There are four basic steps to propose a hypothesis of the phylogenetic relationships:

1. Prepare a character set of (tentatively) homologous characters of the taxa (or genes) that you want to study. Also include at least one outgroup if rooting is needed.
2. Select an optimality criterion: this is a way to decide whether or not a particular tree is a better hypothesis of the phylogeny than another tree based on your data from step 1.
3. Find the best tree according to the criterion: given a certain number of taxa, the number of possible trees is fixed.
4. Evaluate if this tree is not only the best, but also a good hypothesis according to the data.

In practice, when working with sequences, these steps may be as follow:

1. Multiple alignment. All sequences have to be aligned, i.e. deciding which nucleotide or amino acid to compare to which other nucleotide or amino acid (i.e., homologous characters). This step is very important! If the sequences are not aligned properly, the analysis will be based on artifacts...
2. Optimality criteria. A simple criterion is maximum parsimony. Here character states (e.g., the nucleotide or amino acid at a site) are used, and the best tree is the tree that requires the fewest changes in character states to explain the actual data. Maximum likelihood is similar in spirit, although a statistical model is used to calculate the
estimated number of actual changes (as opposed to the minimum number of changes in parsimony). The tree with the highest likelihood (the conditional probability of the observed data given the tree) is the best hypothesis. Another option is to calculate pair-wise distances from the original data. Taking this route, one can use Minimum Evolution as criterion; the tree with the smallest sum of branch lengths that explains the data is selected as the best.

3. Find the best tree. Unfortunately, the number of possible trees increases extremely quickly with the number of taxa (terminal nodes). For four taxa we have only three different unrooted trees, for ten taxa 2,027,025, and for 53 taxa we have $2.75 \times 10^{46}$ unrooted trees. This is about the same as the number of hydrogen atoms in the universe. So, for few taxa — less than 12, say — one can evaluate all trees, but for bigger data sets some heuristic (“clever”) algorithm is needed. Alas, there exists no quick algorithm that guarantees finding the best tree. These methods commonly use a method where terminal nodes are assembled stepwise, keeping the best tree in each step. Finally, some branch swapping is applied to the tree to see if there are simple rearrangements that will give a better tree in reasonable time.

4. Data evaluation. In order to evaluate the statistical significance of a result, some statistical analysis is needed. This can be done analytically or by resampling. Resampling methods (e.g., the bootstrap and the jackknife) resample data and empirically infer the variability of the data by applying steps 2. and 3. to each (pseudo-) replicate. In phylogenetic studies, bootstrap (resampling with replacement) is the most widespread method. Bootstrap values are usually presented with the topology of the tree in the form of numbers at the internal nodes; these numbers are the percentage of the replicates where that particular node is found in the best tree.

As finding the best tree is such a daunting task, there are (not surprisingly) “quick-and-dirty” methods to get a tree quicker, but at the cost of loosing the
possibility of comparing trees ("which is the better tree") and also loosing some information in the process. The advantage is that one can quickly get a single decent tree, and thus a fair idea of the phylogeny. So, as an alternative we can use a method that does not have a specific criterion, but only a specific algorithm. Consequently, we replace steps 2. and 3 above with

3. (Alternative) Algorithmic tree building. This is an approach where you just follow a number of steps and end up with a tree. Almost all of these are based on pair-wise distances, so the first step is to calculate the pair-wise distances. Then the algorithm itself, for example neighbor joining, is applied and in each step a new branch in the tree is fixed. After just a few steps the tree is finished.

**BLAST: Detecting New Sequence Similarities**

Currently, the characters most widely used for phylogenetic analysis are DNA and protein sequences. DNA sequences may be compared directly, or for those regions that code for a known protein, translated into protein sequences. Creating phylogenies from nucleotide or amino acid sequences first requires aligning the bases so that the differences between the sequences being studied are easier to spot.

The introduction of NCBI’s BLAST, or The Basic Local Alignment Search Tool, in 1990 made it easier to rapidly scan huge databases for overt homologies, or sequence similarity, and to statistically evaluate the resulting matches. BLAST works by comparing a user’s unknown sequence against the database of all known sequences to determine likely matches. In a matter of seconds, the BLAST server compares the user’s sequence with up to a million known sequences and determines the closest matches. Specialized BLASTs are also available for human, mouse, microbial, and many other genomes. A single BLAST search can compare a sequence of interest to all other sequences stored in GenBank, NCBI’s nucleotide sequence database. In this step, a re-
searcher has the option of limiting the search to a specific taxonomic group. If the full scientific name or relationship of species of interest is not known, the user can search for such details using NCBI’s Taxonomy Browser, which provides direct links to some of the organisms commonly used in molecular research projects, such as the zebrafish, fruit fly, bakers yeast, nematode, and many more.

BLAST next tallies the differences between sequences and assigns a "score" based on sequence similarity. The scores assigned in a BLAST search have a well-defined statistical interpretation, making real sequence matches easier to distinguish from random background hits. This is because BLAST uses a special algorithm, or mathematical formula, that seeks local as opposed to global alignments and is therefore able to detect relationships among sequences that share only isolated regions of similarity. Taxonomy-related BLAST results are presented in three formats based on the information found in NCBI’s Taxonomy database. The Organism Report sorts BLAST comparisons, also called hits, by species such that all hits to a given organism are grouped together. The Lineage Report provides a view of the relationships between the organisms based on NCBI’s Taxonomy database. The Taxonomy Report provides in-depth details on the relationship between all the organisms in the BLAST hit list.

The Importance of Molecular Phylogenetics

The field of molecular phylogenetics has grown, both in size and in importance, since its inception in the early 1990s, attributable mostly to advances in molecular biology and more rigorous methods for phylogenetic tree building. The importance of phylogenetics has also been greatly enhanced by the successful application of tree reconstruction, as well as other phylogenetic techniques, to more diverse and perplexing issues in biology. Today, a survey of the scientific literature will show that molecular biology, genetics, evolution, development, behavior, epidemiology, ecology,
systematic, conservation biology, and forensics are but a few examples of the many disparate fields conceptually united by the methods and theories of molecular phylogenetics. Phylogenies are used essentially the same way in all of these fields, either by drawing inferences from the structure of the tree or from the way the character states map onto the tree. Biologists can then use these clues to build hypotheses and models of important events in history. Broadly speaking, the relationships established by phylogenetic trees often describe a species' evolutionary history and, hence, its phylogeny the historical relationships among lineages or organisms or their parts, such as their genes. Phylogenies may be thought of as a natural and meaningful way to order data, with an enormous amount of evolutionary information contained within their branches. Scientists working in these different areas can then use these phylogenies to study and elucidate the biological processes occurring at many levels of life's hierarchy. An accurate phylogeny for nematodes including their relationship to other animals has major consequences for our understanding of how diversity has evolved in morphology, genes, developmental mechanisms, behavior, and life history, but also for studies of comparative functional genomics. We need species phylogenies to allow discrimination between orthologues and paralogues in gene phylogenies. Discriminating orthologues from paralogues enables us to make predictions about the functions of genes in a genome for which there is little or no experimental data. Whereas paralogues share homology through gene duplication and often have diverged functions or expression patterns, orthologues generally have retained similarity in function. Orthologues are found by overlaying a gene tree with the species tree to ascertain which branching events were due to speciation events.

Reconstructing a phylogeny also allows us to infer the ancestral states that were preadaptive to novel life histories. Although we know that parasitism has evolved several times in nematodes, it is often not clear how this has happened. Dis-
covering the closest nonparasitic relatives provides data from which ancestral features can be inferred. These nonparasitic models are also likely to share important features (e.g., anthelminthic drug sensitivity) A phylogenetic framework is also required for testing hypotheses about the evolutionary correlation of traits that address questions regarding developmental constraints, epistasis or pleiotropy, coevolution, and adaptive scenarios (Brooks and McLennan, 1993; Maddison, 2000). Such tests might show that the phylogenetic distribution of one trait depends significantly on the distribution of a second trait.

1.7 Purpose of the work

Approximately 170 million people in the tropical and subtropical areas of southeast Asia, South America, Africa, and the islands of the Pacific are affected by this debilitating parasitic disease. While filariasis is rarely fatal, it is the second leading cause of permanent and long-term disability in the world.

The World Health Organization (WHO) has named filariasis one of only six “potentially eradicable” infectious diseases and has embarked upon a 20-year campaign to eradicate the disease. The two most common types of the disease are Bancroftian and Malayan filariasis, both forms of lymphatic filariasis. The Bancroftian variety is found throughout Africa, southern and southeastern Asia, the Pacific islands, and the tropical and subtropical regions of South America and the Caribbean. Malayan filariasis occurs only in southern and southeastern Asia. Filariasis is occasionally found in the United States, especially among immigrants from the Caribbean and Pacific islands. The Global Alliance to Eliminate Lymphatic Filariasis (the Global Alliance) was formed in 2000 with the sole purpose of supporting the Global Programme to Eliminate Lymphatic Filariasis (the Global Programme), which is based in the Filari-
asis Unit of the World Health Organization (WHO).

The nine known endemic countries in the Region are Bangladesh, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand and Timor-Leste. No cases of indigenous infection have been reported from Bhutan and De of Korea. Lymphatic filariasis control programs are in operation in all endemic countries, having national goals to achieve elimination by 2020.

Lymphatic filariasis was successfully eliminated from Japan. In China its elimination is in final stages. So in India such steps also taken.

In Amravati there was no study on mapping of lymphatic filariasis. So present work is a small effort taken in this direction for screening and identifying factors of the lymphatic filarial people in Amravati.

NFCU, Amravati started MDA program since 1985. As a result of this program the number of filarial peoples decreases. But till new cases arising. This means till there is no complete eradication of the disease. Besides this there are many hidden cases. So the present work includes the survey of the people to know the biochemical, hematological pattern of medication, identifying factors for the disease, their family history, identification of infective incidence in different localities of Amravati population and hygienic condition of the population.

The present work also includes the phylogenetic study. For that the 19 species 18S rRNA gene is studied. The nucleotide of the rRNA gene taken from NCBI. The 19 species selected by blasting the 18s rRNA gene of Wuchereria bancrofti microfilariae (mf) from different zones of India including Wardha (Maharashtra state), Guntur, Calicut.