

# Insect as vector of diseases

BIOS GE

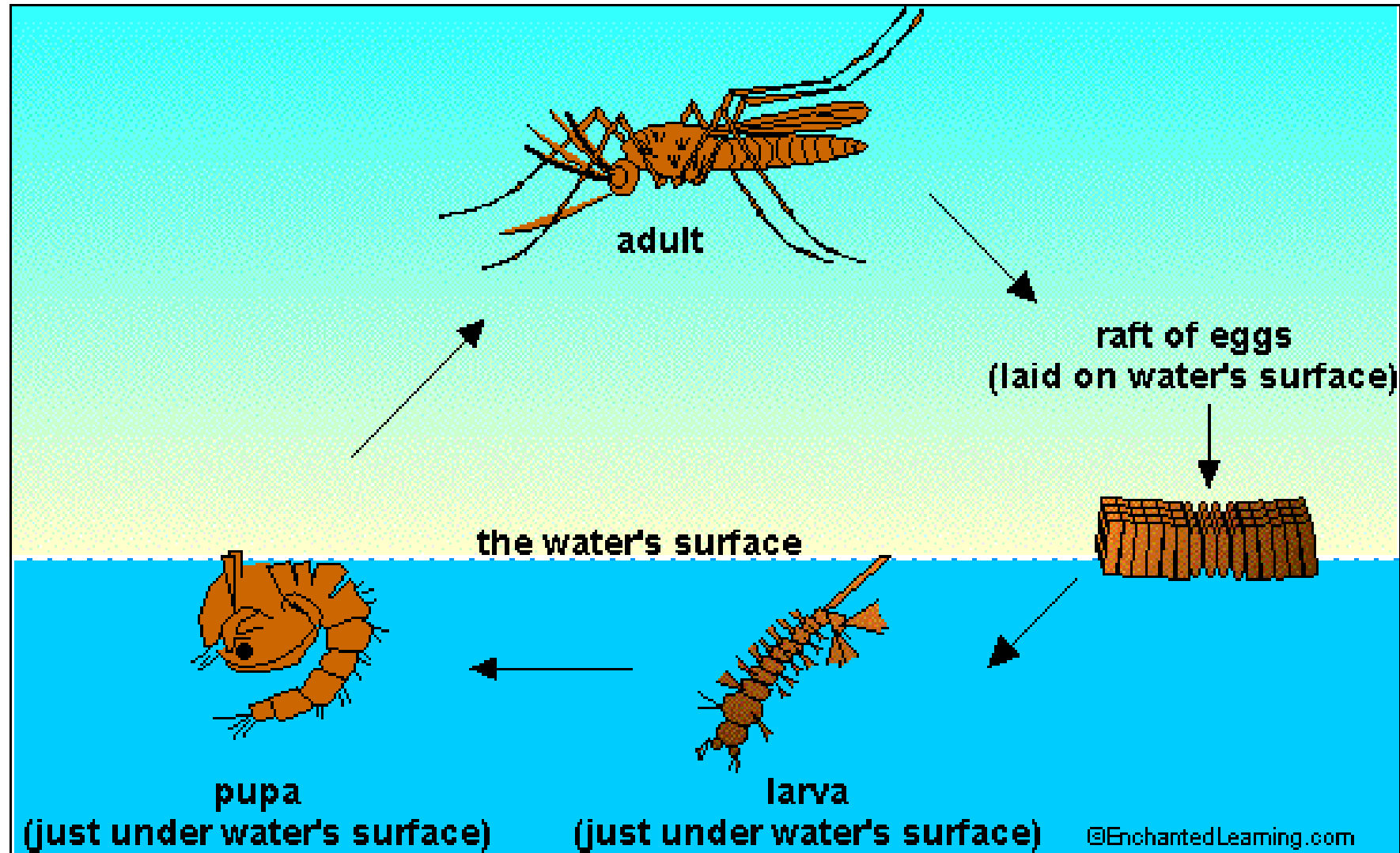
# The Family Culicidae - Mosquitoes

- Worldwide distribution
- > 3450 species and subspecies (38 genera)
- Great habitat diversity
- Approximately 40 million years older than humans (fossils from Eocene, 38-54 mya)
- **Anophelinae** (subfamily) - *Anopheles* (genus)
- **Culicinae** (subfamily) - *Aedes*, *Culex*, *Haemagogus*, *Mansonia*, *Ochlerotatus* and all other genera

# Mosquito Characteristics

- Body: small, fragile, 3-6mm long
- Mouthparts, piercing and sucking type. Proboscis and 6 needles.
- Bloodfeeding - only females take blood
- Males and females feed on plant sugars
- Gonotrophic cycle - feed, egg development, oviposition (half-gravid, gravid)
- Egg biology - oviposition location, type of egg, desiccation resistance, diapause
- Larval biology - aquatic, spiracle for breathing, filter-feeders, some cannibalistic, variable habitats

# Life cycle



# Medical Importance

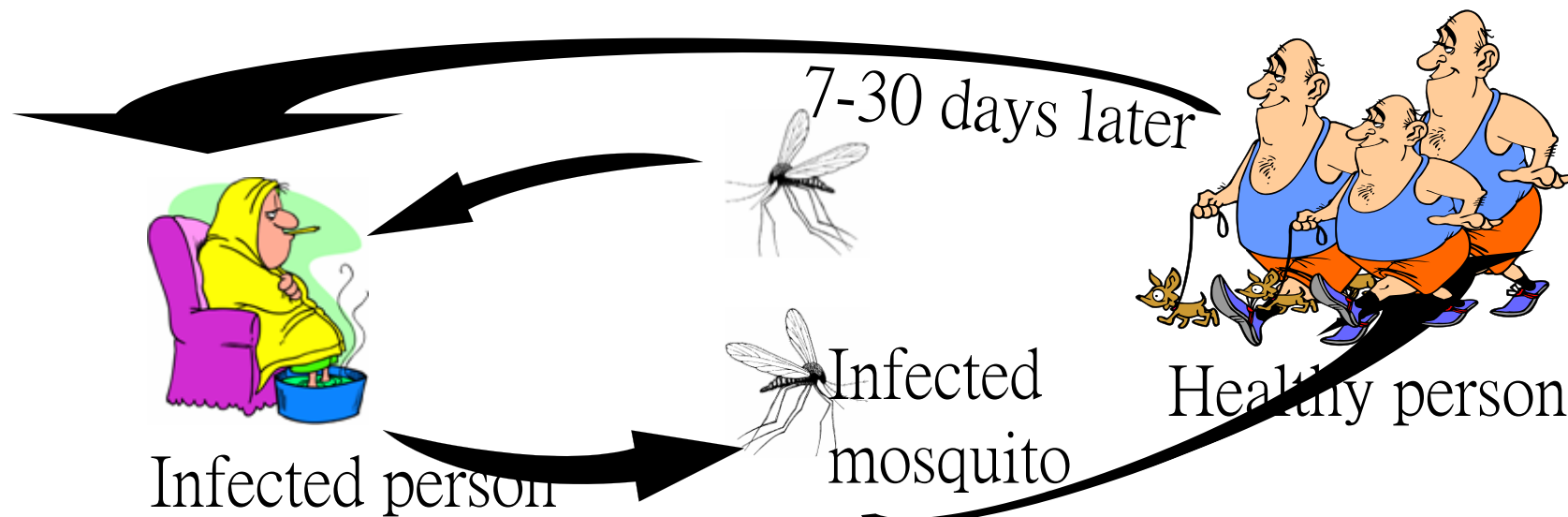
- Biting Nuisance (annoyance)
- Arboviruses
  - Numerous (Yellow Fever, Dengue Fever, WNV, JE, SLE, EEE, WEE, VEE).
- Filariasis
  - Bancroftian and Brugian filariasis.
- Malaria
  - 4 *plasmodium* species

# Malaria

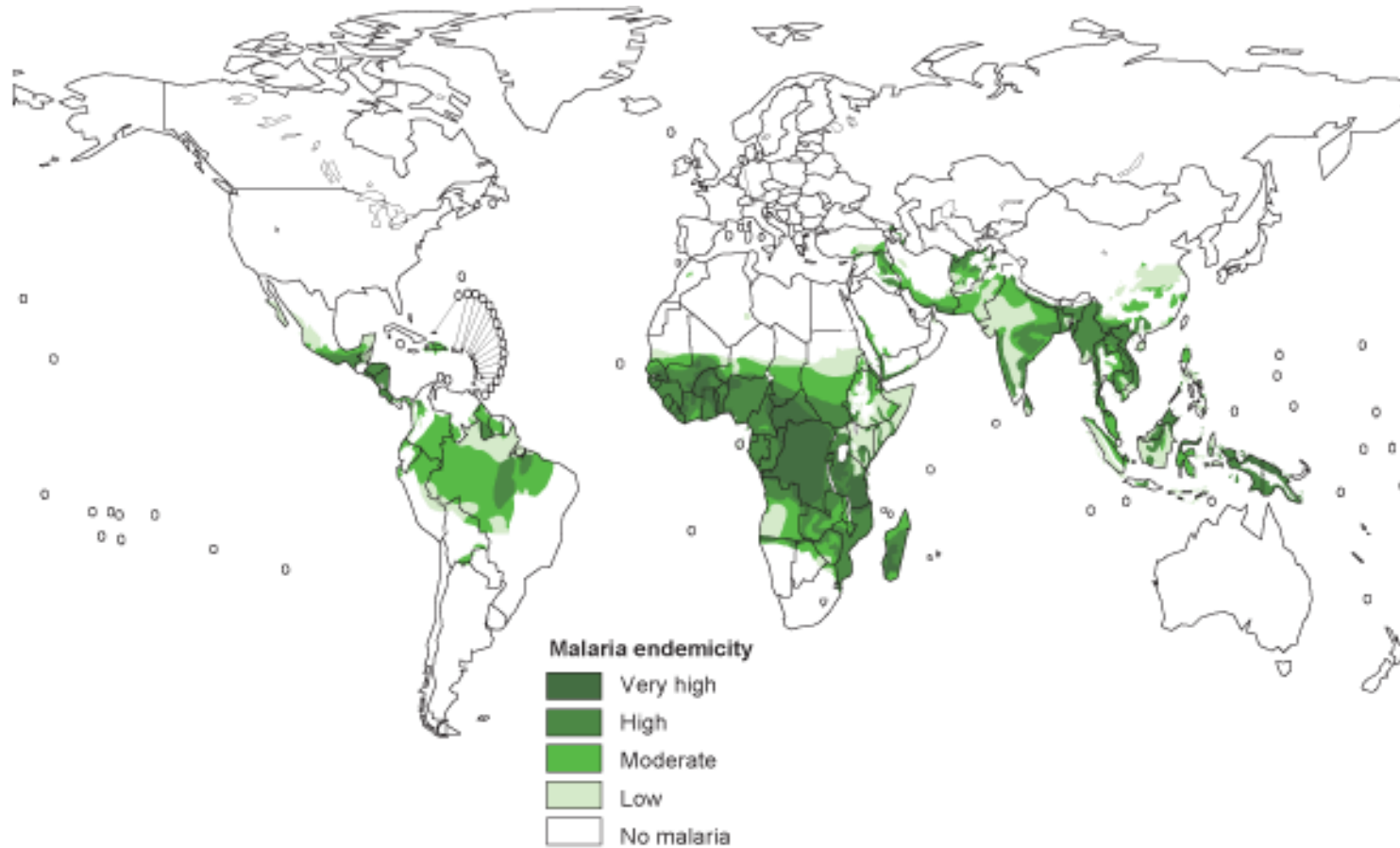
- Ronald Ross (1897)
- Between 350 and 500 million clinical episodes of malaria occur every year.
- 1-2 million deaths occur every year.
- About 60% of the cases of malaria worldwide and more than 80% of the malaria deaths worldwide occur in Africa south of the Sahara.
- Parasite – *Plasmodium spp.*
  - *P. falciparum*, *P. vivax*, *P. malaria*, *P. ovale*
- Vector – *Anopheles spp.*

# Malaria – Mode of Transmission

- When the mosquito bites a malaria patient, the mosquito becomes infected and will pass on the disease when it bites another person.
- Malaria is not transmitted from person to person.
- Malaria can be transmitted through contaminated blood transfusion, organ transplant, or shared needles or syringes.
- It may also be transmitted from a mother to her foetus/newborn baby before or during delivery.



# Global Distribution



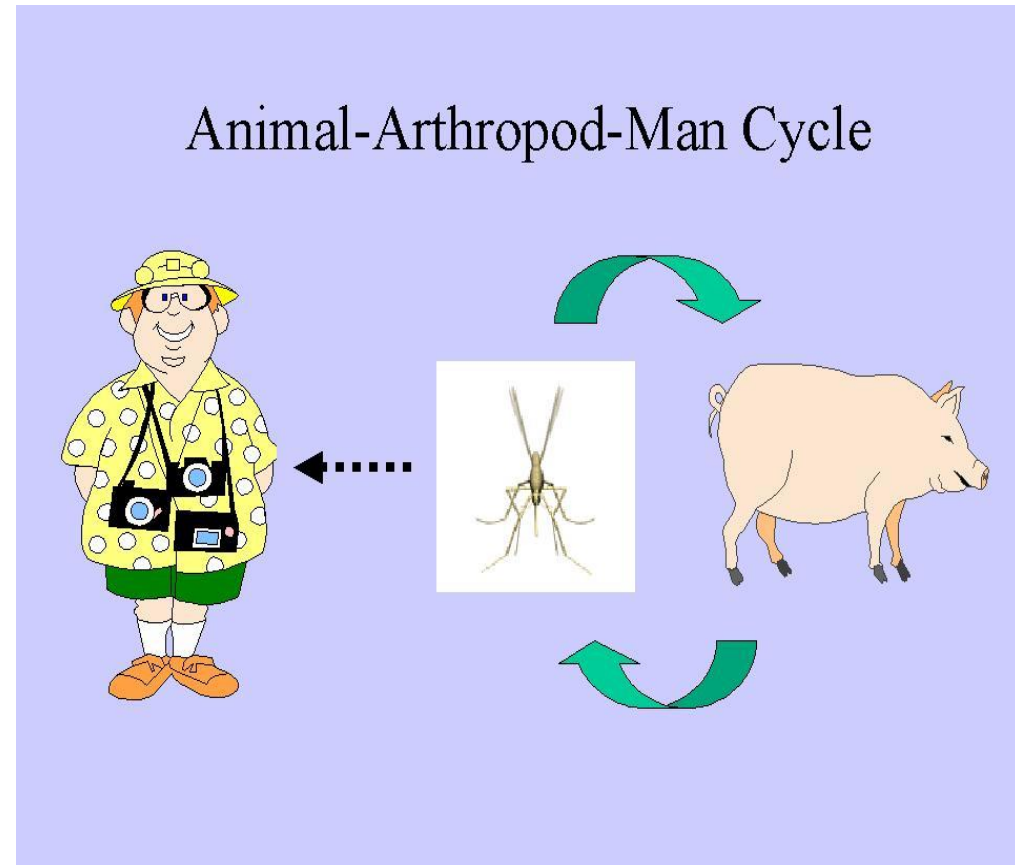


# Malaria – Signs and symptoms

- Intermittent fever, chills, sweating, headache, tiredness, poor appetite and muscle pain.
- In typical cases, the fever comes, then subsides for 1 to 3 days and then comes again in a cyclical pattern.
- Complications include anaemia, liver and kidney failure, seizures, mental confusion, coma, and death if the disease is not treated promptly.
- Consult a doctor for early diagnosis is crucial.
- The doctor would prescribe a course of anti-malarial drugs with other supportive measures.
- The patient should complete the whole course of medication to ensure clearance of the malaria parasites.

# Mosquito Arboviruses

- Intrinsic incubation period of a virus in humans is a few days.
- Host becomes viraemic.
- Viraemia lasts typically 3 days then disappears from the peripheral blood.
- An arthropod must bite a viraemic host if it is to become infected.



# Yellow fever

- *Aedes aegypti*
- Originally in New World Monkey populations
- Yellow fever is an acute viral haemorrhagic disease transmitted by infected mosquitoes. The "yellow" in the name refers to the jaundice that affects some patients.
- Up to 50% of severely affected persons without treatment will die from yellow fever.
- There are an estimated 200 000 cases of yellow fever, causing 30 000 deaths, worldwide each year, with 90% occurring in Africa.
- The virus is endemic in tropical areas of Africa and Latin America, with a combined population of over 900 million people.
- The number of yellow fever cases has increased over the past two decades due to declining population immunity to infection, deforestation, urbanization, population movements and climate change.

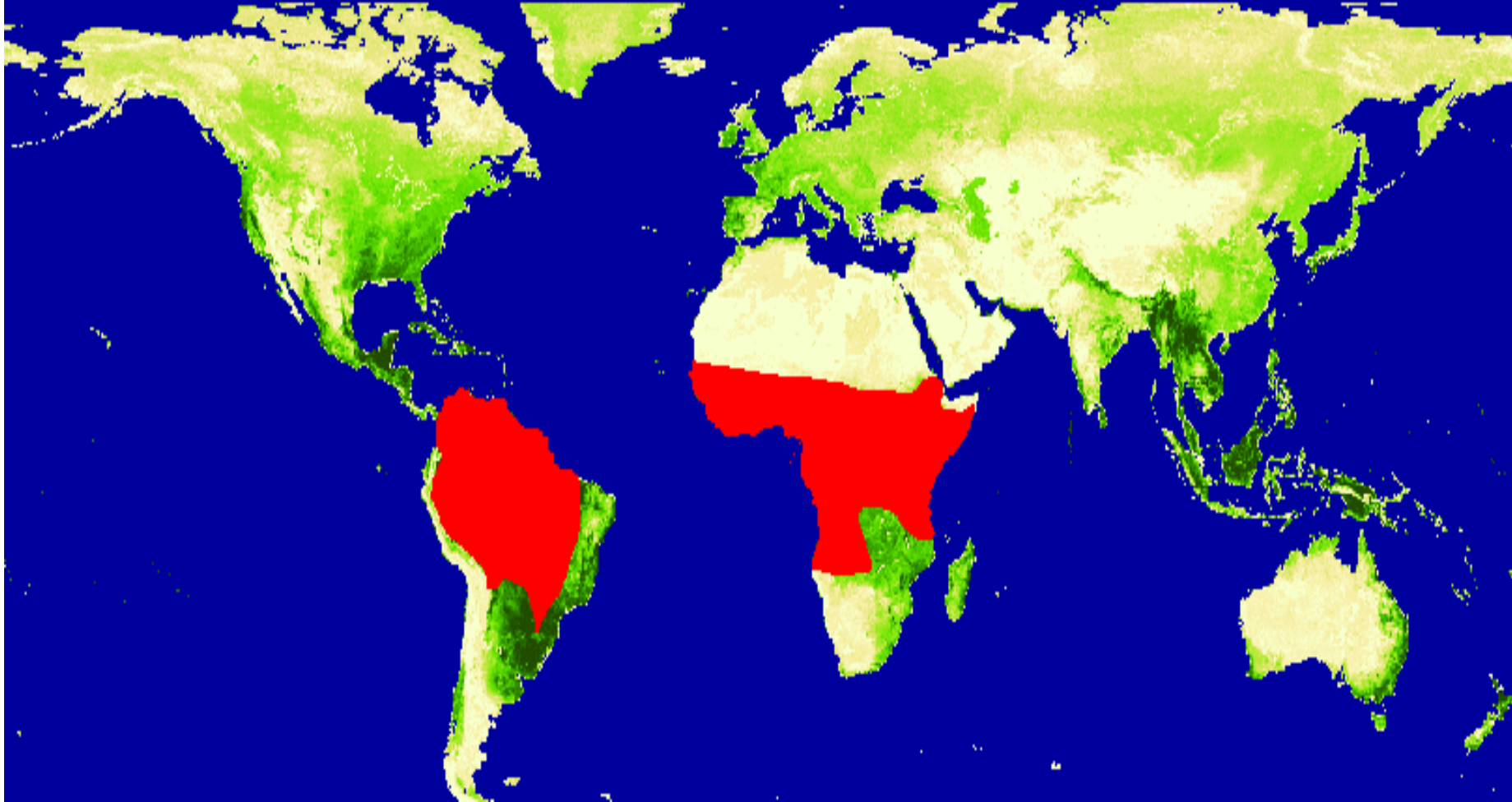
# Yellow fever – continued

- There is no specific treatment for yellow fever. Treatment is symptomatic, aimed at reducing the symptoms for the comfort of the patient.
- Vaccination is the most important preventive measure against yellow fever. The vaccine is safe, affordable and highly effective, and a single dose of yellow fever vaccine is sufficient to confer sustained immunity and life-long protection against yellow fever disease and a booster dose of yellow fever vaccine is not needed. The vaccine provides effective immunity within 30 days for 99% of persons vaccinated.
- Prevented the building of the Panama Canal.
- Pathogen: The yellow fever virus is an arbovirus of the *flavivirus* genus
- Vector: *Aedes spp.* and *Haemagogus spp* (It carries the virus from one host to another, primarily between monkeys, from monkeys to humans, and from person to person.)

# Transmission

- The mosquitoes either breed around houses (domestic), in the jungle (wild) or in both habitats (semi-domestic). There are three types of transmission cycles.
- *Sylvatic (or jungle) yellow fever*: In tropical rainforests, yellow fever occurs in monkeys that are infected by wild mosquitoes. The infected monkeys then pass the virus to other mosquitoes that feed on them. The infected mosquitoes bite humans entering the forest, resulting in occasional cases of yellow fever. The majority of infections occur in young men working in the forest (e.g. for logging).
- *Intermediate yellow fever*: Semi-domestic mosquitoes (that breed in the wild and around households) infect both monkeys and humans. This is the most common type of outbreak in Africa that can become a more severe epidemic if the infection is carried into an area populated with both domestic mosquitoes and unvaccinated people.
- *Urban yellow fever*: Large epidemics occur when infected people introduce the virus into densely populated areas with a high number of non-immune people and *Aedes* mosquitoes. Infected mosquitoes transmit the virus from person to person.

# Distribution



# Dengue

- More than 100 countries are endemic to dengue, primarily affecting 2.5 billion inhabitants in the tropical and subtropical regions
- WHO estimates approximately 100 million infections, 500,000 people with dengue hemorrhagic fever (DHF) requiring hospitalization
- DHF may develop into dengue shock syndrome (DSS)
- Successful treatment is labor intensive and expensive, but without proper treatment, fatality rates may exceed 20%
- In India
  - In India first outbreak of dengue was recorded in 1812
  - First dengue epidemic in India was at Calcutta 63-64
  - In New Delhi, outbreaks of dengue fever reported in 67, 70, 82, & 96
  - Average mortality rate 1%, rural areas: 3-5%

# Dengue

- Dengue is a mosquito-borne viral infection.
- The infection causes flu-like illness, and occasionally develops into a potentially lethal complication called severe dengue.
- The global incidence of dengue has grown dramatically in recent decades.
- About half of the world's population is now at risk.
- Dengue is found in tropical and sub-tropical climates worldwide, mostly in urban and semi-urban areas.
- Severe dengue is a leading cause of serious illness and death among children in some Asian and Latin American countries.
- There is no specific treatment for dengue/ severe dengue, but early detection and access to proper medical care lowers fatality rates below 1%.
- Dengue prevention and control solely depends on effective vector control measures.



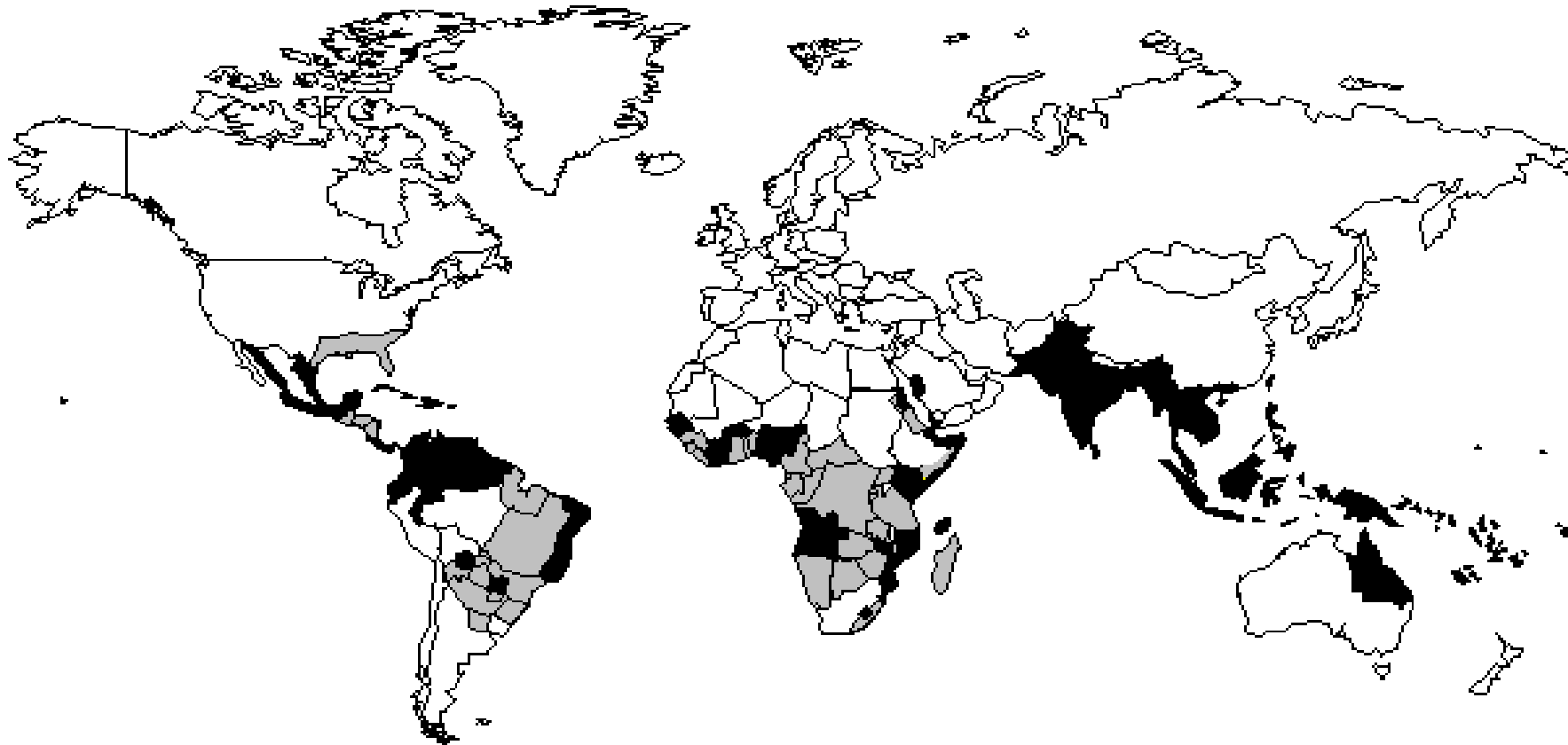
# Transmission

- The *Aedes aegypti* mosquito is the primary vector of dengue. The virus is transmitted to humans through the bites of infected female mosquitoes. After virus incubation for 4–10 days, an infected mosquito is capable of transmitting the virus for the rest of its life.
- Infected humans are the main carriers and multipliers of the virus, serving as a source of the virus for uninfected mosquitoes. Patients who are already infected with the dengue virus can transmit the infection (for 4–5 days; max 12) via *Aedes* mosquitoes after their first symptoms appear.
- The *Aedes aegypti* mosquito lives in urban habitats and breeds mostly in man-made containers. Unlike other mosquitoes *Aedes* is a daytime feeder; its peak biting periods are early in the morning and in the evening before dusk.

# Symptoms

- Dengue fever is a severe, flu-like illness that affects infants, young children and adults, but seldom causes death.
- Dengue should be suspected when a high fever (40°C/ 104°F) is accompanied by two of the following symptoms: severe headache, pain behind the eyes, muscle and joint pains, nausea, vomiting, swollen glands or rash. Symptoms usually last for 2–7 days, after an incubation period of 4–10 days after the bite from an infected mosquito.
- Severe dengue is a potentially deadly complication due to plasma leaking, fluid accumulation, respiratory distress, severe bleeding, or organ impairment. Warning signs occur 3–7 days after the first symptoms in conjunction with a decrease in temperature (below 38°C/ 100°F) and include: severe abdominal pain, persistent vomiting, rapid breathing, bleeding gums, fatigue, restlessness, blood in vomit. The next 24–48 hours of the critical stage can be lethal; proper medical care is needed to avoid complications and risk of death.

# Distribution



■ Areas infested with *Aedes aegypti*

■ Areas with *Aedes aegypti* and dengue epidemic activity

# Japanese Encephalitis

- Japanese encephalitis (JE) is a flavivirus related to dengue, yellow fever and West Nile viruses, and is spread by mosquitoes.
- JE is the main cause of viral encephalitis in many countries of Asia with nearly 68 000 clinical cases every year.
- Although symptomatic JE is rare, the case-fatality rate among those with encephalitis can be as high as 30%. Permanent neurologic or psychiatric sequelae can occur in 30%–50% of those with encephalitis.
- 24 countries in the WHO South-East Asia and Western Pacific regions have endemic JE transmission, exposing more than 3 billion people to risks of infection.
- Safe and effective vaccines are available to prevent JE. WHO recommends JE vaccination in all regions where the disease is a recognised public health problem.

# Transmission

- 24 countries in the WHO South-East Asia and Western Pacific regions have JE transmission risk, which includes more than 3 billion people.
- JE is transmitted to humans through bites from infected mosquitoes of the *Culex* species (mainly *Culex tritaeniorhynchus*). Humans, once infected, do not develop sufficient viraemia to infect feeding mosquitoes. The virus exists in a transmission cycle between mosquitoes, pigs and/or water birds (enzootic cycle). The disease is predominantly found in rural and periurban settings, where humans live in closer proximity to these vertebrate hosts.
- In most temperate areas of Asia, the Japanese Encephalitis Virus (JEV) is transmitted mainly during the warm season, when large epidemics can occur. In the tropics and subtropics, transmission can occur year-round but often intensifies during the rainy season and pre-harvest period in rice-cultivating regions.

# Sign, symptoms and treatment

- Most JE virus infections are mild (fever and headache) or without apparent symptoms, but approximately 1 in 250 infections results in severe disease characterized by rapid onset of high fever, headache, neck stiffness, disorientation, coma, seizures, spastic paralysis and death. The case-fatality rate can be as high as 30% among those with disease symptoms.
- Of those who survive, 20%–30% suffer permanent intellectual, behavioural or neurological problems such as paralysis, recurrent seizures or the inability to speak.
- There is no antiviral treatment for patients with JE. Treatment is supportive to relieve symptoms and stabilize the patient. Clinical care guidelines have been developed by PATH.

# Distribution



# *Musca domestica*

- 6-7 mm long, grey color
- marked by 4 dark longitudinal stripes
- breed in animal/human excrement or domestic organic waste
- land, breed, and feed on feces and human food



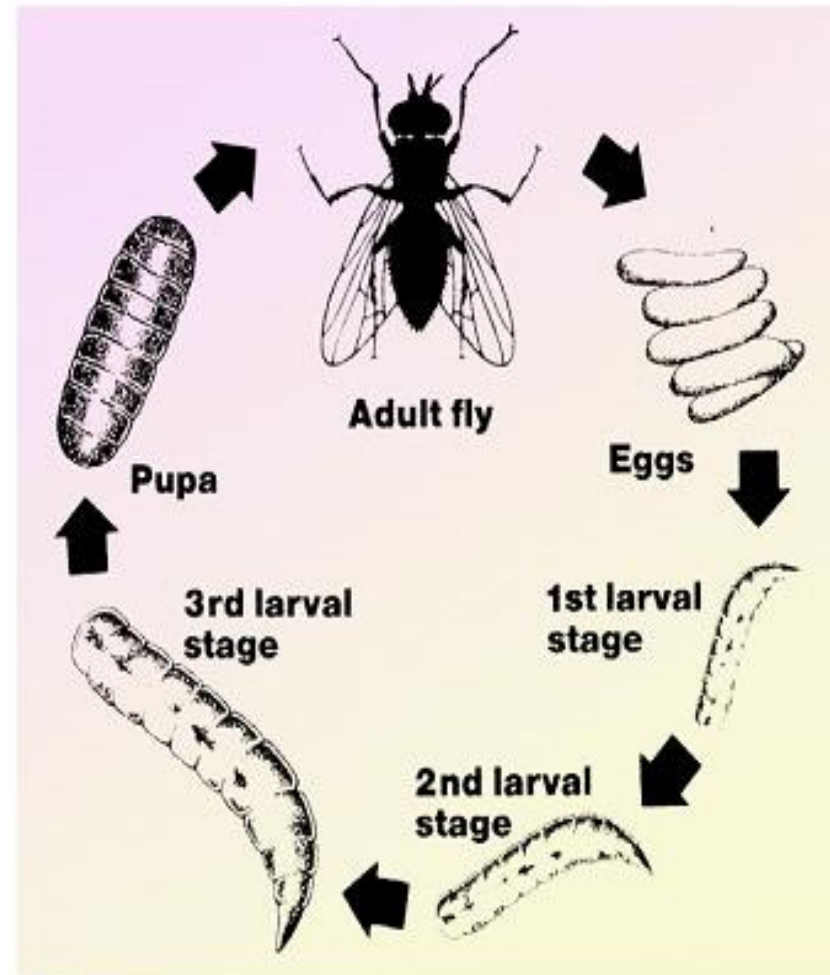


# Details

- Lives in all continents; tropical to temperate
- Prefers warmer climate
- Loves to live with human
- Have little sticky pads at the bottom of each leg
- Helps them hang on to walls, even glass
- Those pads are also their taste buds, among others
- They have hairs all over the body
- And these are fanatical clean animal, they are always cleaning their hairs and feet
- And that is our biggest problem
- These are mechanical vector or carriers. They just carry in their legs and hair the germs from one place to the next

# Life cycle

- Eggs
- Larvae (1 – 5)
- Pupa



# Eggs

- white eggs, about 1.2 mm in length,
- laid singly.
- Each female fly can lay up to 500 eggs in several batches of about 75 to 150 eggs, each over a three to four day period
- The number of eggs produced is a function of female size, which is principally a result of larval nutrition.



# Larvae

- The mature larva is 3 to 9 mm long, typical creamy whitish in color, cylindrical but tapering toward the head
- The head contains one pair of dark hooks
- Legless
- The posterior spiracles are slightly raised and the spiracular openings are sinuous slits which are completely surrounded by an oval black border.
- feed on and develop in the material (organic material) where the eggs were laid.
- The larvae go through three instars
- When the maggots are full-grown, they crawl up to 50 feet to a dried, cool place near breeding material and transform to the pupal stage.

# Diseases

- Major
  - Cholera
  - Conjunctivitis
  - Salmonella
  - Diarrheal diseases
  - Trachoma
- Minor
  - Poliomyelitis
  - Yaws



# Cholera

- Cholera is an acute diarrhoeal disease that can kill within hours if left untreated.
- Caused by bacterium *Vibrio cholerae*
- There are an estimated 3–5 million cholera cases and 100 000–120 000 deaths due to cholera every year.
- Up to 80% of cases can be successfully treated with oral rehydration salts.
- Effective control measures rely on prevention, preparedness and response.
- Provision of safe water and sanitation is critical in reducing the impact of cholera and other waterborne diseases.
- Oral cholera vaccines are considered an additional means to control cholera, but should not replace conventional control measures.

# Conjunctivitis

- Pink eye (conjunctivitis) is an inflammation or infection of the transparent membrane (conjunctiva) that lines your eyelid and covers the white part of your eyeball. When small blood vessels in the conjunctiva become inflamed, they're more visible. This is what causes the whites of your eyes to appear reddish or pink.
- Symptoms:
  - Redness, itchiness in one or both eyes
  - A discharge in one or both eyes that forms a crust during the night that may prevent your eye or eyes from opening in the morning

# Trachoma

- Trachoma is the result of infection of the eye with *Chlamydia trachomatis*.
- Infection spreads from person to person, and is frequently passed from child to child and from child to mother, especially where there are shortages of water, numerous flies, and crowded living conditions.
- Infection often begins during infancy or childhood and can become chronic. If left untreated, the infection eventually causes the eyelid to turn inwards, which in turn causes the eyelashes to rub on the eyeball, resulting in intense pain and scarring of the front of the eye. This ultimately leads to irreversible blindness, typically between 30 and 40 years of age.



# Salmonella

- Salmonellosis, is one of the most common and widely distributed foodborne diseases, with tens of millions of human cases occurring worldwide every year.
- Most cases of salmonellosis are mild, however, sometimes people die from salmonellosis. The severity of the disease may depend on host factors and the strain of salmonella.
- Since the beginning of the 1990s, *salmonella* strains which are resistant to a range of antimicrobials have emerged and are now a serious public health concern.
- Salmonellosis is a disease caused by the bacteria *salmonella*. It is usually characterized by acute onset of fever, abdominal pain, diarrhoea, nausea and sometimes vomiting.
- The onset of disease symptoms occurs 6 - 72 hours (usually 12-36 hours) after ingestion of *salmonella*, and illness lasts 2-7 days.

# Polio

- Polio (poliomyelitis) mainly affects children under 5 years of age.
- One in 200 infections leads to irreversible paralysis. Among those paralysed, 5% to 10% die when their breathing muscles become immobilized.
- Polio cases have decreased by over 99% since 1988, from an estimated 350 000 cases then, to 406 reported cases in 2013. The reduction is the result of the global effort to eradicate the disease.
- In 2014, only 3 countries (Afghanistan, Nigeria and Pakistan) remain polio-endemic, down from more than 125 in 1988.
- As long as a single child remains infected, children in all countries are at risk of contracting polio. Failure to eradicate polio from these last remaining strongholds could result in as many as 200 000 new cases every year, within 10 years, all over the world.

# Yaws

- Yaws, also known as framboesia or pian, caused by *Treponema pallidum pertenue*
- Yaws is a neglected tropical disease that affects the skin, bone and cartilage.
- The disease is caused by a bacterium from the same group of organisms that cause venereal syphilis; however, the transmission of yaws is not sexually-related.
- Most common in children
- 2 countries - Ecuador and India - which were once endemic reported interruption of transmission in 2003.

# Family: Glossinidae (Tsetse-flies)

Found in Sub-Saharan Africa, and only common to Africa.

Found in vegetation by rivers and lakes, in gallery-forests and in vast stretches of wooded savannah. Mostly tropical areas.

Many regions where tsetse flies are found, but the Sleeping Sickness is not.

It can bite through clothing, and the bite is very painful.

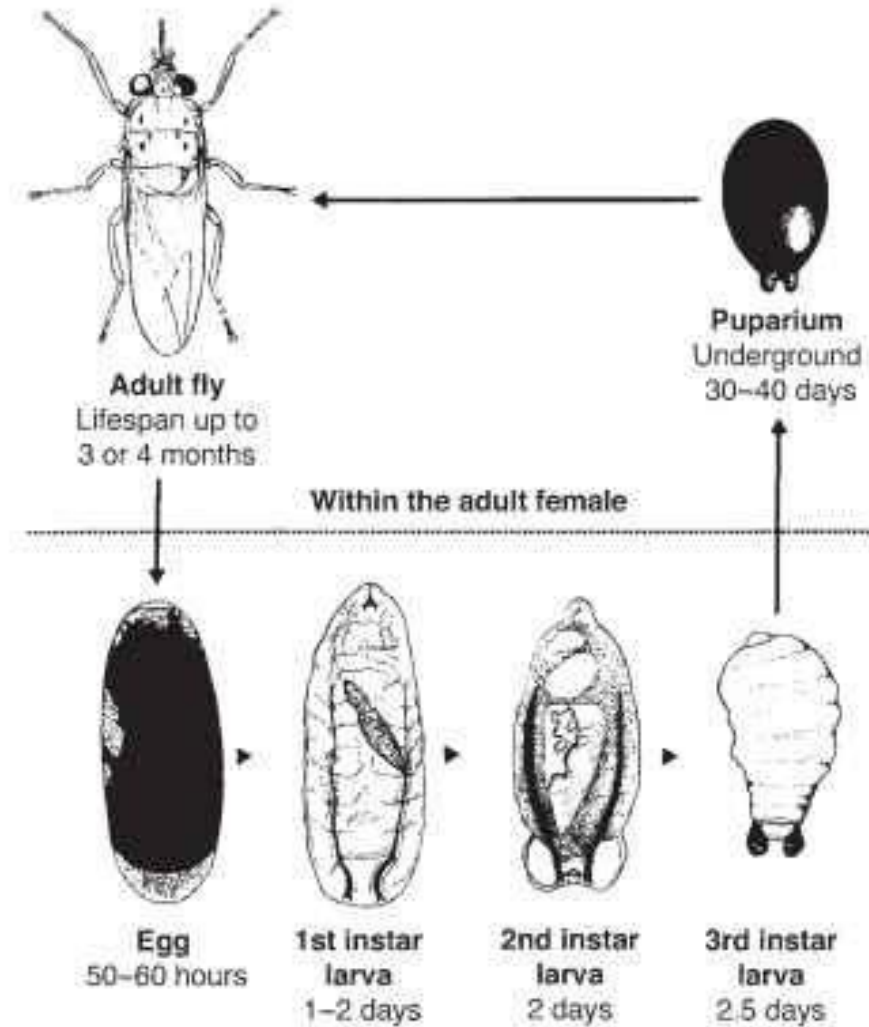
The fly becomes infected with the disease by biting animals or humans who are already infected with the disease.



# Life History

Egg → Larvae → Pupae  
→ Adult

- Egg completes maturation in ovary
- Larvae goes through 3 instars in the female
- Larviposition in shaded areas.
- Larvae bury itself in soil and pupates.
- Pupal stage is long.
- Adults spend day resting on vegetation or dark humid sites. (Twigs, branches, tree trunks)



# Feeding Habits

- Both male and females blood feed on humans, wild and domesticated animals, as well as reptiles and amphibians.
- Feed in dry-hot weather, cooler weather they feed every 10 days.
- Vision is important in host location.
- Females must take several bloodmeals to feed larvae.
- Many species rarely feed on people.

# In words

- Uninfected tsetse fly (*Glossina*) bites an infected vertebrate host and ingests trypomastigote circulating in the bloodstream.
- Trypomastigotes multiply by longitudinal binary fission in fly gut.
- Trypomastigotes migrate to the salivary glands and transform into epimastigotes and multiply for several generation.
- Epimastigotes transform back into Metacyclic Trypomastigotes (short stumpy forms) in the salivary glands. These form the infective stage.
- Tsetse fly bites a human or ruminant host and inoculates metacyclic trypomastigotes into bloodstream.
- Trypomastigotes live and multiply in the blood and lymph. In some cases, trypomastigotes migrate to the central nervous system.

# Symptoms

- Fever
- Personality changes
- Disturbance of sleep patterns
- Troubles with walking and talking
- Aching muscles and joints
- Slurred speech
- Seizures
- Rashes
- Swelling around the eyes and hands
- Headaches
- Fatigue
- Prolonged sleep
- Death shortly happens a few months after the invasion of the central nervous system.



# Facts

- Affects 36 countries in sub-Saharan Africa.
- Killed 48,000 people in 2002.
- A threat to 60 million people, only 7% have access to diagnosis and treatment.
- An estimated 300,000-500,000 people are currently infected, and this figure appears to be on the rise.
- If left untreated, the disease is 100% fatal, killing within a few weeks to a few years.

# Sand fly



# Characters

- Class: Insecta
  - Order: Diptera
    - *Phlebotomus* spp. (Old World)
    - *Lutzomyia* spp. (New World )
- Adults - small (less than 5 mm long)
- Slender with piercing mouthparts and long antennae
- Brown (but appear white when illuminated)
- Wings held in erect V-shape
- Nocturnal
- Do not hover
- Silent
- Painful bite

# Characters

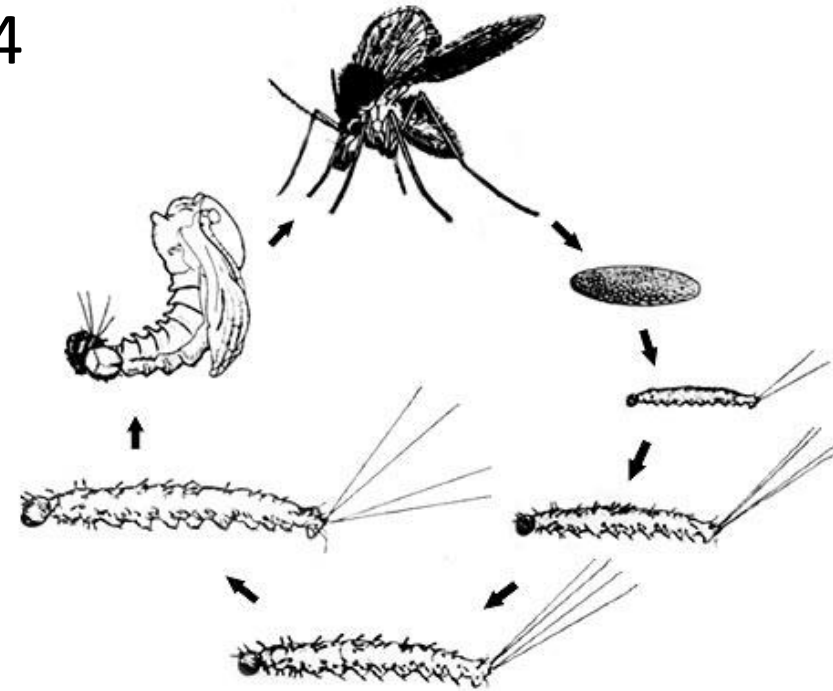
- Found throughout the year but increases rainy and post rainy months (in West Bengal).
- Only female sandflies are blood sucker and they are nocturnal feeders.
- The female sandfly lays its eggs in the burrows of certain rodents, the bark of old trees, ruined buildings, cracks in the walls of houses, animal shelters and household rubbish, where the larvae can find the organic matter, heat and humidity they need to develop.
- In its search for blood (usually in the evening and at night), the female sandfly can cover a distance of up to several hundred metres around its habitat.
- They are poor flier and fly in a characteristic hopping

# Life cycle

- The eggs are elongated oval-shaped, pale at first and darkening on exposure to air with a single black “eye spot”.
- Eggs are laid in dark humid animal burrows, cracks or crevices, or under dead leaves
- The larvae emerge through a J-shaped fissure and are legless and whitish with a dark head capsule.
- There are 4 larval instars, the larval stage lasting a total of 4-6 weeks
- Those of the first instar can be distinguished by the presence of two caudal bristles, all subsequent instars bearing four.
- The pupae are golden brown and are affixed to the surface of the substrate in which they developed by the final larval shell/exoskeleton.
- The pupa requires 10 days for development

Life cycle  
males and flies emerge about 24 h before females.

- The time from oviposition to adult emergence at ambient temperature is around 4-6 weeks, 30-50 eggs/female.
- Only adult females suck blood



eggs

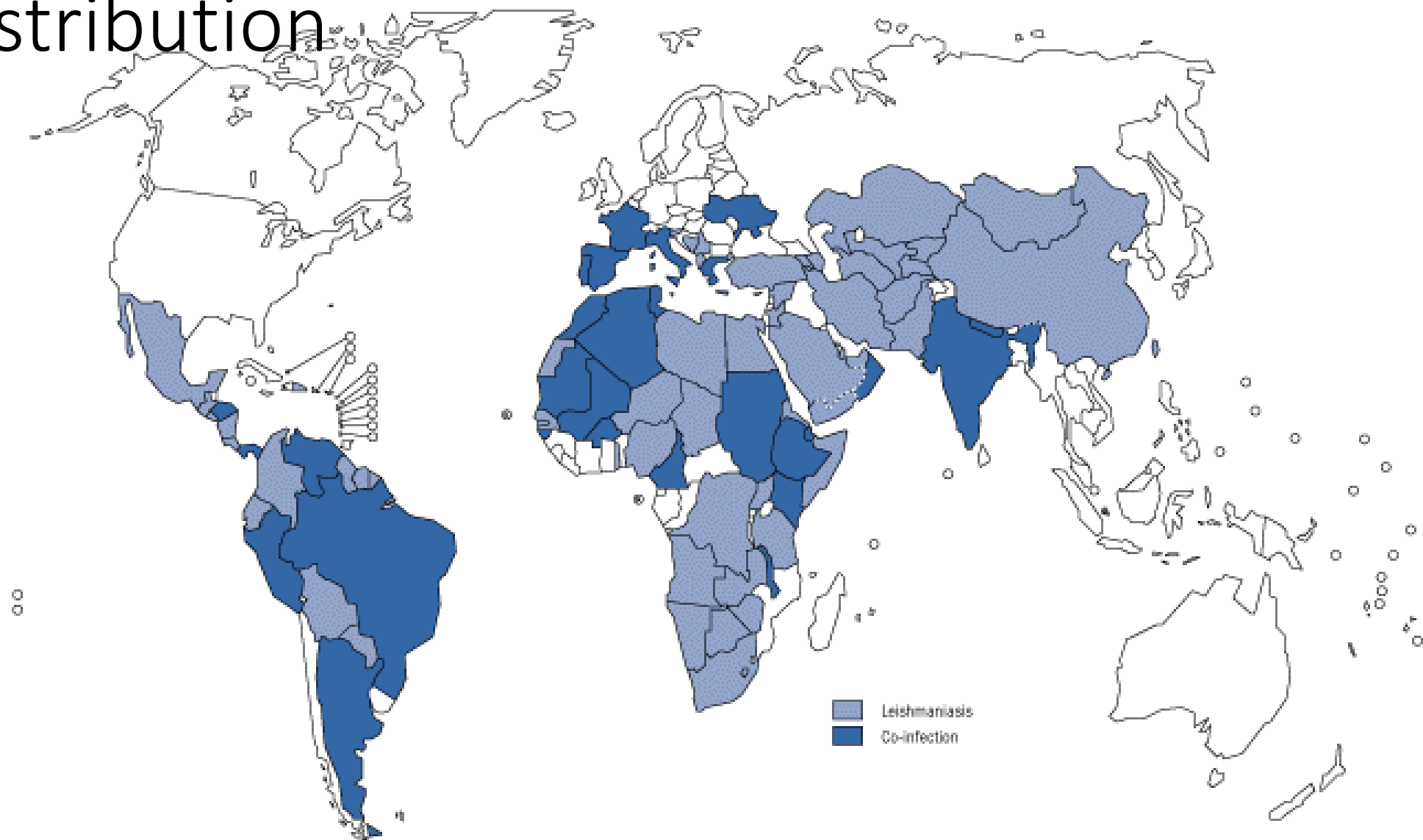


larvae



pupae

# Distribution



# Diseases

- *Leishmania* spp. (Cutaneous and visceral leishmaniases in 89 countries worldwide)
- *Bartonella bacilliformis* (Bartonellosis or Carrión's disease in Peru, Ecuador and Colombia
  - Fever and haemolytic anaemia. Very high fatality rate if untreated, especially with opportunistic infection.
- Chandipura virus
  - Encephalitis like phenotype. The virus is found in India and West Africa but outbreaks only reported in India



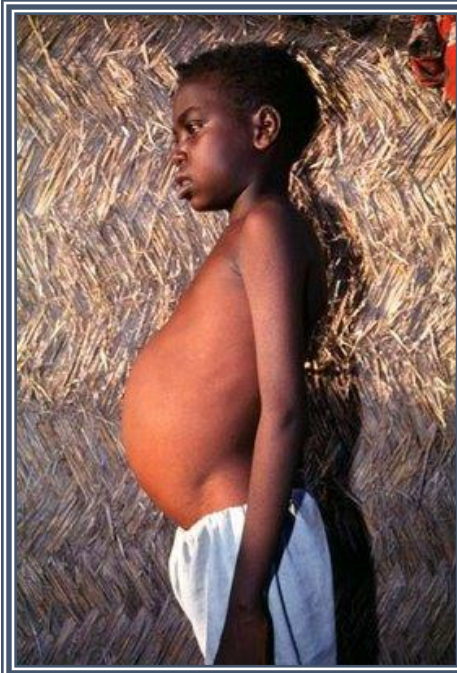
# Leishmaniasis

- Leishmaniasis is caused by protozoan parasites belonging to the genus *Leishmania*. The parasites are transmitted by the bite of a tiny – only 2–3 mm long – insect vector, the *phlebotomine sandfly*.
- There are some 500 known phlebotomine species, but only about 30 have been found to transmit leishmaniasis. Only the female sandfly transmits the parasites. Female sandflies need blood for their eggs to develop, and become infected with the *Leishmania* parasites when they suck blood from an infected person or animal. Over a period of between 4 and 25 days, the parasites develop in the sandfly. When the infectious female sandfly then feeds on a fresh source of blood, it inoculates the person or animal with the parasite, and the transmission cycle is completed.

# Leishmaniasis

- **Visceral leishmaniasis** (VL also known as kala-azar) is fatal if left untreated. It is characterized by irregular bouts of fever, weight loss, enlargement of the spleen and liver, and anaemia. It is highly endemic in the Indian subcontinent and in East Africa. An estimated 200 000 to 400 000 new cases of VL occur worldwide each year. Over 90% of new cases occur in six countries: Bangladesh, Brazil, Ethiopia, India, South Sudan, and Sudan.
- **Cutaneous leishmaniasis** (CL) is the most common form of leishmaniasis and causes ulcers on exposed parts of the body, leaving life-long scars and serious disability. About 95% of CL cases occur in the Americas, the Mediterranean basin, and the Middle East and Central Asia. Over two-third of CL new cases occur in six countries: Afghanistan, Algeria, Brazil, Colombia, Iran (Islamic Republic of) and the Syrian Arab Republic. An estimated 0.7 million to 1.3 million new cases occur worldwide annually.
- **Mucocutaneous leishmaniasis** leads to partial or total destruction of mucous membranes of the nose, mouth and throat. Almost 90% of mucocutaneous leishmaniasis cases occurs in the Plurinational State of Bolivia, Brazil and Peru.

# Images



VL



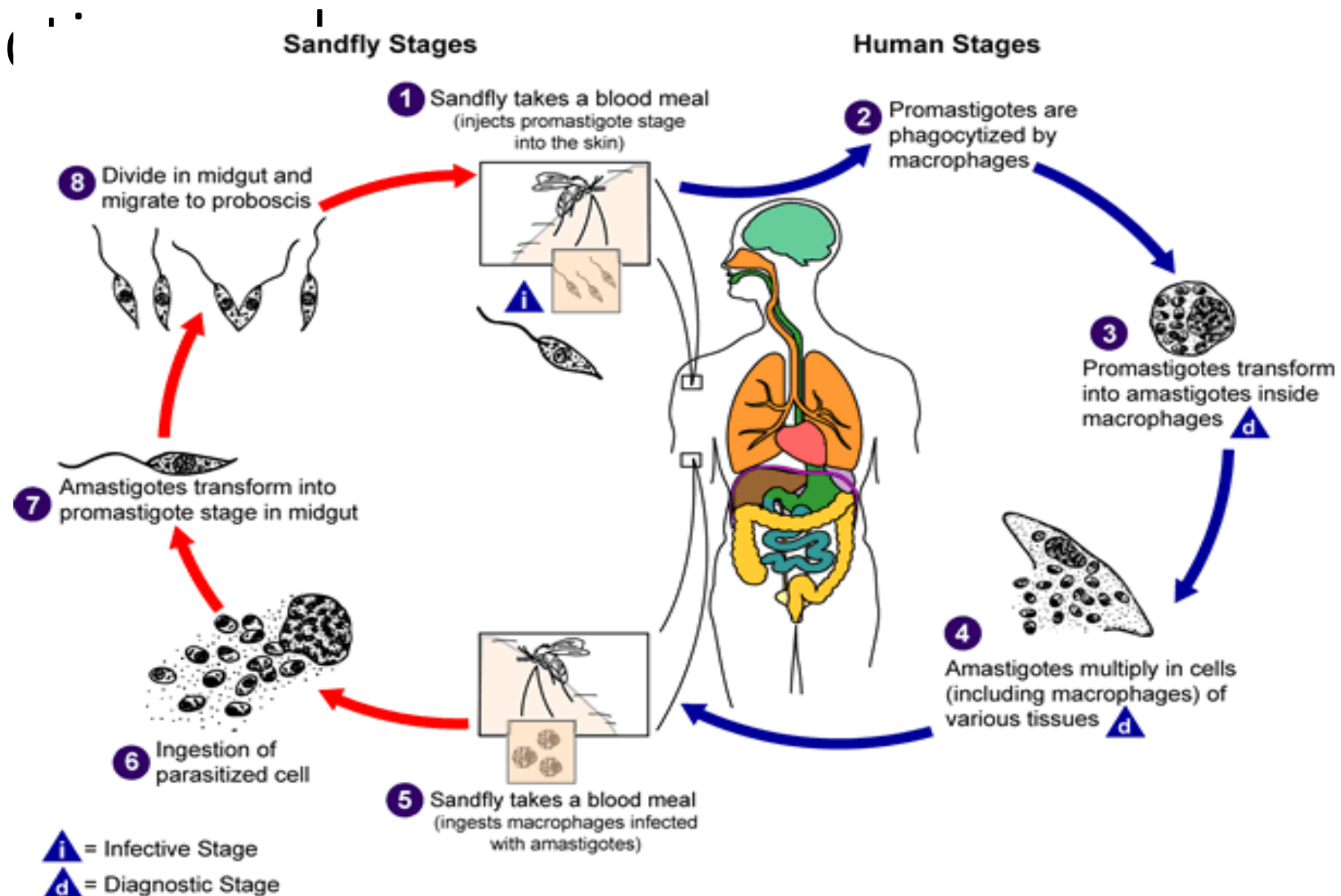
ML



CL

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# Infection



# Sand fly control

- Cracks around the domicile is where flies live, spray insecticide there
- Avoid living close to domesticated animals
- Use mosquito net at night
- See a doctor

# Louse or lice

## Three types of lice:

- Head lice: *Pediculus humanus capitis* (2-3 mm long)

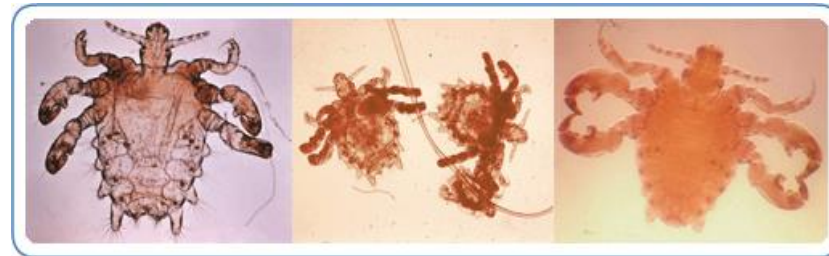
- Do not spread disease

- Body lice: *Pediculus humanus humanus* (2.3-3.6 mm long)

- Do spread disease

- Pubic lice (crabs): *Phthirus pubis* (1.1-1.8 mm long)

- Do not spread disease



# Lice

## All three types of lice:

- Are ectoparasites: lice live on the surface of the host
- Move by crawling, as opposed to flying
- Have humans as their only host
- Have similar life cycles



Head Lice



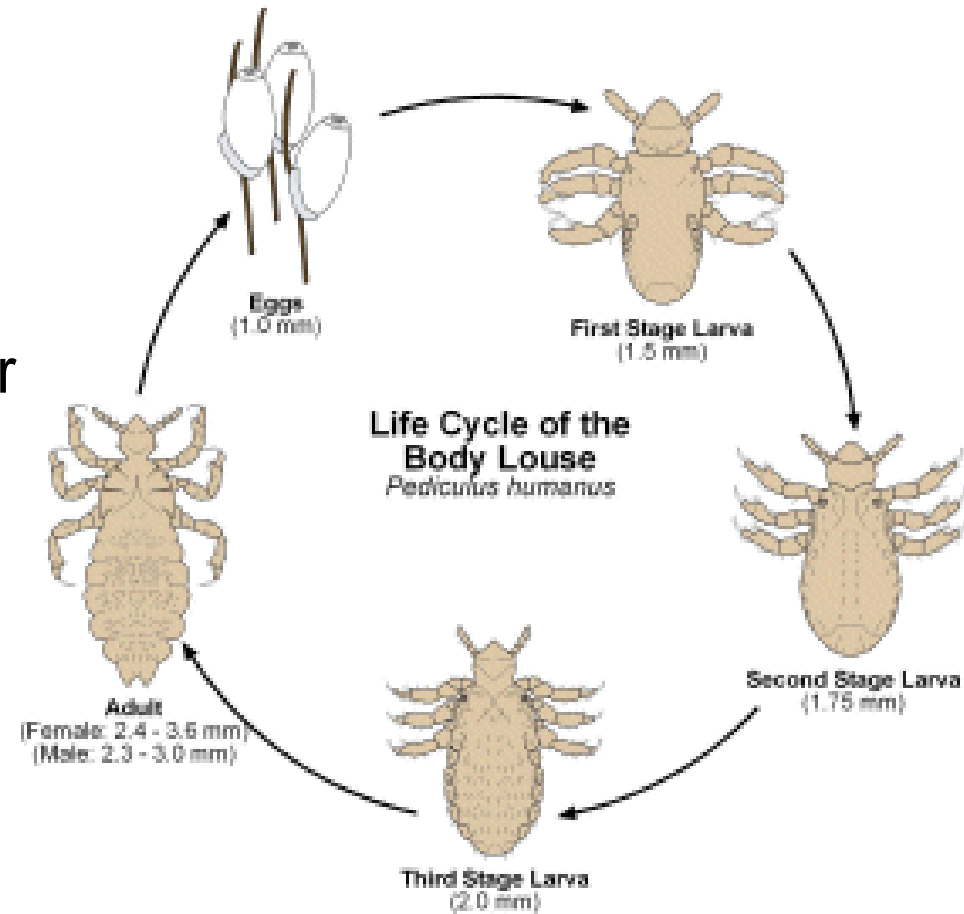
Body Lice



Pubic Lice

# Life cycle

- Mature female can lay 3 – 6 eggs/day and live for about 1 month
- Eggs hatch within 6 – 10 days, maturity reached after another 10 days
- Nits may survive up to 3 weeks after removal from the host



Note: Lice take several blood meals daily in larval stages and as adults.



# Transmission

- Usually head-to-head contact
- Can be contracted through the sharing of brushes, hats, scarves, coats, bedding/linens, etc.



- Obligate human parasite (a parasite organism that cannot complete its life cycle without dependence on its host) **cannot** be transferred through pets/animals

# IDENTIFICATION

- Live lice may be detected, but they move very quickly, and shy away from light so detection of live lice may be difficult – advantageous to use 2 people to check the infected person
  - many of those infected will have  $< 10$  organisms present
- Lice appear sluggish away from the warm scalp
- Usually 24 hour survival off the host Some recent data suggest for up to 55 hours



# IDENTIFICATION OF NITS

- Important to distinguish nits from other possibilities
- Dandruff, residues from gels/lacquers can look like nits
- Recent, viable “un-hatched” eggs are creamy-yellow and very close to the scalp while older “nit shells” are further away from the scalp and white in colour
- Oval in shape, slightly smaller than a sesame seed, **never** irregular in shape, fuzzy, or encircle the hair



# Pubic Lice (“Crabs”):

- Current worldwide prevalence estimated 2%
- Spread through sexual contact and is considered an STD
- Can be spread through fomites: contact with clothing, linens, and towels belonging to an infected person.
- Pubic lice found on children can be an indicator of sexual abuse.

# History

- Pathogen type: gram negative bacteria
- In North America, animal reservoir is the flying squirrel
- Was first observed and described in Italy in year 1083
- Typhus epidemics associated with extremely high mortality throughout history
- Civil War
  - WWI: 3 million deaths in Russia
  - WWII
- Featured in literature
  - Jane Eyre, Lolita, Doctor Zhivago, among others!



# Recent past

- United States
  - 30 cases since 1975
- Africa
  - 1997: Burundi 1997
    - 20,000 cases from Jan. to March
- Most common in people living under unhygienic conditions
  - Refugee camps

# Epidemic Typhus (*Rickettsia prowazekii*)

- Also known as: “jail fever”, “camp fever”, “famine fever”
- Body lice
- Transmission:
  1. Louse feeds on human infected w/ *R. prowazekii*
  2. *R. prowazekii* grows in louse’s gut
  3. *R. prowazekii* excreted in louse feces
  4. Human scratches louse bite, rubs feces into wound
  5. Lice dies within 2 weeks
- Symptoms:
  - Severe headache, sustained high fever, rash, muscle pain
- Can be treated with antibiotics

# Symptoms

- Incubation: 7-14 days
- High fever, chills, headache, cough, severe muscle pain
  - May lead to coma
- Macular eruption
  - 5-6 days after onset
  - Initially on upper trunk, spreads to entire body
    - Except face, palms and soles of feet



# Lice control

- Treat clothing and bedding
  - 70 degrees for one hour
- Chemical control
  - Permethrin (0.5%) temephos (2%), popoxur (1%) and carbaryl (5%)
- Biosafety level 3
  - Handling infectious materials, lice, carcasses
- Proper hygiene