Introduction to Public Health
Module # 13

Concept of Dengue Fever, Malaria, Zika virus infection and Chikungunya with mode of transmission ,Prevention and control .

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OBJECTIVES OF THE LECTURE

By the end of this lecture you will be able to:

- *Conceptualize*
  - *DF, Den virus, DF transmission etc.*
  - *Malaria transmission.*
  - *Symptoms & treatment of DF & Malaria*
- *Understand the preventive measures of Malaria & DF in Bangladesh.*

Dengue

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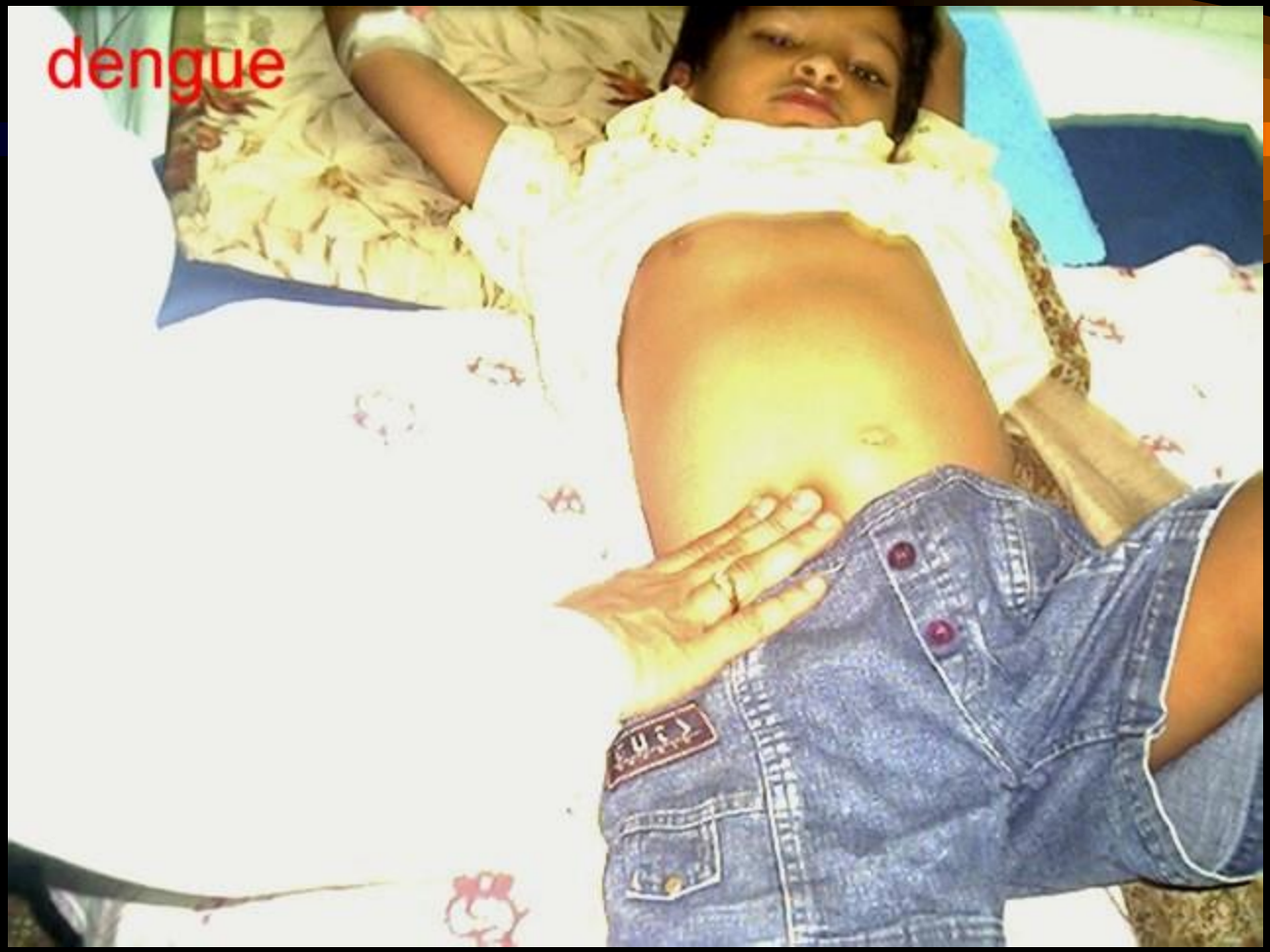

dengue

Dengue

- The word dengue is derived from African word denga: meaning *fever with hemorrhage* .
- Is caused by virus transmitted of bites of mosquito aedes.

History

- Over the last two hundred years dengue was known to the physician as a self limiting benign febrile condition.
- The first outbreak that resembles a disease now recognized as dengue fever was that described by Benjamn Rush in Philadelphia, Pennsylvania in 1780.
- Epidemics probably due to dengue were common from the eighteenth to the twentieth centuries among the inhabitants of the Atlantic coast of the United States.

History

- Dengue viruses almost certainly were the cause of the 5 and 7 day fevers that occurred among European Colonists in Tropical Asia.
- In 1905 Aedes Aeggpti was identified as a dengue vector by Bancroft Ashburn and C raig.

History

- When Dengue viruses were isolated in the laboratory mice in 1943 and 1944, the modern era of dengue research began.
- In the beginning only two different dengue viruses named dengue virus type I and II.
- During most of the previrologic era, dengue viruses were thought to be the cause of a generally benign self limited febrile exanthema.

History

- In 1956 Philippine hemorrhage fever was associated with dengue when types 3 and 4 were recovered.
- It now has become endemic through out tropical Asia since 1967 the term dengue hemorrhagic fever and DSS have come in to general use.

Epidemiology

- In India first outbreak of dengue was recorded in 1812
- A double peak hemorrhagic fever epidemic occurred in India for the first time in Calcutta between July 1963 & March 1964
- In New Delhi, outbreaks of dengue fever reported in 1967,1970,1982, &1996

Dengue Virus

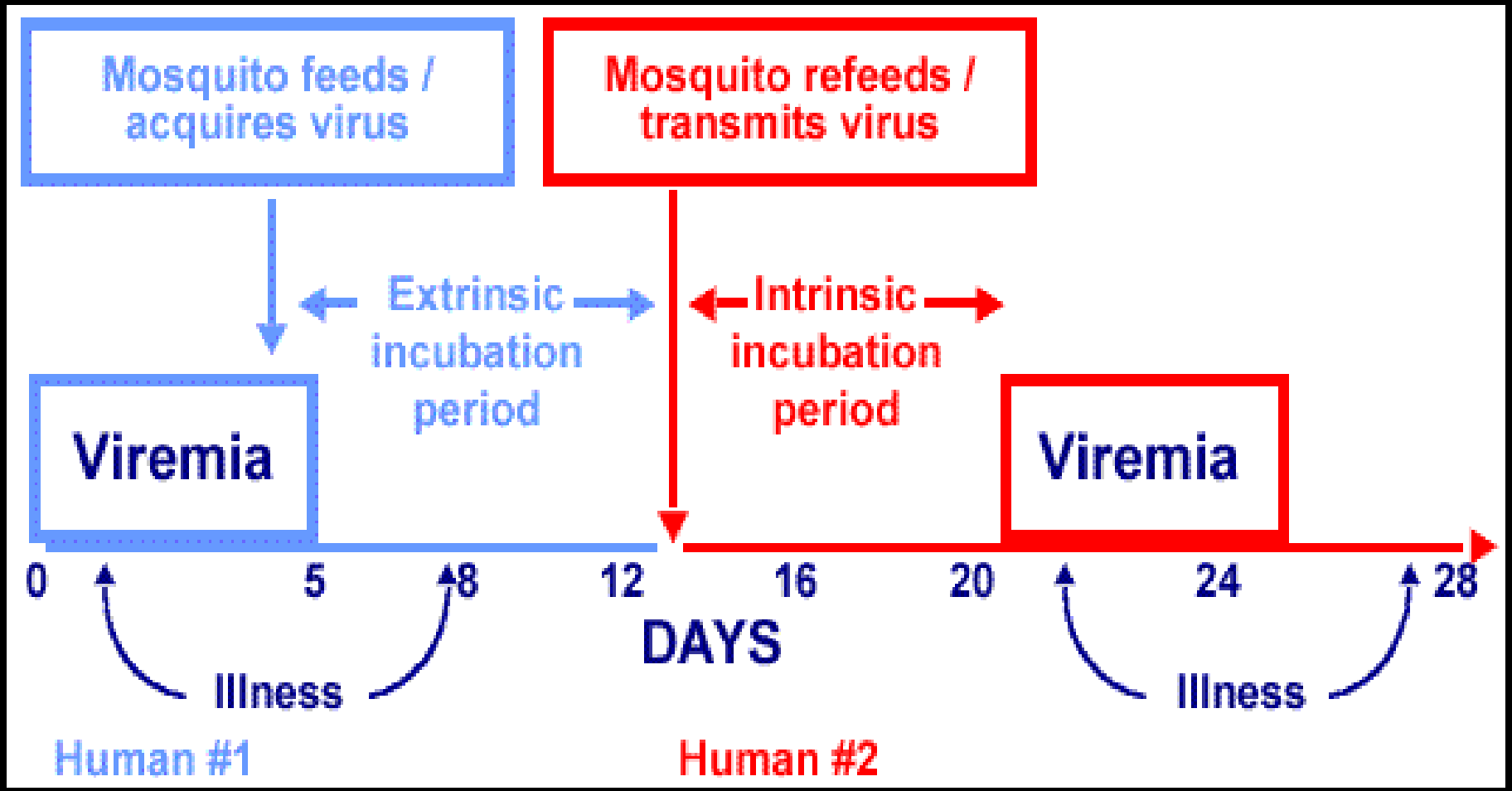
1. *Causes dengue and dengue hemorrhagic fever*
2. *It is an arbovirus*
3. *Transmitted by mosquitoes*
4. *Composed of single-stranded RNA*
5. *Has 4 serotypes (DEN-1, 2, 3, 4)*

BURDEN OF DISEASE IN S.E.ASIA

- CATEGORY-A (INDONESIA,MYANMAR,AND THAILAND)
- CATEGORY-B (INDIA,BANGALADESH,MALDIVES,AND SRILANKA)
- CATEGORY-C (BHUTAN, NEPAL)
- CTEGORY-D (DPR KOREA)

Dengue Virus

- *Each serotype provides specific lifetime immunity, and short-term cross-immunity*
- *All serotypes can cause severe and fatal disease*
- *Genetic variation within serotypes*
- *Some genetic variants within each serotype appear to be more virulent or have greater epidemic potential*


Mosquito feeds / acquires virus
Mosquito refeeds / transmits virus
Extrinsic incubation period
Intrinsic incubation period
Viremia
Viremia
0
5
8
12
16
20
24
28
DAYS
Illness
Illness
Human #1
Human #2

The most common epidemic vector of dengue in the world is the *Aedes aegypti* ***mosquito. It can be identified by the white bands*** *or scale patterns* ***on its legs and thorax.***

They are approximately 5 mm in size:

Magnified 5 times

Dengue mosquitos bite in the early morning and the late afternoon.

Aedes aegypti

- *Dengue transmitted by infected female mosquito*
- *Primarily a daytime feeder*
- *Lives around human habitation*
- *Lays eggs and produces larvae preferentially in artificial containers*

Clinical Characteristics of Dengue Fever

- *Fever*
- *Headache*
- *Muscle and joint pain*
- *Nausea/vomiting*
- *Rash*
- *Hemorrhagic manifestations*

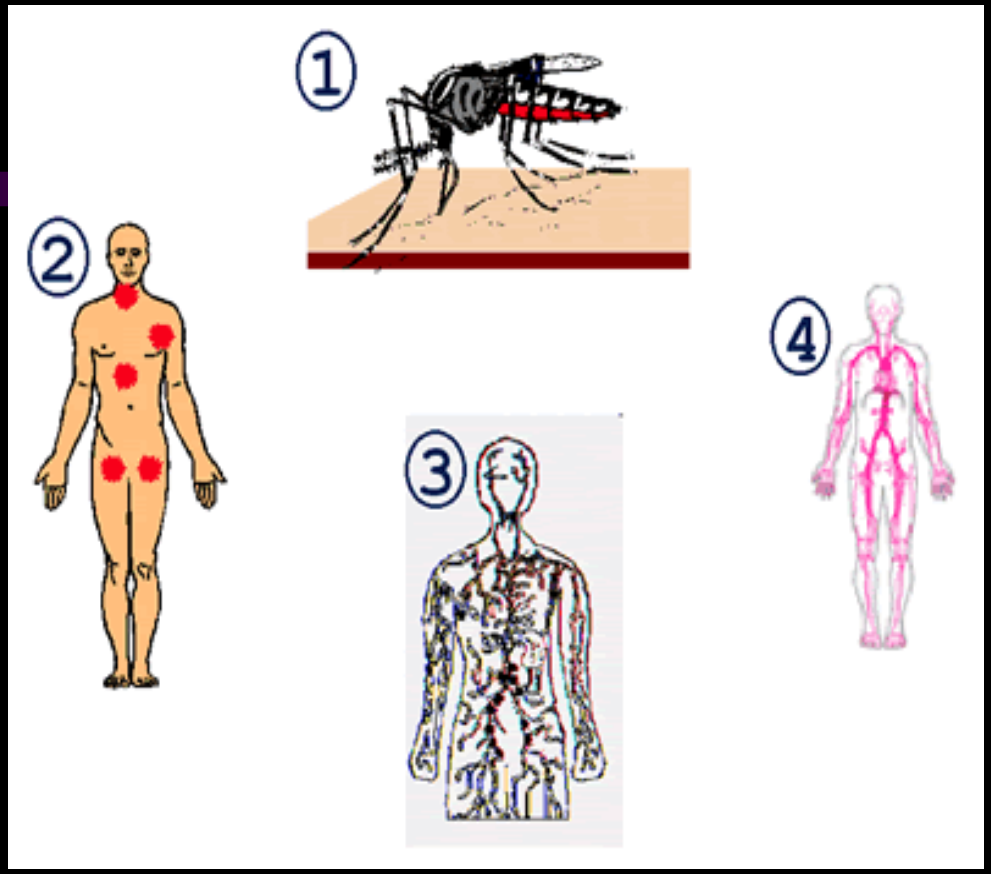
Patients may also report other symptoms, such as itching and aberrations in the sense of taste, particularly a metallic taste. In addition, there have been reports of severe depression after the acute phase of the illness.

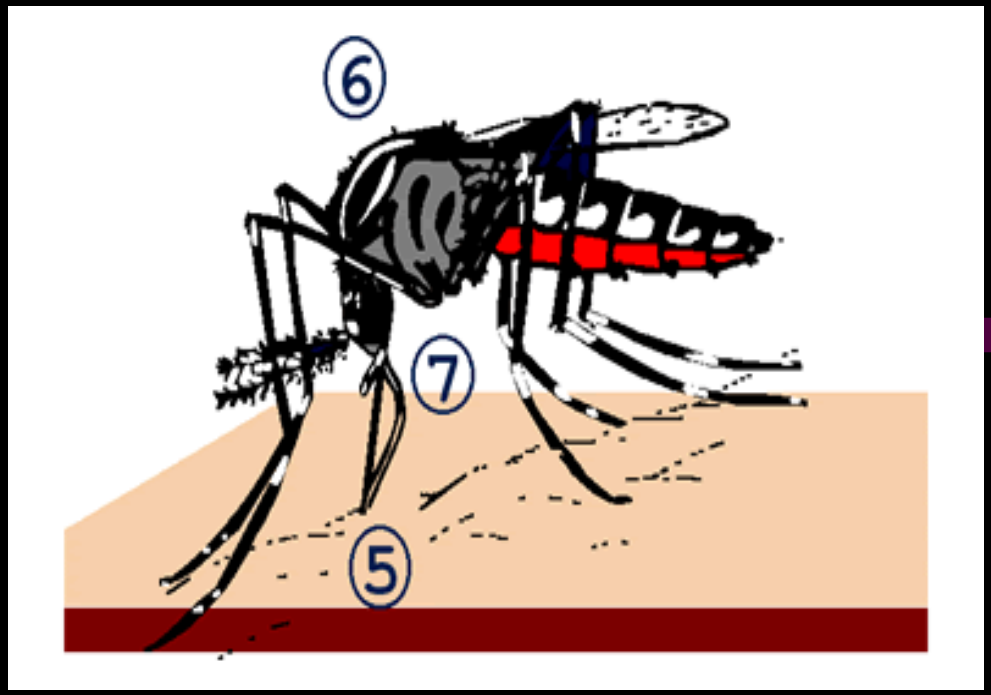
1.The virus is inoculated into humans with the mosquito saliva.

2.The virus localizes and replicates in various target organs, for example, local lymph nodes and the liver.

3.The virus is then released from these tissues and spreads through the blood to infect white blood cells and other lymphatic tissues.

4.The virus is then released from these tissues and circulates in the blood.





5.The mosquito ingests blood containing the virus.

6.The virus replicates in the mosquito midgut, the ovaries, nerve tissue and fat body. It then escapes into the body cavity, and later infects the salivary glands.

7.The virus replicates in the salivary glands and when the mosquito bites another human, the cycle continues.

*The transmission cycle of dengue virus by the mosquito **Aedes aegypti** begins with a dengue-infected person. This person will have virus circulating in the blood—a **viremia** that lasts for about five days. During the viremic period, an uninfected female **Aedes aegypti** mosquito bites the person and ingests blood that contains dengue virus. Although there is some evidence of transovarial transmission of dengue virus in **Aedes aegypti**, usually mosquitoes are only infected by biting a **viremic** person.*

*Then, **within the mosquito**, the virus replicates during an **extrinsic** incubation period of eight to twelve days.*

The mosquito then bites a susceptible person and transmits the virus to him or her, as well as to every other susceptible person the mosquito bites for the rest of its lifetime.

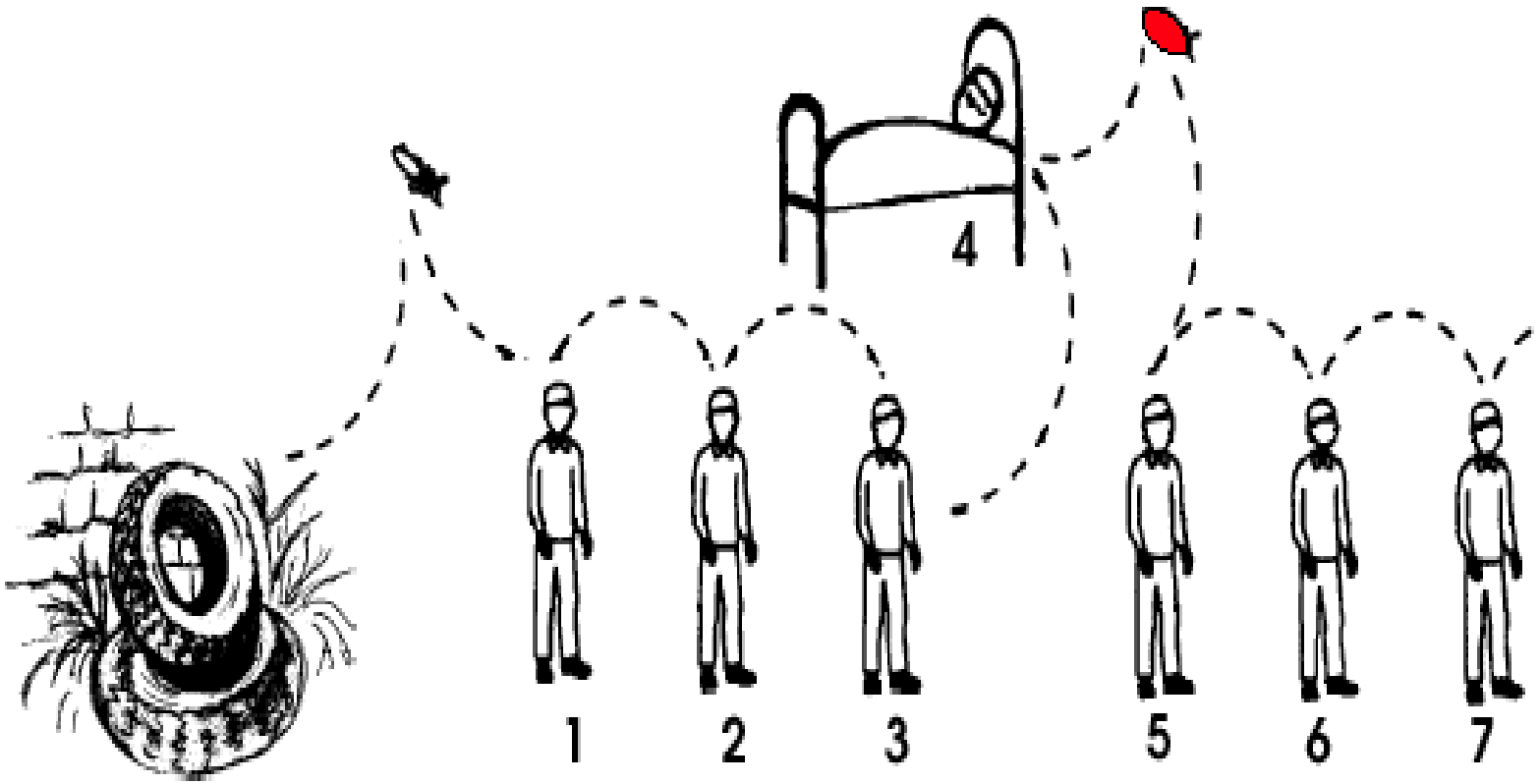
*The virus then replicates in the second person and produces symptoms. The symptoms begin to appear an average of four to seven days after the mosquito bite—this is the **intrinsic** incubation period, **within humans**. While the intrinsic incubation period averages from four to seven days, it can range from three to 14 days.*

*The **viremia** begins slightly before the onset of symptoms. Symptoms caused by dengue infection may last three to 10 days, with an average of five days, after the onset of symptoms—so the illness persists several days after the **viremia** has ended.*

There are actually four dengue clinical syndromes:

1. *Undifferentiated fever;*
2. *Classic dengue fever;*
3. *Dengue hemorrhagic fever, or DHF; and*
4. *Dengue shock syndrome, or DSS.*

Dengue shock syndrome is actually a severe form of DHF.


4
1
2
3
5
6
7

Clinical Case Definition for Dengue Fever

Classical Dengue fever or Break bone fever is an acute febrile viral disease frequently presenting with headaches, bone or joint pain, muscular pains,rash,and leucopenia

Clinical Case Definition for Dengue Hemorrhagic Fever

4 Necessary Criteria:

1. *Fever, or recent history of acute fever*
2. *Hemorrhagic manifestations*
3. *Low platelet count (100,000/mm3 or less)*
4. *Objective evidence of "leaky capillaries:"*

- *elevated hematocrit (20% or more over baseline)*
  - *low albumin*
  - *pleural or other effusions*

Four Grades of DHF

Grade 1

Fever and nonspecific constitutional symptoms

Positive tourniquet test is only hemorrhagic manifestation

Grade 2

Grade 1 manifestations + spontaneous bleeding

Grade 3

Signs of circulatory failure (rapid/weak pulse, narrow pulse pressure, hypotension, cold/clammy skin)

Grade 4

Profound shock (undetectable pulse and BP)

Clinical Case Definition for Dengue Shock Syndrome

- *4 criteria for DHF*

  +

- *Evidence of circulatory failure manifested indirectly by all of the following:*
  - *Rapid and weak pulse*
  - *Narrow pulse pressure (≤ 20 mm Hg) OR hypotension for age*
  - *Cold, clammy skin and altered mental status*
- *Frank shock is direct evidence of circulatory failure*

- *Increasing urban populations*
- *Expanding mosquito breeding due to:*
  - *Unreliable water supply*
  - *Traditional water storage practices*
  - *Poor garbage collection (creates more mosquito breeding places)*
  - *Changing lifestyles*
- *Rapid transportation:*
  - *Movement of infected humans*
  - *Spread of dengue mosquitos*

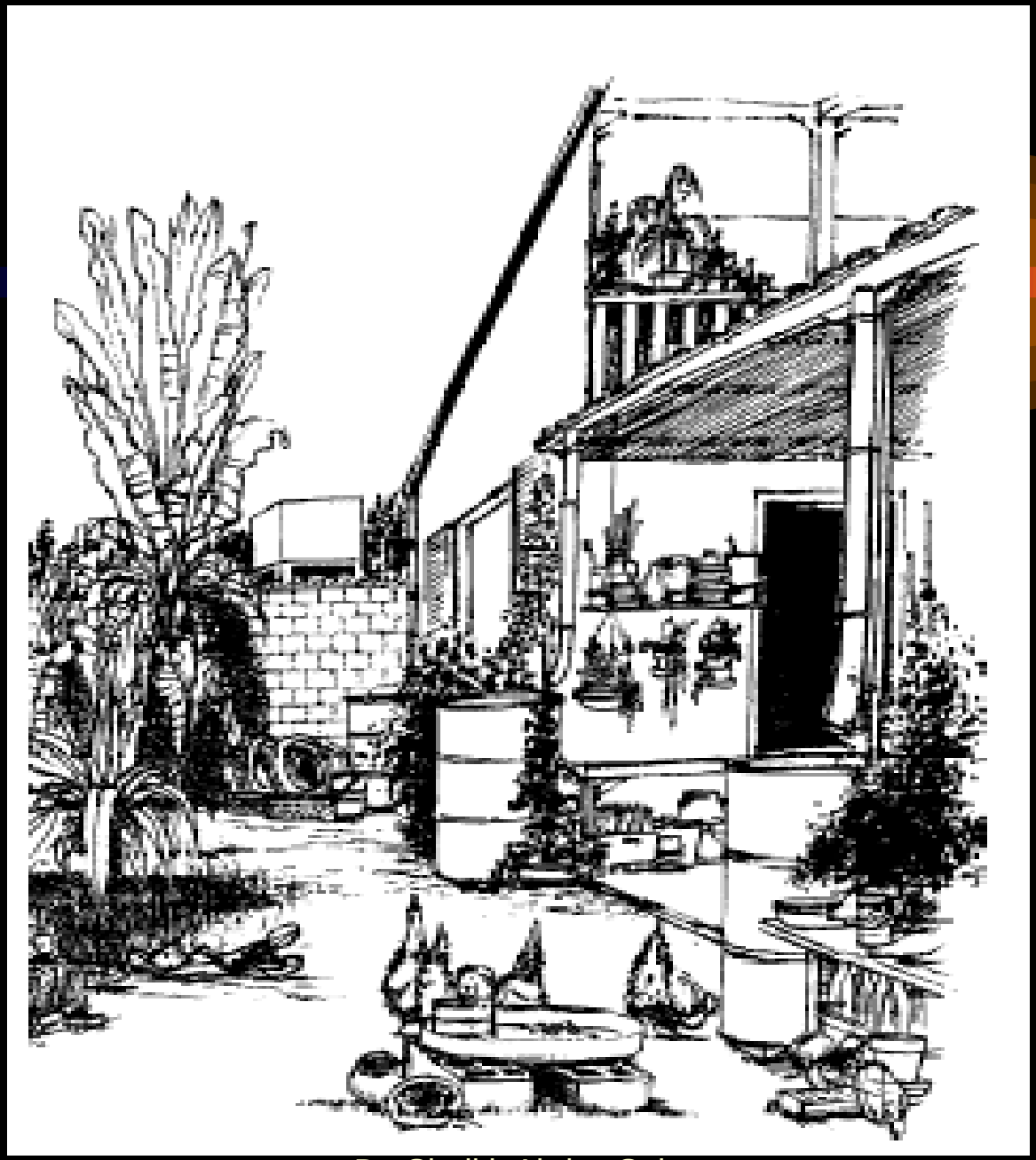
Other related factors: inadequate health education, limited financial resources, insufficient mosquito control programmes, and resistance of mosquitos to insecticides.

Purpose of Control

- *Reduce female vector density to a level below which epidemic vector transmission will not occur*

- *Based on the assumption that eliminating or reducing the number of larval habitats in the domestic environment will control the vector*

- *The minimum vector density to prevent epidemic transmission*



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1. Elimination of mosquito breeding places

- **Cover water containers**—Tight covers on water storage containers, will prevent the mosquitos laying their eggs there. If the cover is loose, mosquitos can go in and out.

- **Septic tanks and soak-away pits**—Cover and seal these, so that dengue mosquitos cannot breed there.

- **Removal of rubbish**—Garbage articles and other rubbish found around houses can collect rain water. They should be removed or smashed and buried in the ground or burned, where this is permissible.

- **Biological control**—Mosquito wigglers can be controlled by small larva-eating fish, such as guppies. These fish can be found in streams or ponds or obtained through pet shops. Bacterial pesticides will also kill mosquito wigglers.

- **Chemical control**—Safe and easily used larvicides such as temephos sand core granules can be placed in water containers to kill developing wigglers.

2. Prevent mosquito bites

People can protect themselves from mosquito bites by using any of the following means—

- **Mosquito coils and electric vapour mats**—Slow burning **mosquito coils** or electric vapour mats are effective in the rainy season, just after sunrise and/or in the afternoon hours before sunset, when dengue mosquitos bite.

- **Mosquito nets**—Nets placed over sleeping places can protect small children and others who may rest during the day. The effectiveness of such nets can be improved by treating them with permethrin (a pyrethroid insecticide). Curtains (cloth or bamboo) can also be treated with insecticide and hung at windows or doorways, to repel or kill mosquitos.

- **Repellents**—Mosquito repellents can be applied to exposed parts of the body where mosquitos bite. Care should be taken in using repellents on small children and the elderly.

- **Screens**—Screens on windows and doorways are effective protection against the entry of mosquitos in homes.

- **Protection of people sick with dengue**—Mosquitos become infected when they bite people who are sick with dengue. Mosquito nets and mosquito coils will effectively prevent mosquitos from biting sick people and help stop the spread of dengue.

LABORATORY CRITERIA

- ISOLATION OF DENQUE VIRUS
- INCREASED IgM OR IgM ANTIBODIES TITRES
- DENQUE ANTIGEN DETECTION BY IMMUNOHISTOCHEMISTRY,IMMUNOFLUROSCENCE,ELISA
- PCR
- LEUCOPENIA,THROMPOCYTOPENIA

- **Provision of reliable water supply**
  A reliable water supply is vital to prevent dengue fever. Water shortages force people to store water, providing breeding places for dengue mosquitos.

- **Reliable rubbish collection**
  Regular garbage collections will reduce potential mosquito breeding sites.

- **House-to-house inspections to control mosquito breeding**
  Where appropriate, house-to-house inspections will determine whether mosquitos are breeding around the houses. Inspectors can teach household members how to prevent mosquito breeding.

- **Health education campaigns**
  The first step in action against the dengue mosquito is to inform communities about what dengue is and what measures can be taken to combat it.

Vector Control Methods:

Biological and Environmental Control

- Biological control
  - Largely experimental
  - Option: place fish in containers to eat larvae
- Environmental control
  - Elimination of larval habitats
  - Most likely method to be effective in the long term

Vector Control Methods:

Chemical Control:

- *Larvicides may be used to kill immature aquatic stages*
- *Ultra-low volume fumigation against adult mosquitoes*
- *Mosquitoes may have resistance to commercial aerosol sprays*

BIOLOGICAL CONTROL *methods are not widely used and are primarily experimental. One option in which biological control is often used, however, is the placement of small fish that eat mosquito larvae in certain containers, such as decorative fountains or 55-gallon drums. Recently, a few countries have also reported success in controlling larvae with copepods, small invertebrate crustaceans that feed on first- and second-stage mosquito larvae.*

ENVIRONMENTAL CONTROL *involves eliminating or controlling the larval habitats where the mosquito lays her eggs and the immature mosquitoes develop. This includes emptying water from containers or covering containers that are being used, cleanup campaigns to dispose of containers that are not being used, and improving water supplies so that there is less need to store water in containers. Since chemical control is generally restricted to containers that cannot otherwise be eliminated or managed, and biological control is still largely experimental, environmental methods are likely to be the most effective for long-term control of Aedes aegypti.*

Larviciding involves placing chemicals into containers that cannot easily be eliminated to kill the mosquito larvae.
Ultra-low volume, or ULV spraying of insecticides is widely practiced to kill adult mosquitoes.
ULV spraying uses machines that produce very small particles of insecticide, which are carried by wind currents.
Typically, ULV machines are either mounted on trucks or are portable machines that can be carried by field workers.
The insecticide particles must come in contact with the mosquito to kill it.

Unfortunately, the Aedes aegypti mosquito tends to reside inside houses, often resting in secluded locations such as closets that are not easily penetrable by the insecticide spray.
Thus, ULV spraying from vehicles is generally ineffective, killing very few Aedes aegypti mosquitoes.
The method is, therefore, expensive and ineffective.
Commercial aerosol sprays to kill the mosquitoes found indoors are useful, but "knockdown resistance" may occur in some locations.
Individual householders may note that spray insecticide has only a temporary effect, knocking down or paralyzing mosquitoes that later recover and fly away.
In such cases, the sprayed mosquitoes must also be squashed to prevent their

Although the goal of disease control is to prevent epidemic transmission, if an epidemic does occur, ways to minimize its impact include:

- *Teaching the medical community how to diagnose and manage dengue and dengue hemorrhagic fever (DHF), so they are better prepared to effectively manage and treat large numbers of cases. Mortality from DHF will thus be minimized.*

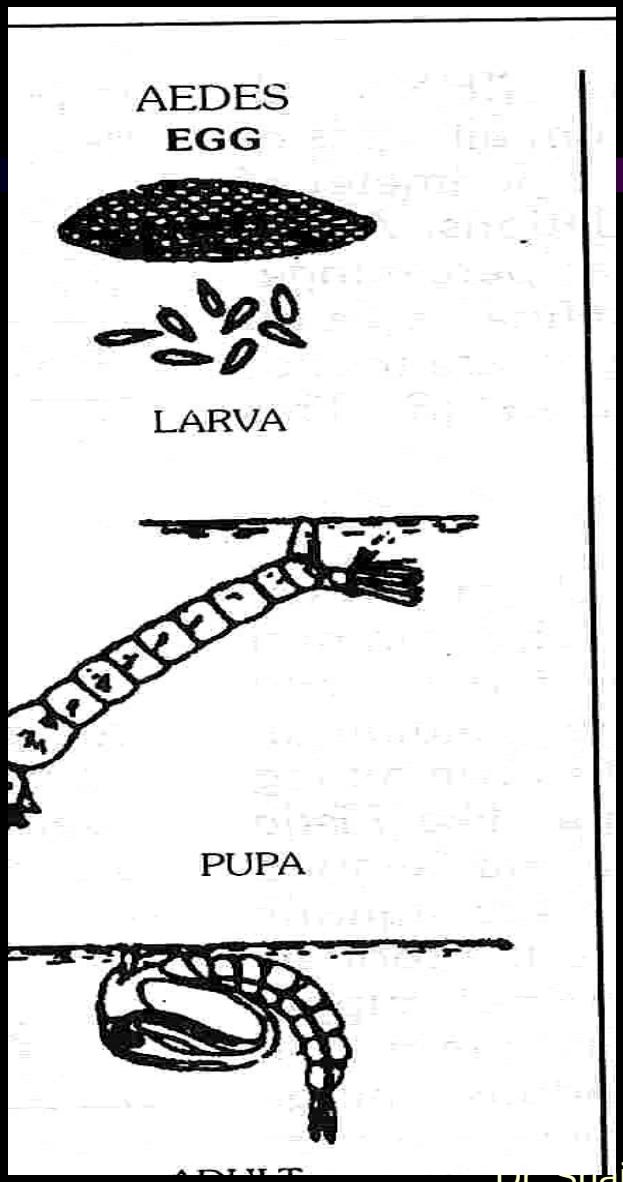
- *Implementing an emergency contingency plan to anticipate the logistical issues of hospitalizing large numbers of patients and to outline measures for community-wide vector control activities. Such plans should be prepared with the participation of all parties and agencies involved, and should be ready for implementation prior to the emergence of an epidemic.*

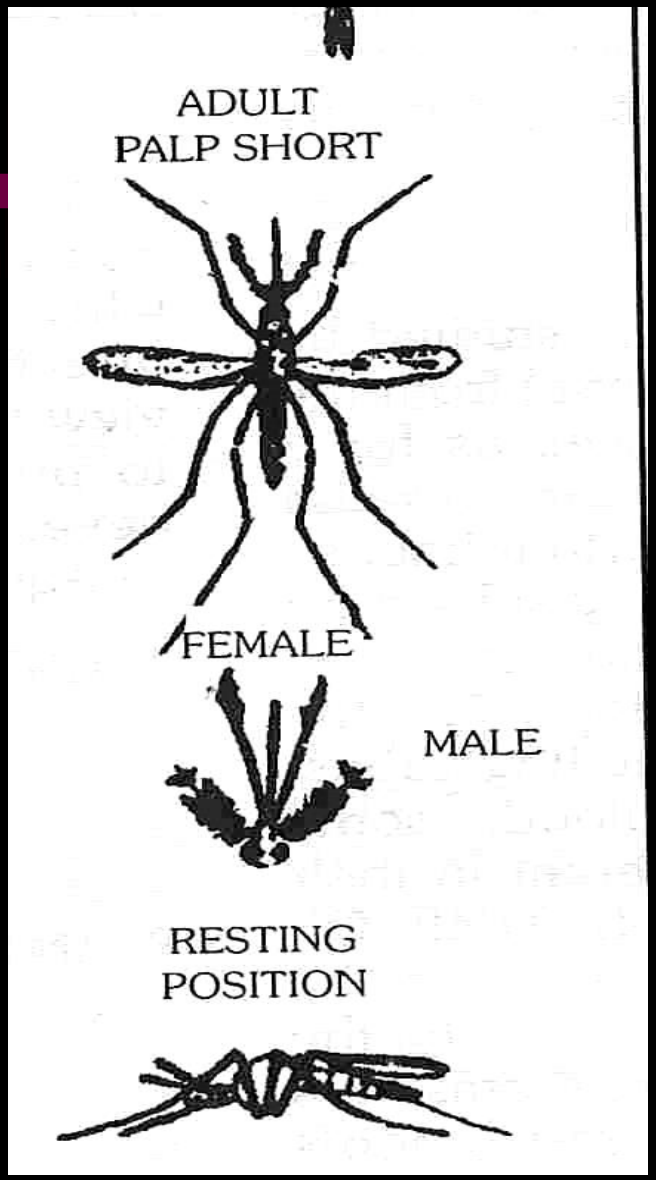
- *Educating the general public to encourage and enable them to carry out vector control in their homes and neighborhoods.*

Programs to Minimize the Impact of Epidemics

- *Education of the medical community*
- *Implementation of emergency contingency plan*
- *Education of the general population*

- *Hold community council meetings about dengue. Participants will decide if dengue is an important problem in the community.*
- *Invite municipal health leaders to participate in action decided on by community.*
- *Organize training sessions for volunteers: films, exhibits and lectures from health workers*
- *conduct surveys to determine mosquito problem.*
- *Use schoolchildren as agents for change to carry out inspections, and teach about where the dengue mosquito lives and how to control it.*
- *Organize house-to-house surveys and "one on one" teaching about dengue and the vector mosquito.*
- *Publicize the activity.*


AEDES
EGG
LARVA
PUPA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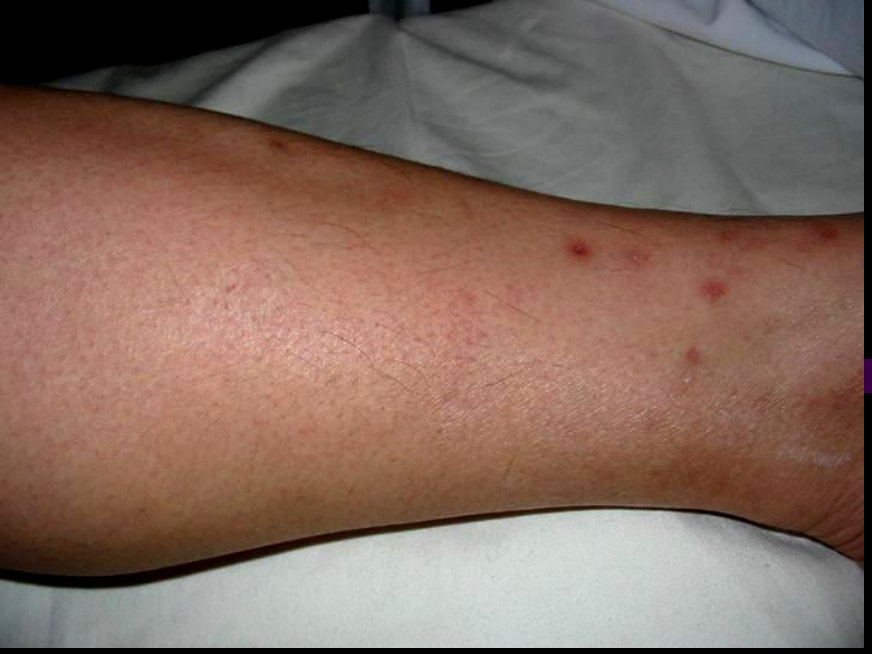

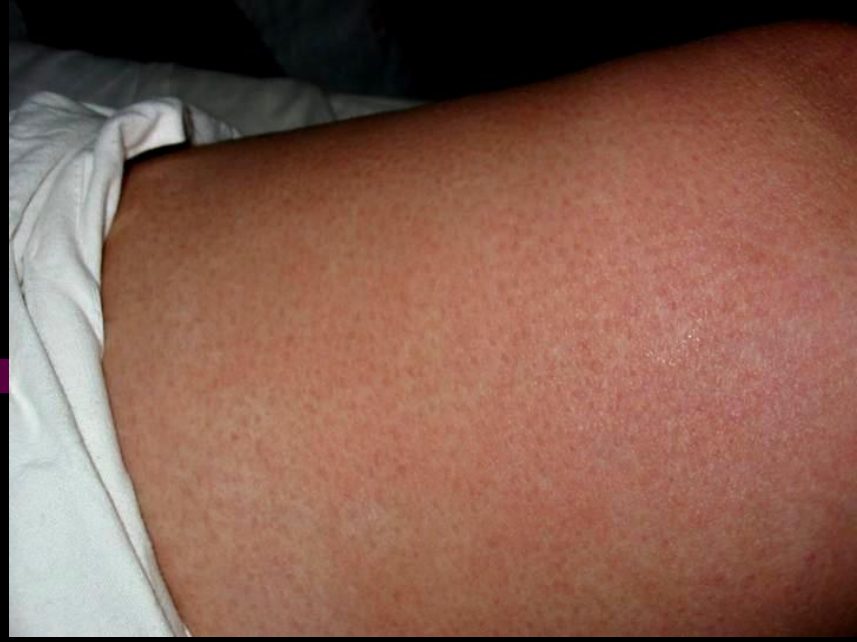

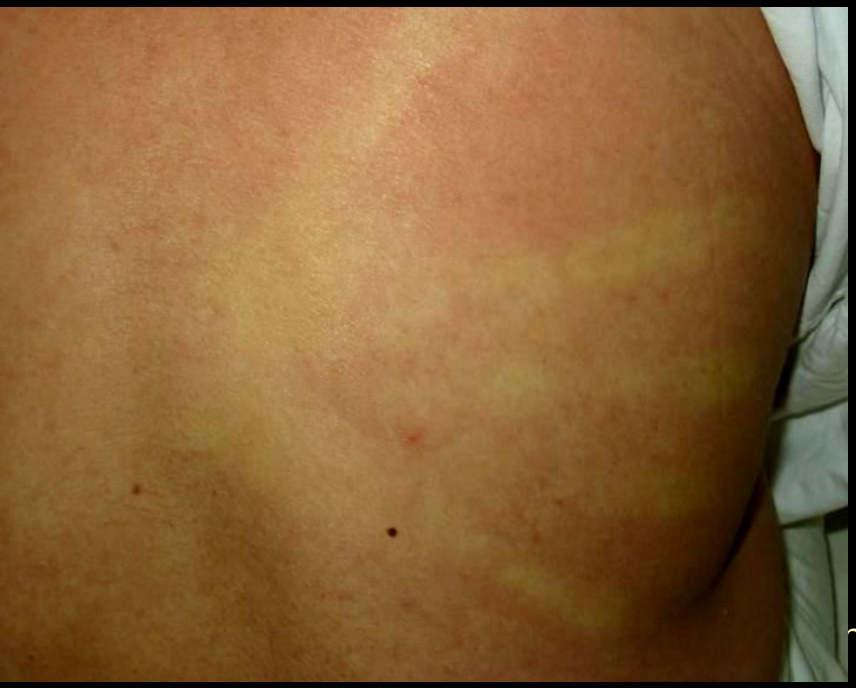

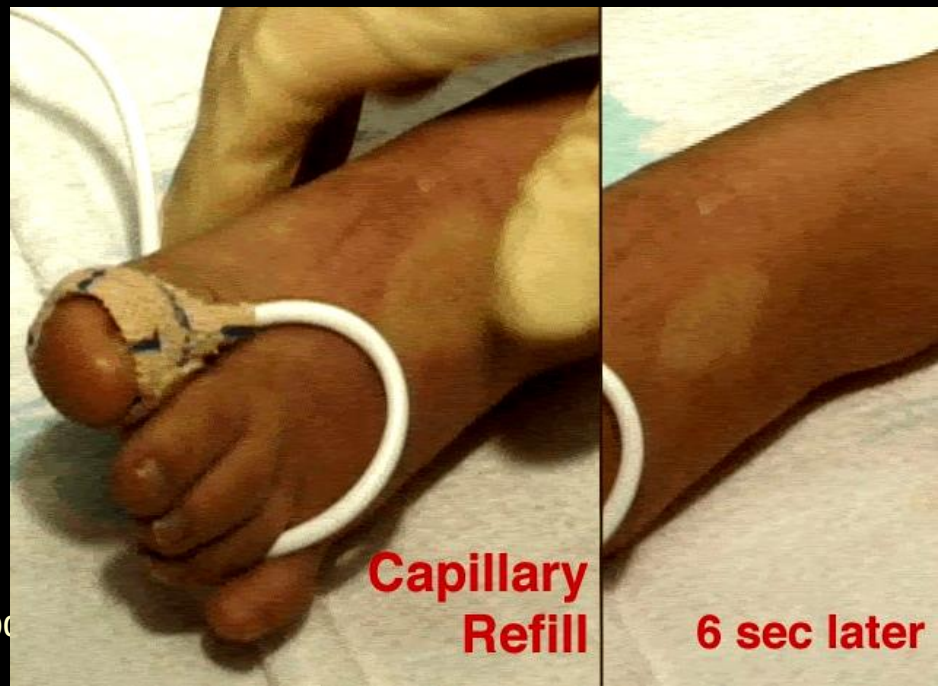
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THANK YOU

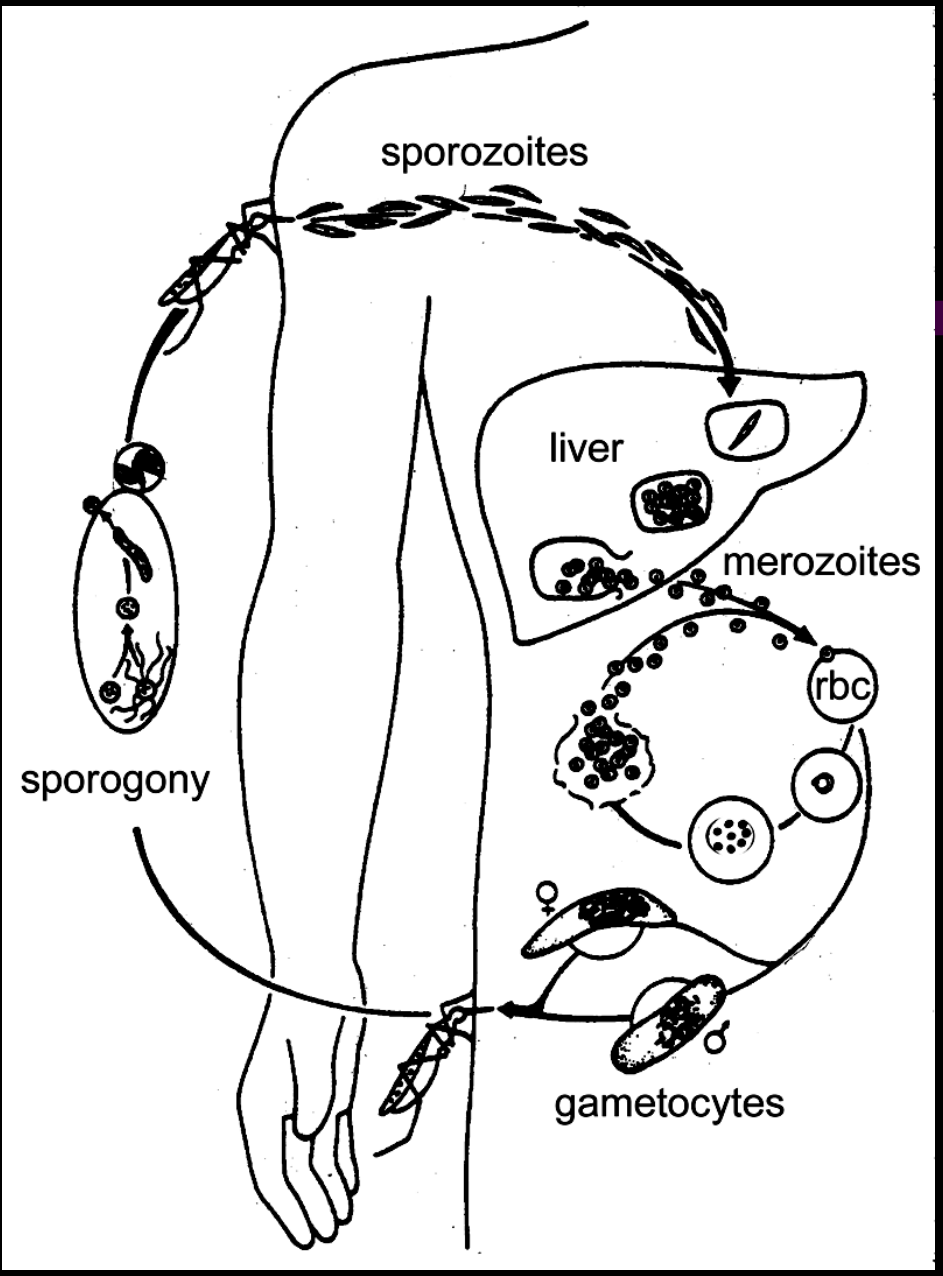
Reference:

1. *http://www.who.int/ctd/docs/dengue.pdf*
2. *http://www.cdc.gov/*
3. *http://www.cdc.gov/ncidod/index.htm*
4. *SUPERCOURSE*

MALARIA

- *40% of the world's population lives in endemic areas*
- *3-500 million clinical cases per year*
- *1.5-2.7 million deaths (90% Africa)*
- *increasing problem (re-emerging disease)*
  - *resurgence in some areas*
  - *drug resistance (↑mortality)*
- *causative agent = Plasmodium species*
  - *protozoan parasite*
  - *member of Apicomplexa*
  - *4 species infecting humans*
- *transmitted by anopholine mosquitoes*

- *P. falciparum*
- *P. vivax*
- *P. malariae*
- *P. ovale*

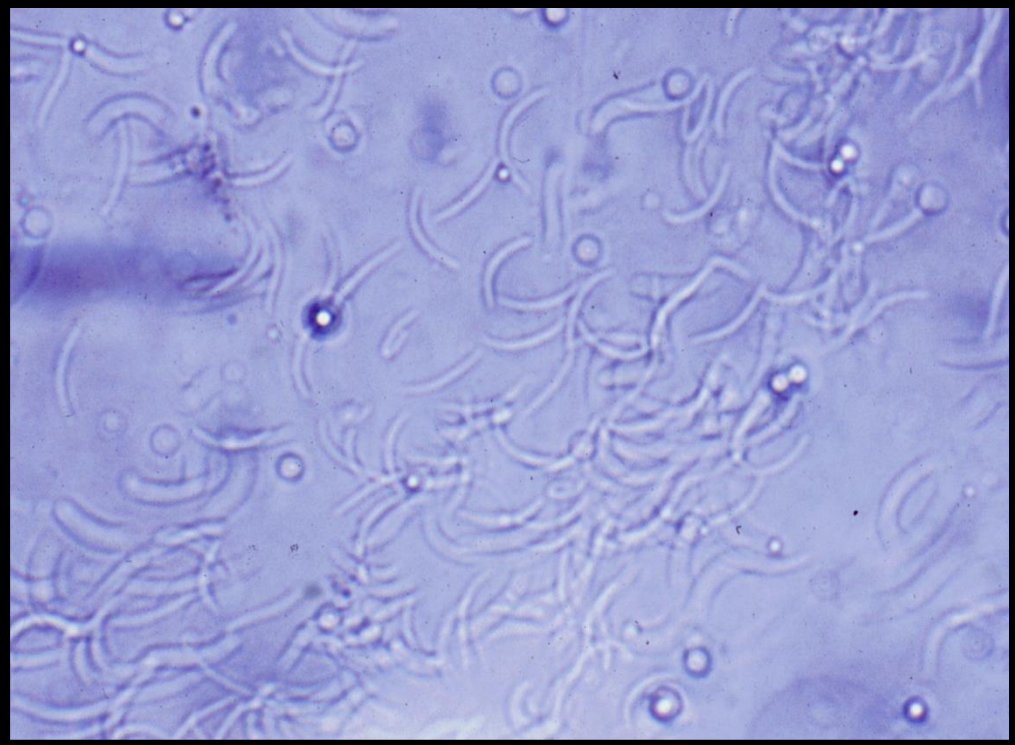


Life Cycle

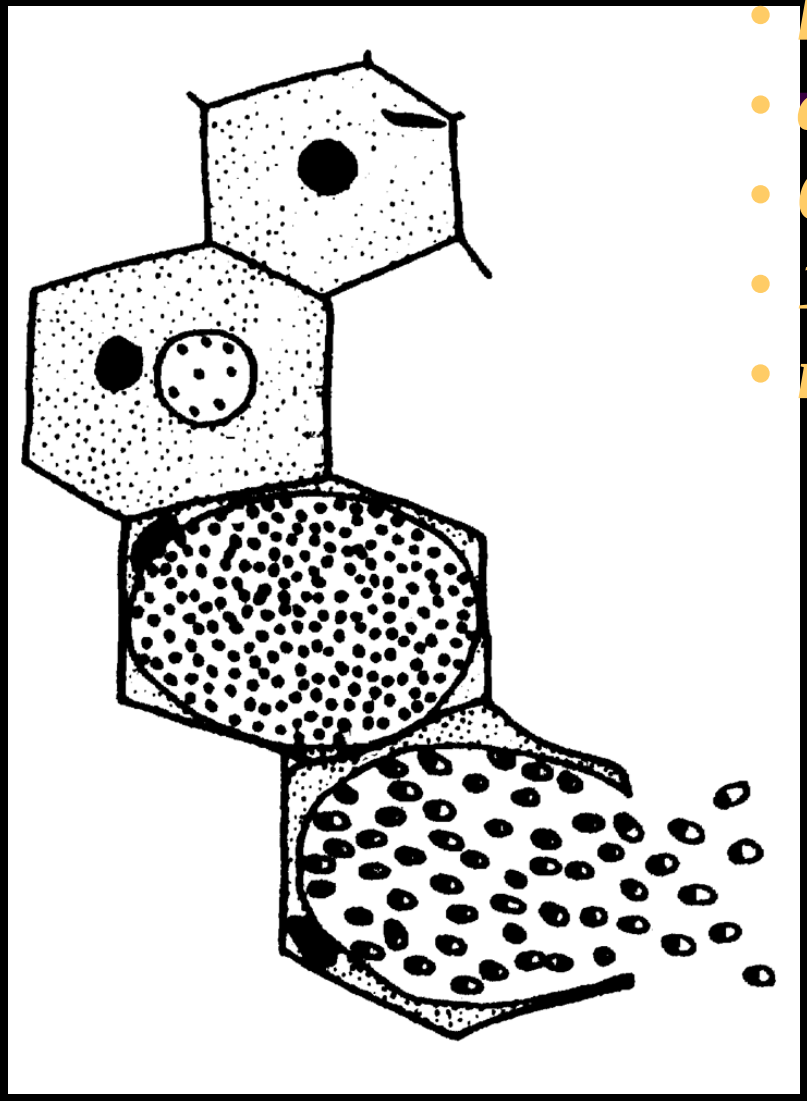
- sporozoites injected during mosquito feeding
- invade liver cells
- exoerythrocytic schizogony (merozoites)
- merozoites invade RBCs
- repeated erythrocytic schizogony cycles
- gametocytes infective for mosquito
- fusion of gametes in gut
- sporogony on gut wall in hemocoel
- sporozoites invade salivary glands

Transmission

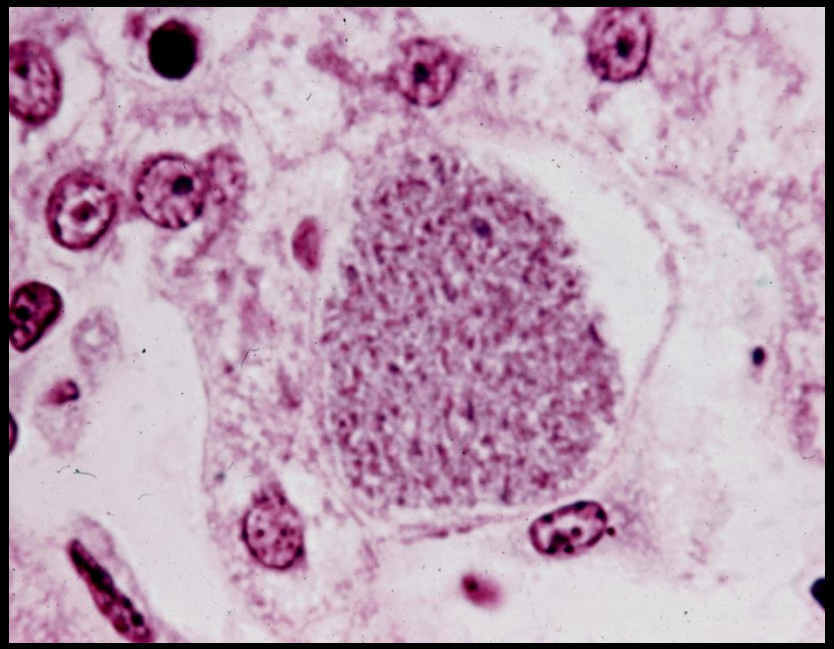
- *sporozoites injected with saliva*
- *enter circulation*
- *trapped by liver (receptor-ligand)*



Exoerythrocytic Schizogony

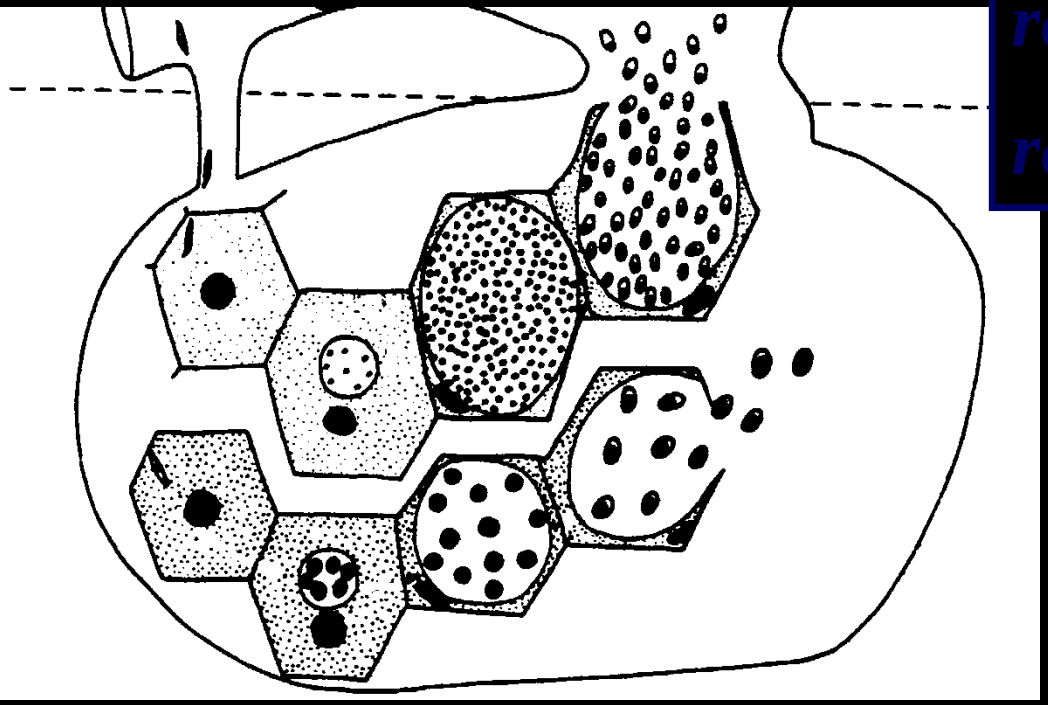


- *hepatocyte invasion*
- *asexual replication*
- *6-15 days*
- *1000-10,000 merozoites*
- *no overt pathology*



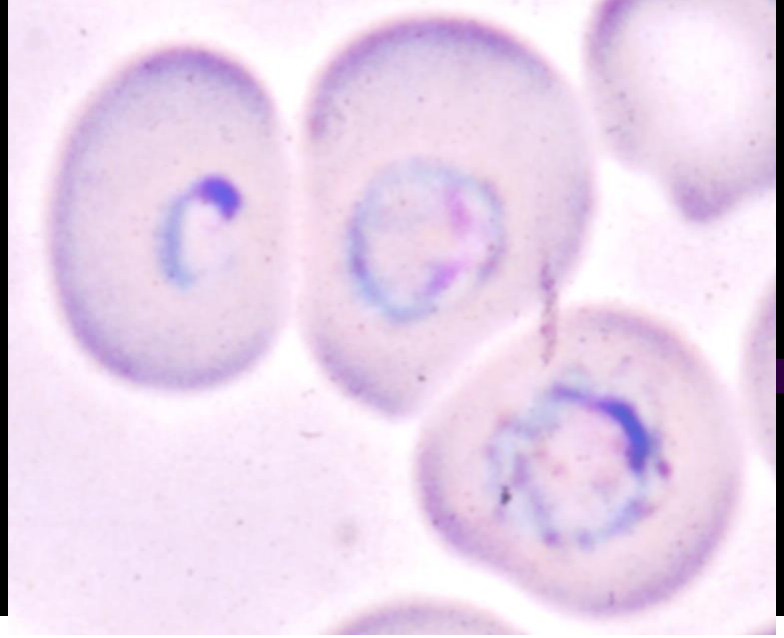
Hyponozoite Forms

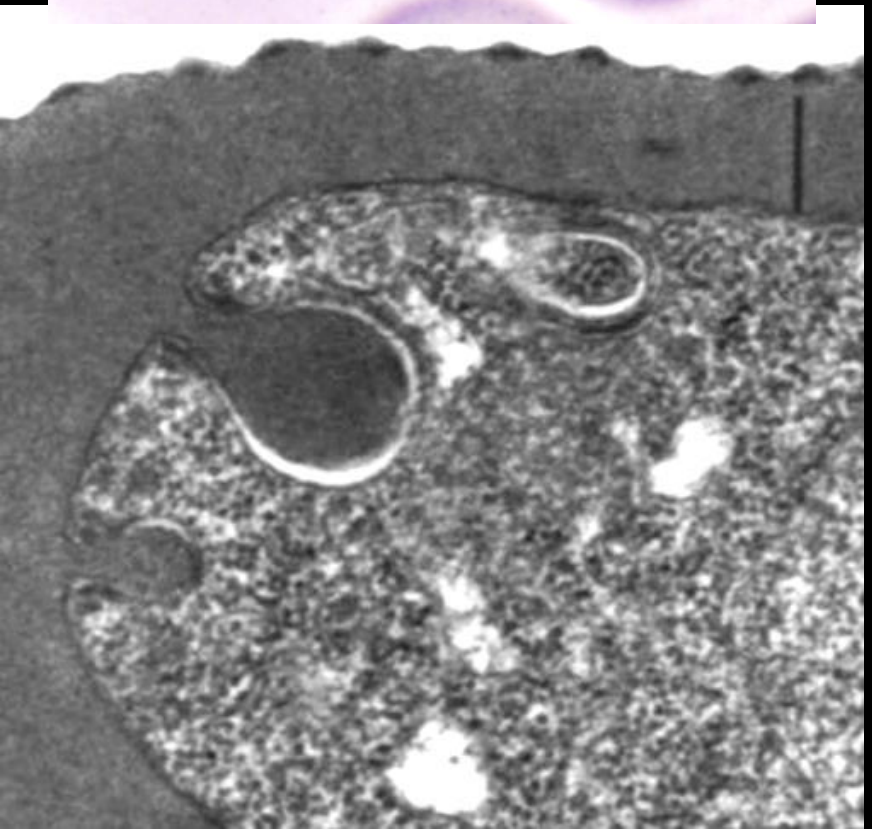
- *some EE forms exhibit delayed replication (ie, dormant)*
- *merozoites produced months after initial infection*
- *only P. vivax and P. ovale*



relapse = hypnozoite

recrudescence = subpatent

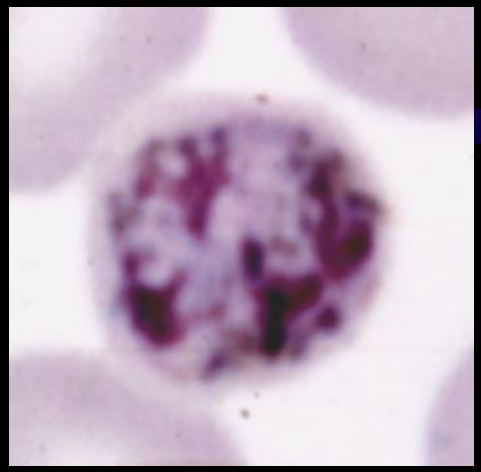
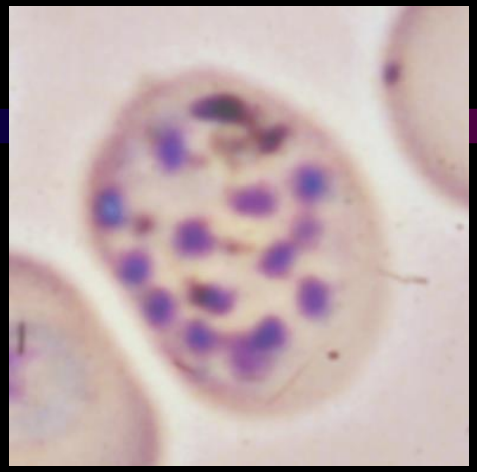
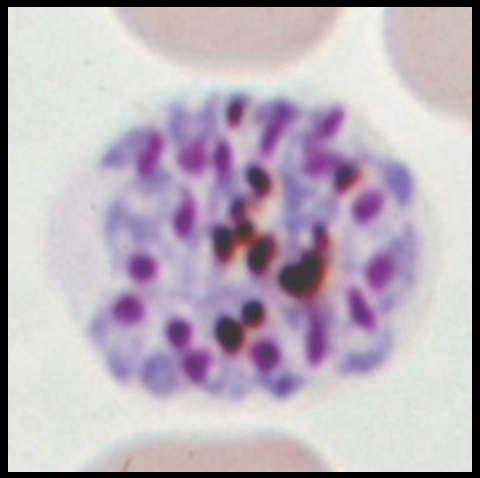
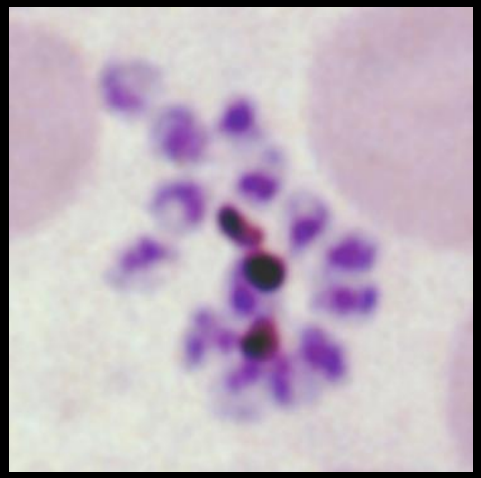




Erythrocytic Stage

- *intracellular parasite undergoes trophic phase*
- *young trophozoite called 'ring form'*
- *ingests host hemoglobin*
  - *cytostome*
  - *food vacuole*
  - *hemozoin (malarial pigment)*

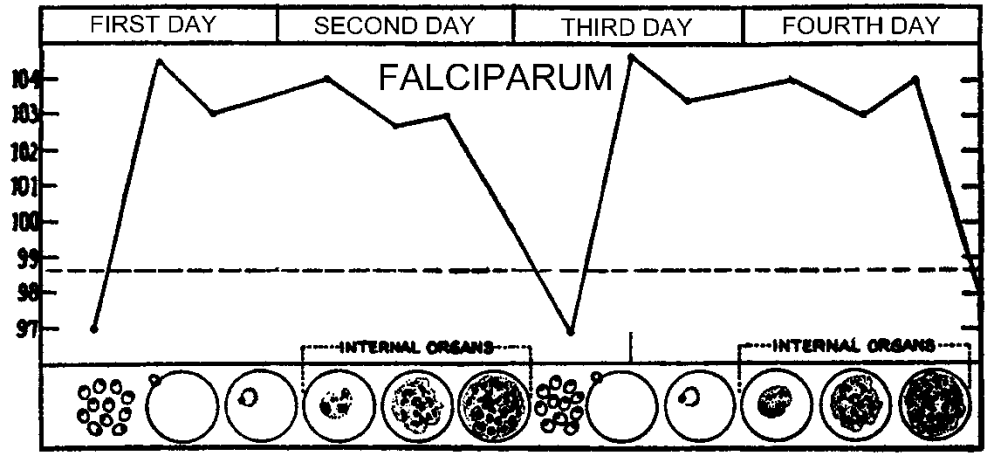
Erythrocytic Schizogony

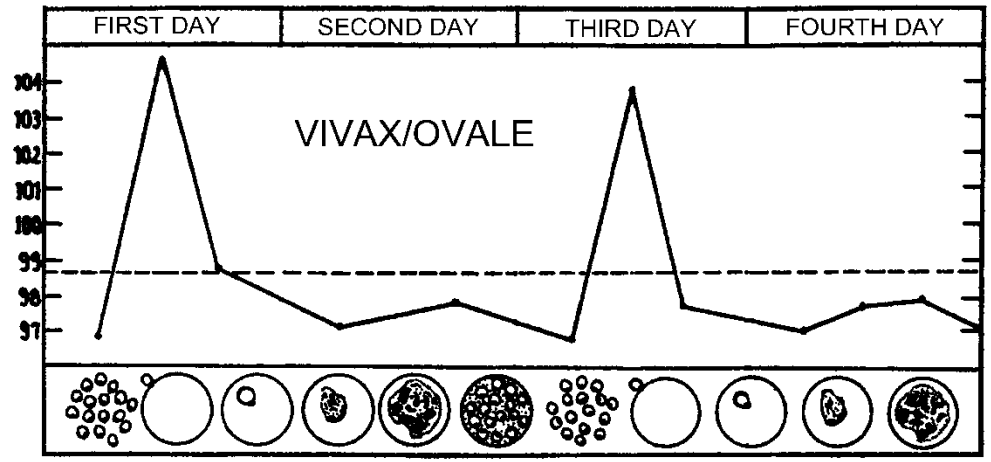





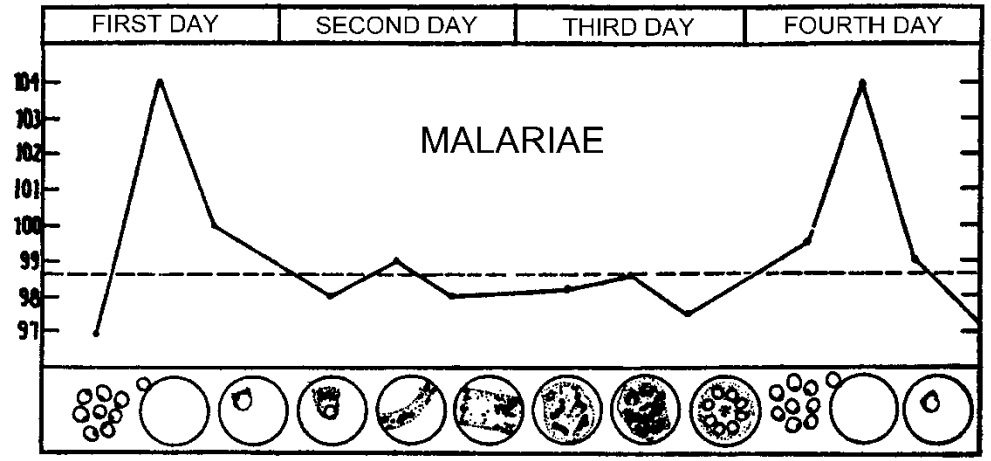
- *nuclear division = begin schizont stage*
- *6-40 nuclei*
- *budding merozoites = segmenter*
- *erythrocyte rupture releases merozoites*
- *blood stage results in disease symptoms*

Clinical Features

- *characterized by acute febrile attacks (malaria paroxysms)*
  - *periodic episodes of fever alternating with symptom-free periods*
- *manifestations and severity depend on species and host status*
  - *immunity, general health, nutritional state, genetics*
- *recrudescences and relapses can occur over months or years*
- *can develop severe complications (especially P. falciparum)*



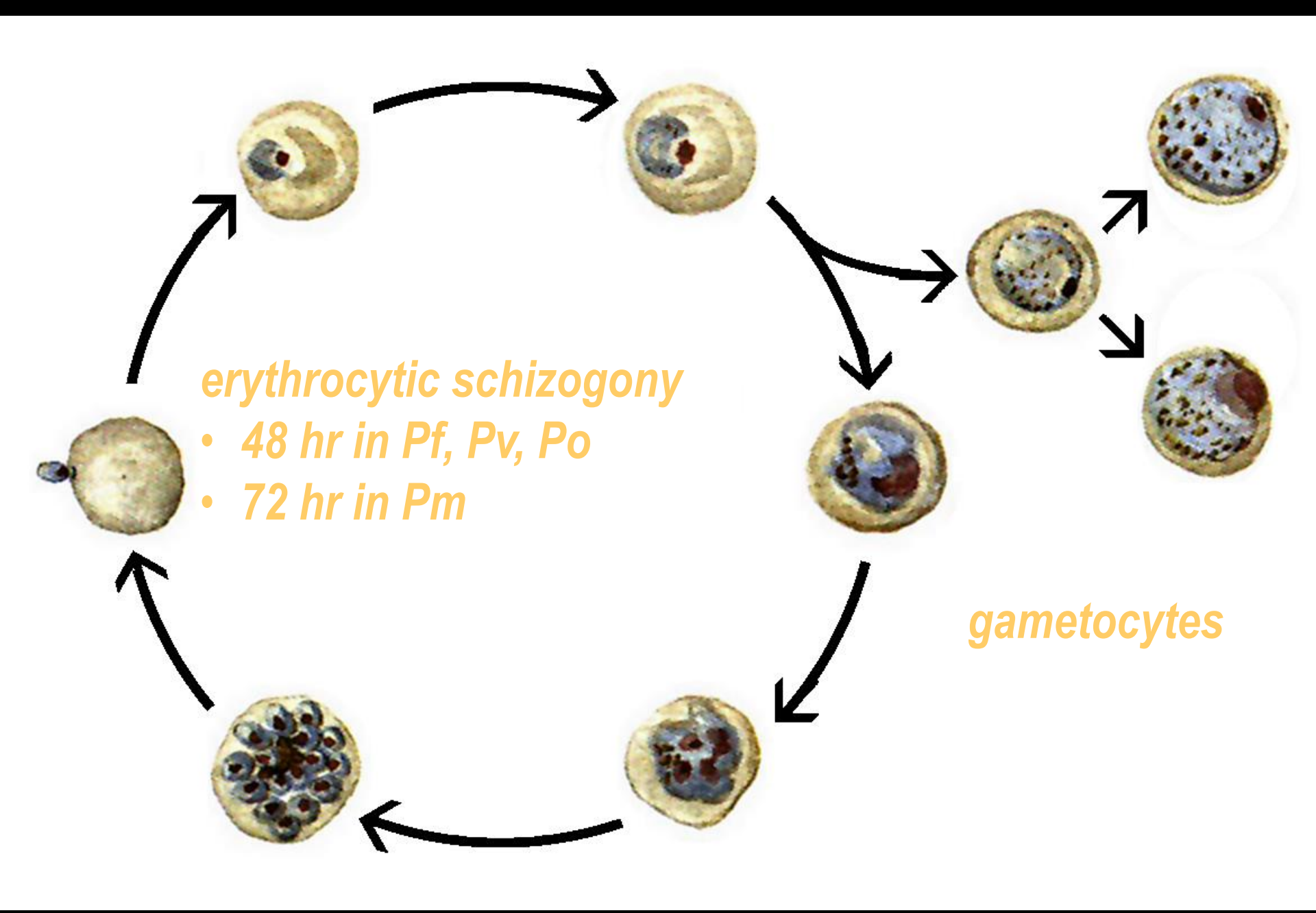




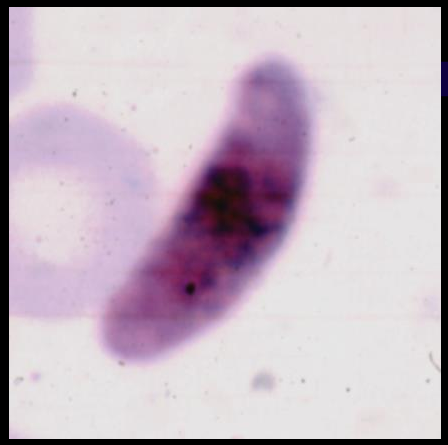
Malaria Paroxysm

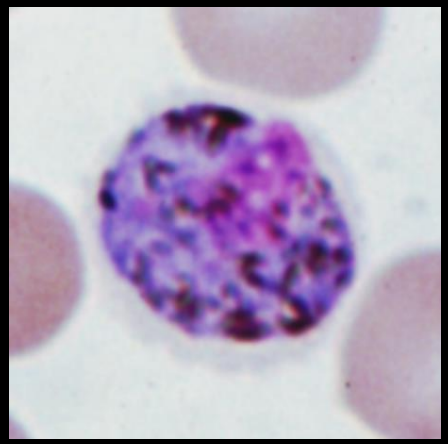
- *paroxysms associated with synchrony of merozoite release*
- *between paroxysms temperature is normal and patient feels well*
- *falciparum may not exhibit classic paroxysms (continuous fever)*

tertian malaria
quartan malaria


erythrocytic schizogony
• 48 hr in Pf, Pv, Po
• 72 hr in Pm
gametocytes

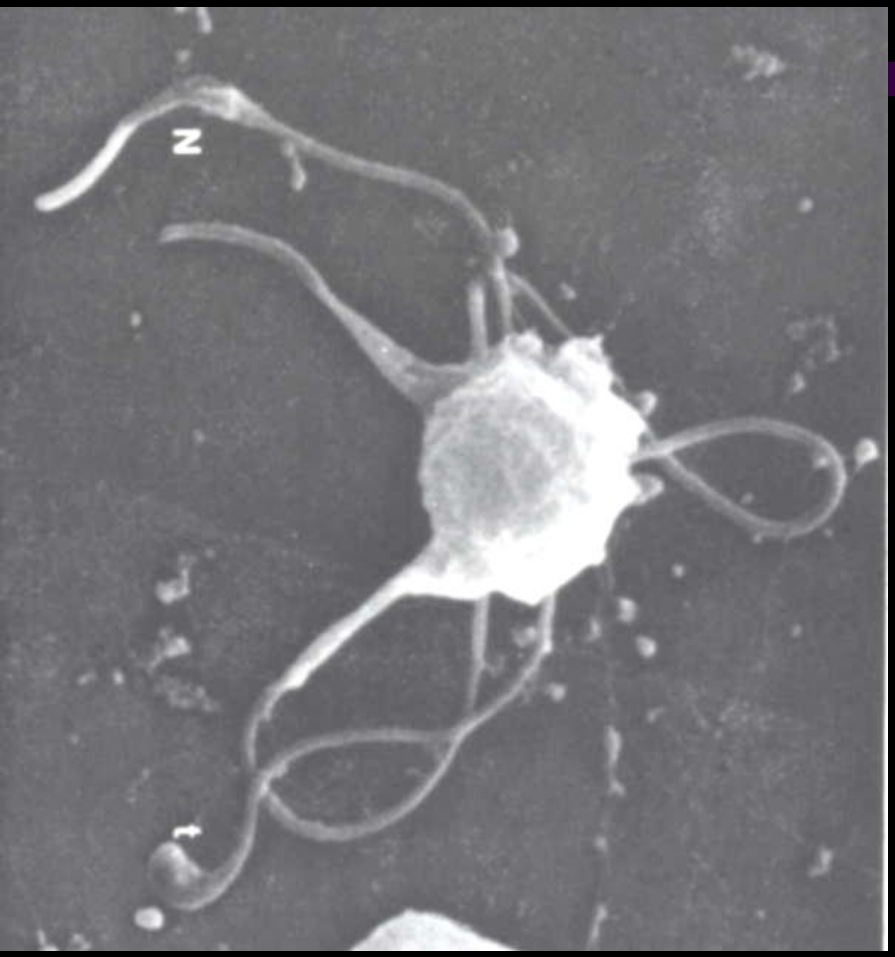
Gametocytogenesis





- *alternative to asexual replication*
- *induction factors not known*
  - *drug treatment ↑#'s*
  - *immune response ↑#'s*
- *ring → gametocyte*
  - *Pf : ~10 days*
  - *others: ~same as schizogony*
- *sexual dimorphism*
  - *microgametocytes*
  - *macrogametocytes*
- *no pathology*
- *infective stage for mosquito*

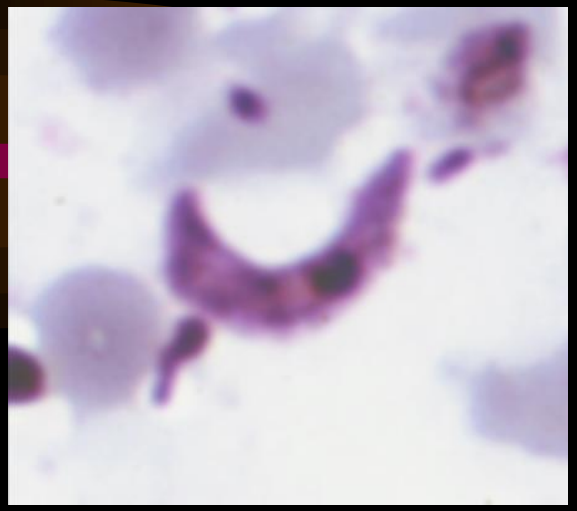
Gametogenesis

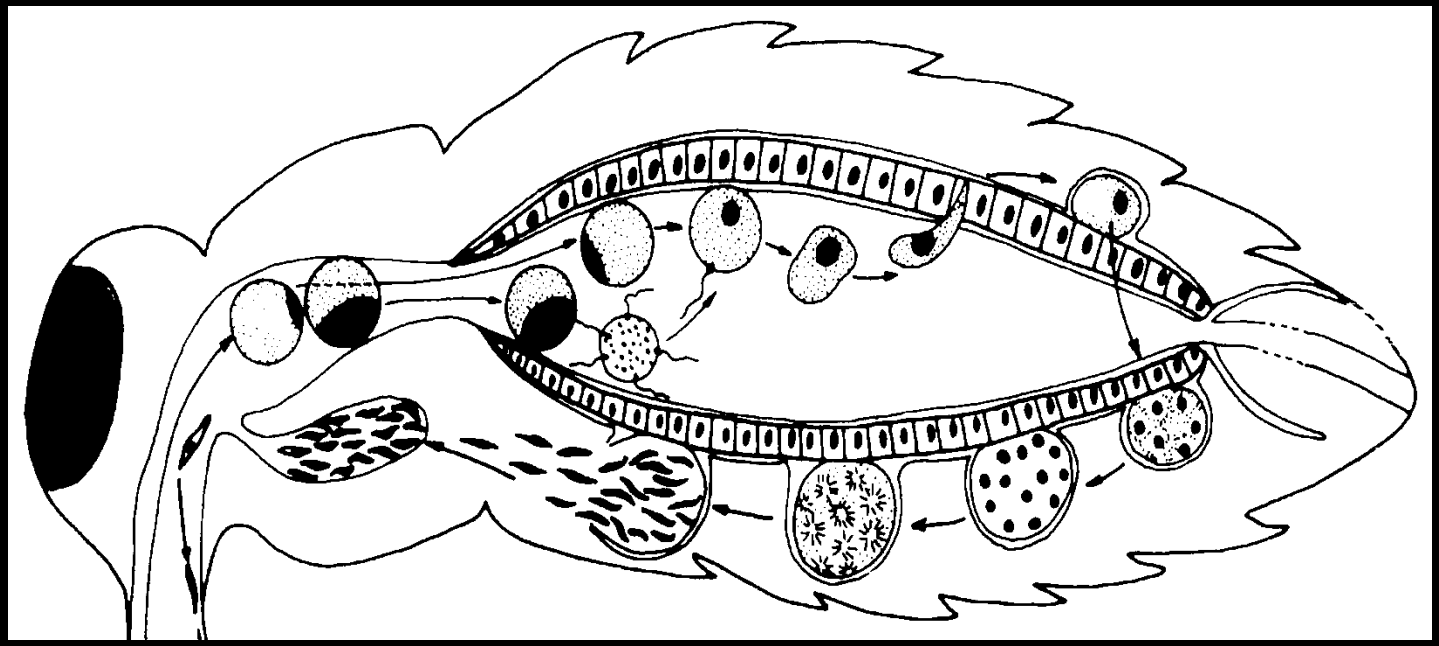


- *occurs in mosquito gut*
- *'exflagellation' most obvious*
  - *3X nuclear replication*
  - *8 microgametes formed*
- *exposure to air induces*
  - *↓temperature (2-3°C)*
  - *↑pH (8-8.3)*
  - *result of ↓pCO_2*
- *gametoctye activating factor in mosquito*
  - *xanthurenic acid*

Sporogony

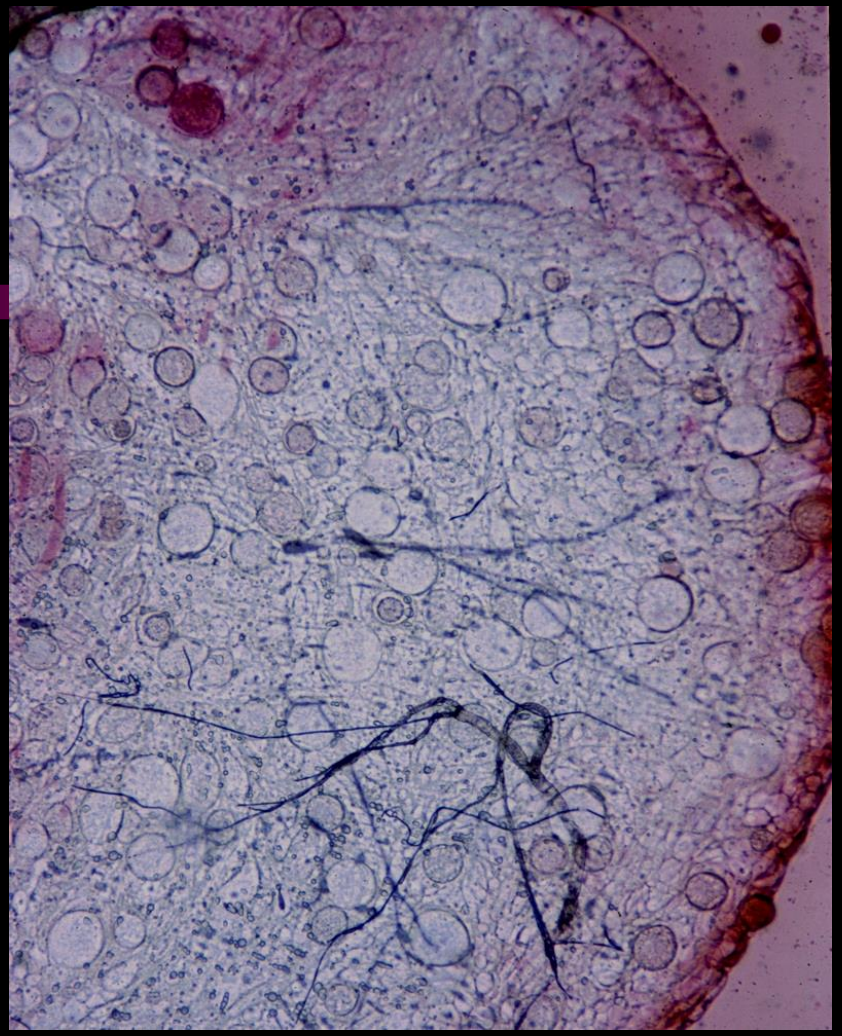
- *occurs in mosquito (9-21 d)*
- *fusion of micro- and macrogametes*
- *zygote → ookinete (~24 hr)*
- *ookinete transverses gut epithelium ('trans-invasion')*





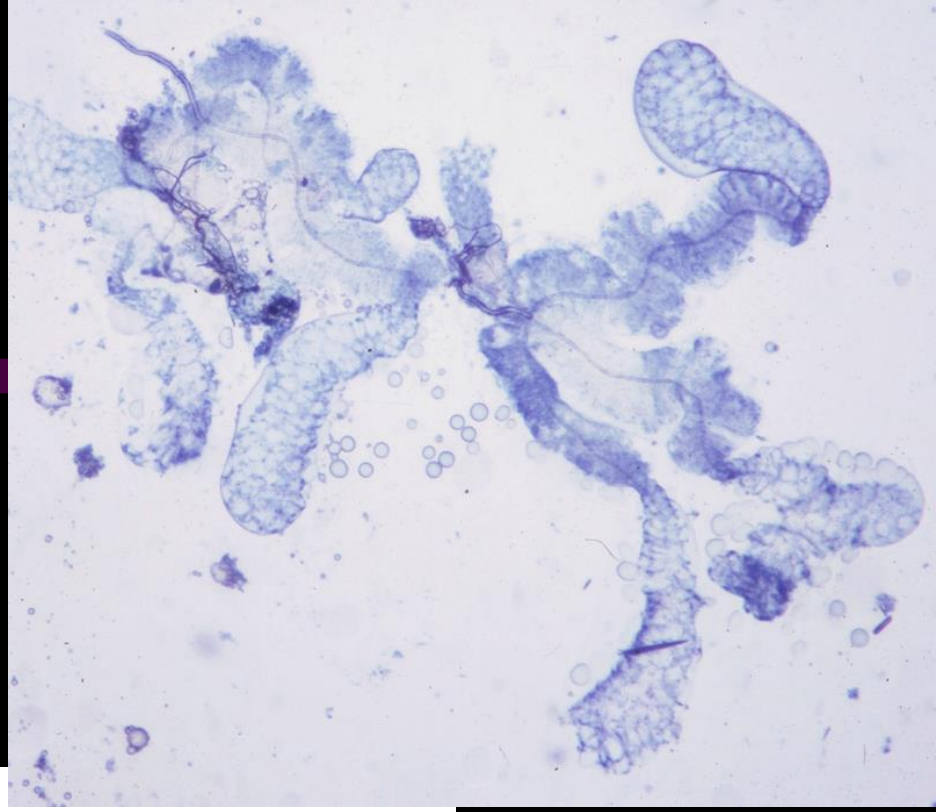
Sporogony

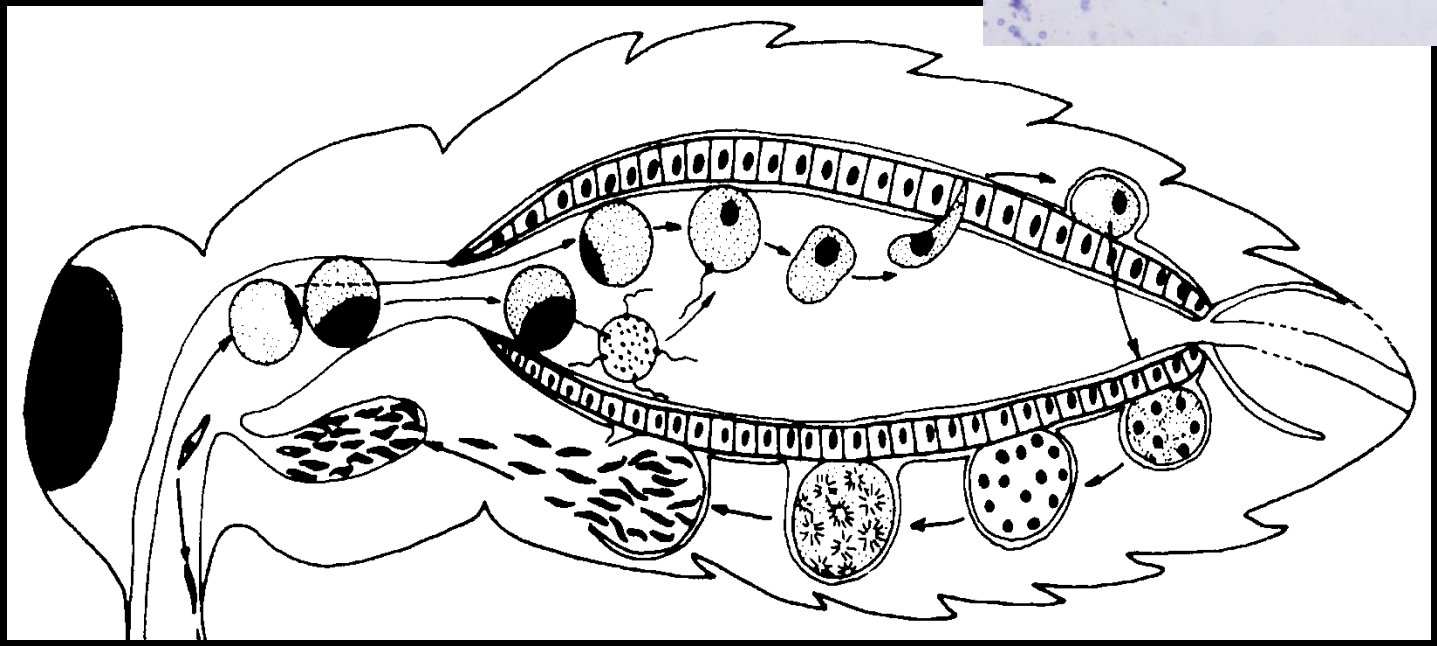
- *ookinete → oocyst*
  - *between epithelium and basal lamina*
- *asexual replication → sporozoites*
- *sporozoites released*

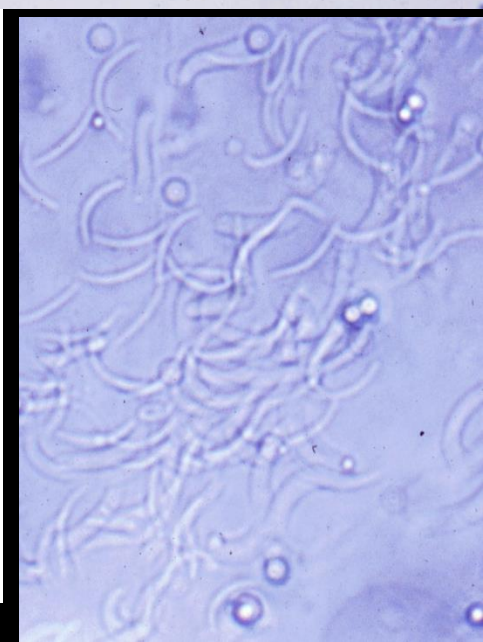


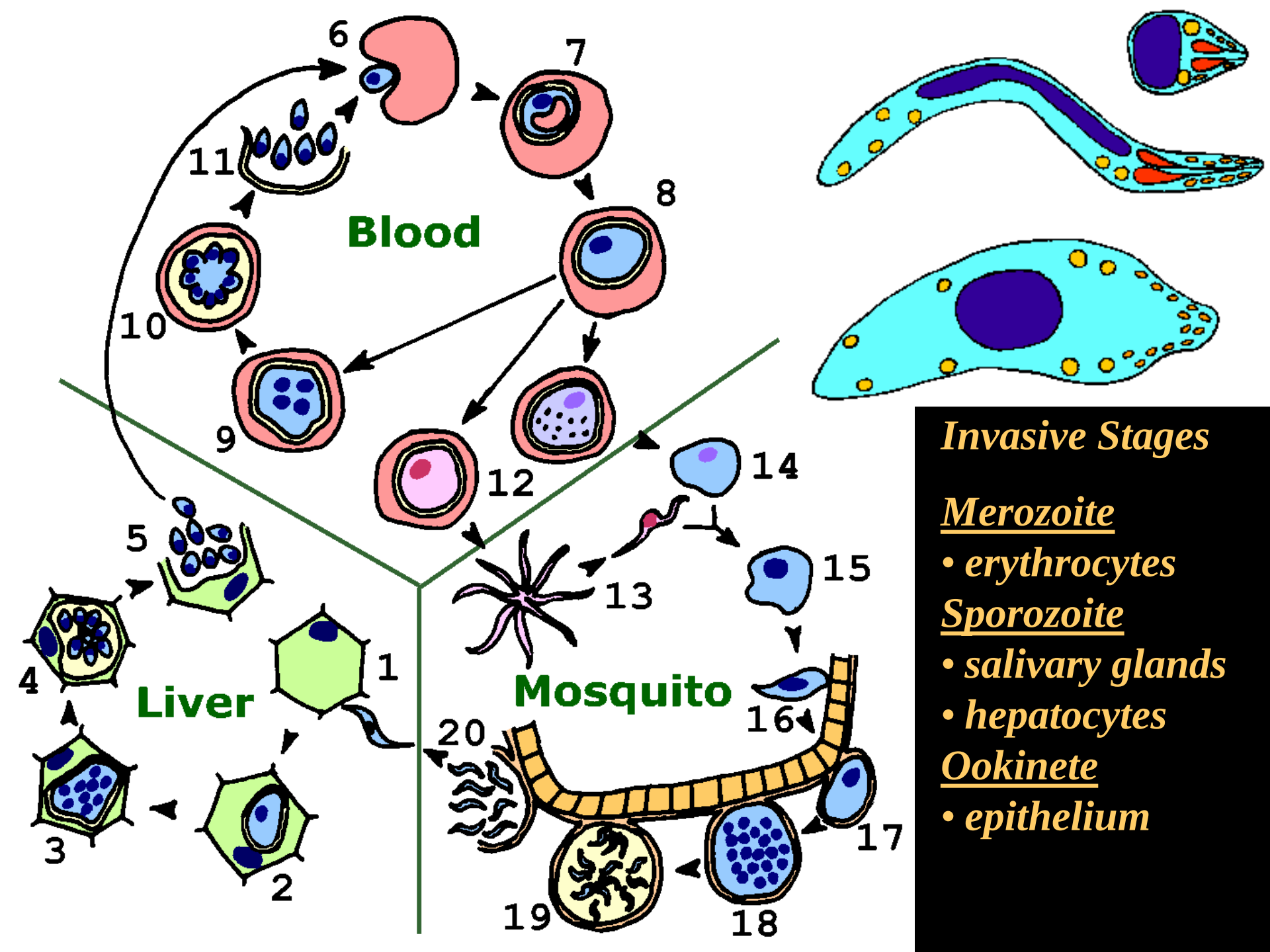
Sporogony

- *sporozoites migrate through hemocoel*
- *sporozoites 'invade' salivary glands*









Invasive Stages

Merozoite

- *erythrocytes*

Sporozoite

- *salivary glands*
- *hepatocytes*

Ookinete

- *epithelium*

Current Malaria Situation -Bangladesh

MALARIA FACTS

Country Area 147,570 sq. km and Pop. 143.8 million

13 out of 64 districts are high endemic

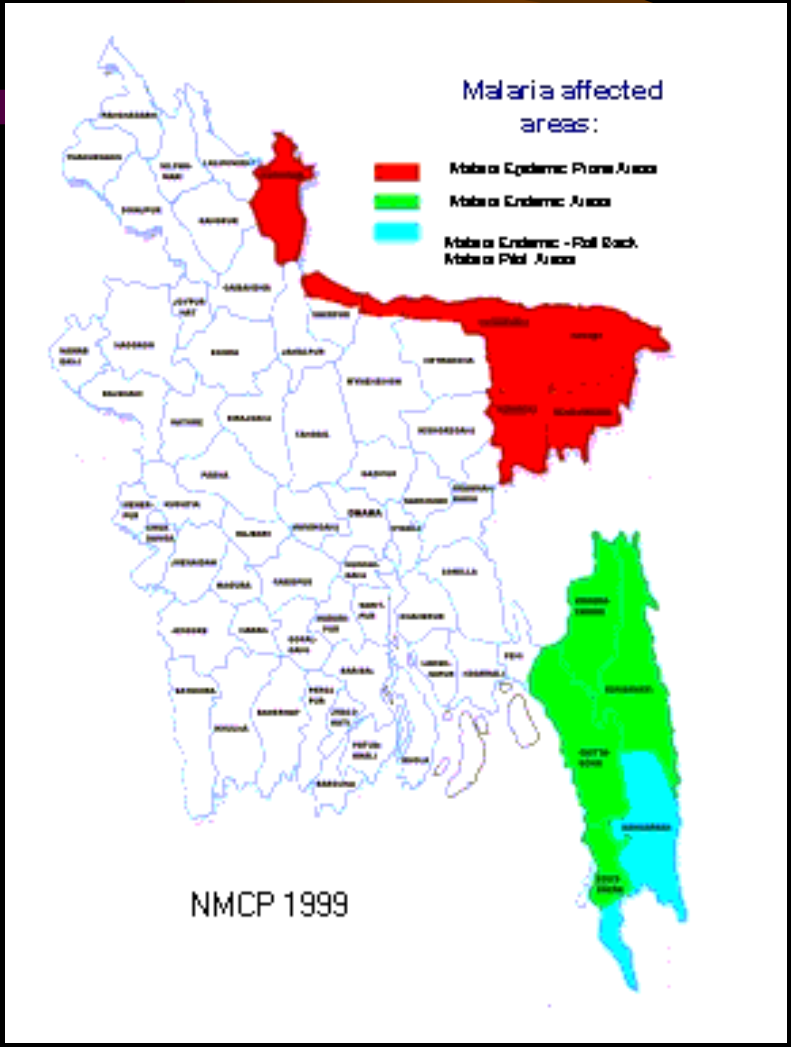
13.3 million people are at high risk

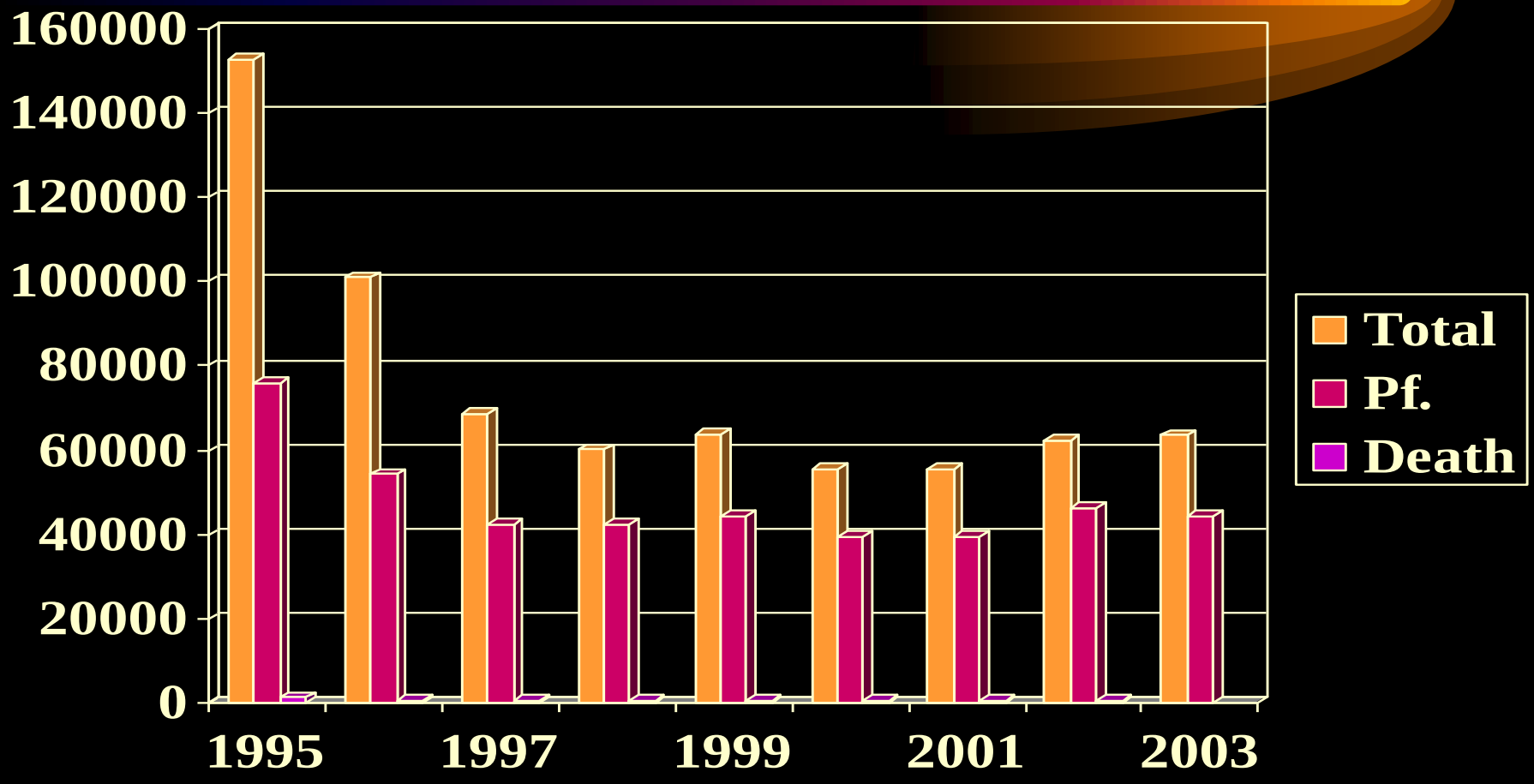
60,000 - 75,000 lab confirmed cases per year

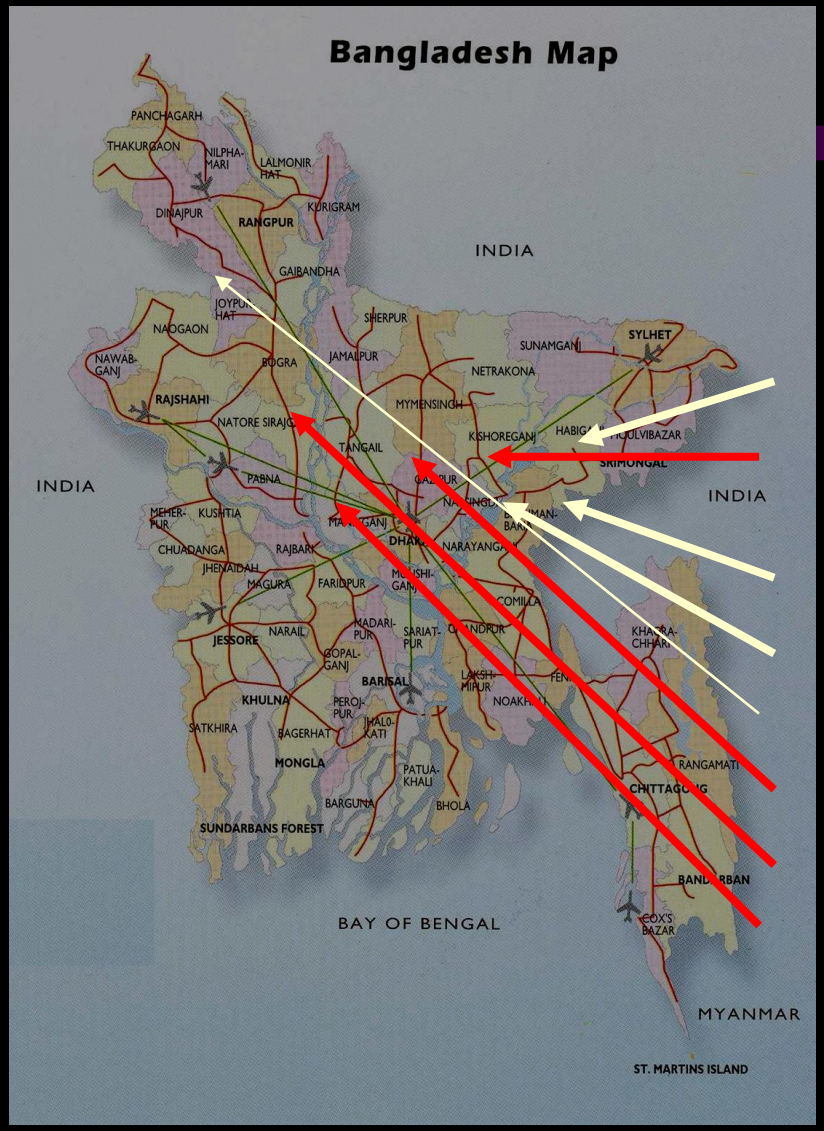
Estimated 1.0 million clinical cases annually

Focal outbreaks in eastern border are not infrequent

High level of Drug resistance (CQ,SP) against pf malaria reported in CHT and other endemic district.




160000
140000
120000
100000
80000
60000
40000
20000
0
1995
1997
1999
2001
2003
Total
Pf.
Death



Sylhet: '91(2), '92(1), 93(1), '95(1), 98 (1)
Sunamganj: '90(1), '91(1), '92(1), '93(1), '95(1), 98 (1), 2000 (1), 2003(1)
MBazar: '89(2), '90(1)
Habiganj: '91(1), '92(1)
Kurigram: '92(1),
Netrakona: '91(1), '92(2), '93(2), '94(2), '95(1)
2000 (1), 2002(1)
Sherpur: '89(2), '92(1), '95(1)
Mymensingh: '92(1), '94(1), '95(1)

Background of Malaria Control Program

- Malaria eradication program (MEP) started in 1961 and continued until 1976
- In 1977 the MEP merged with PHC and Control program was launched.
- In 1994 Revised malaria Control Strategy was adopted
- In 1998 piloting of Roll Back Malaria started in one of the Hill Tract District

Objective of the Program

- To reduce malaria specific mortality rate by 50% by the year 2010
- To provide early diagnosis and prompt treatment (EDPT) to all malaria cases
- To plan and implement selective and sustainable vector control measures including use of Insecticide Treated Mosquito Nets (ITMN) and Indoor Residual Spraying (IRS)

Objective of the Program (Cont'd)

- **To develop and strengthen the malaria epidemiological surveillance system in order to provide adequate information for the planning and resource allocation required for malaria control activities at various levels**

Program Priorities and Strategies

- **The adoption of the three malaria clinical case definitions of Uncomplicated Malaria Confirmed (UMC), Uncomplicated Malaria Presumptive (UMP), Severe Malaria (SM) for the Early Diagnosis and Prompt Treatment (EDPT)**

Program Priorities and Strategies (Cont.)

- **The adoption of revised reporting forms for Malaria Epidemiological Surveillance, which allow for the reporting of malarial deaths**
- **Establishment of a community based Insecticide Treated Mosquito Net (ITMN) program**

Program Priorities and Strategies (Cont'd)

- **Strengthening of the epidemic preparedness and response capacity at the national, district and upazila levels.**

Epidemiological Types of Malaria

Five major epidemiological types based on ecology and vector distribution as follows:

- **Malaria of Forested hill**
- **Malaria of Forest Fringe**
- **Malaria of plain Border Belt areas**
- **Malaria of plain rural areas**
- **Malaria in plain urban areas**

Entomological Information

- **Out of 34 Anopheles species (Spp.) recorded in Bangladesh, 7 (seven) Spp. have been incriminated as malaria vector**
- **These are: An.dirus, An.minimus, An.philipinensis, An. sundaicus, An.aconitus, An.anularis and An.vagus.**
- **An.maculatus group is strongly suspected to be a new vector in certain areas of northern border districts.**

Vector Control Activities

- **DDT has been used over 30 years as the only insecticide for residual indoor spraying until 1991**
- **Since 1994, two insecticides; Malathion 57% EC for IRS and Deltamethrin 2.5% EC and 1% SC for treatment of bed-nets have been used for malaria vector control in the country**

Vector Control Activities (Cont'd)

- **A total of about 120,000 to 140,000 mosquito nets are being treated each year.**
- **The program is planning to introduce LLNs with the support from WHO**

Drug Policy and Drug Regimen

- **Due to high level of resistance against CQ and SP the malaria treatment regimen has been changed**
- **UMC: When diagnosis is confirmed by Blood slide examination or RDT. The treatment is Coartem (ACT) for falciparum malaria.**

Drug Policy and Drug Regimen (Cont'd)

- **UMP: When presumptive diagnosis is done without laboratory confirmation by blood slide examination or RDT. The treatment for this category of patient is CQ + PQ**
- **SM: Parenteral quinine until the patient is able to take orally followed by oral quinine with a total duration of 7 days**

Epidemic preparedness

- Epidemic outbreaks are not infrequent
- Rapid Response Team (RRT) formed at district level
- Civil Surgeon (District Health Officer) is the Team Leader of RRT
- A guideline has been developed
- Team members of RRT has been oriented based on the guidelines
- Buffer stocks of logistics to combat epidemics is maintained
- Health personnel working in the epidemic prone areas alerted

Dr. Shaikh Abdus Salam

Prevention of dengue, malaria & zika virus in the community

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Dengue

- Mosquito borne tropical disease
- Symptoms typically begins 3-14 days after infection
- May have
  - High fever
  - Severe headache
  - Severe pain behind the eyes
  - Muscle, bone & joint pain
  - Skin rash
  - Mild bleeding (nose, gums)

Life threatening in few cases

- Dengue hemorrhagic
  - Bleeding, low level platelets, blood plasma leakage (white & red cells)
  - Can be fatal if unrecognized & not properly treated in a timely manner
- Dengue shock syndrome
  - Dangerously low blood pressure

Treatment

- No specific medication for treatment of a dengue infection
- Should take rest, drink plenty of fluids, and consult a physician
- If feel worse (e.g., develop vomiting and severe abdominal pain) in the first 24 hours after the fever declines, should go immediately to the hospital for evaluation

Outbreak & prevention

- Primarily occurs in areas where *Aedes* mosquitoes live
- Prevention
  - No vaccine for preventing dengue
  - Best preventive is to eliminate the places where the mosquito lays her eggs, primarily artificial containers that hold water
  - Using air conditioning or window and door screens reduces the risk of mosquitoes coming indoors
  - Epidemic prevention: sustainable, community-based, integrated mosquito control

Malaria

- Mosquito-borne disease caused by a parasite
- Often experience fever, chills, and flu-like illness
- Symptoms usually begin 10- 15 days after being bitten
- If not properly treated, may have recurrences of the disease months later
- Left untreated, may develop severe complications and die
- 2015: an estimated 214 million cases of malaria occurred worldwide & 4,38,000 people died

Types of malaria

- Uncomplicated: symptoms
  - Fever
  - Chills
  - Sweats
  - Headaches
  - Nausea and vomiting
  - Body aches
  - General malaise

- Severe
  - Cerebral malaria, with abnormal behavior, impairment of consciousness, seizures, coma, or other neurologic abnormalities
  - Severe anemia due to destruction of the red blood cells
  - Hemoglobin in the urine
  - Acute respiratory distress syndrome (ARDS)
  - Low blood pressure caused by cardiovascular collapse
  - Acute kidney failure
  - Hyperparasitemia, where more than 5% of the red blood cells are infected by malaria parasites
  - Hypoglycemia (low blood glucose)

Prevention

- Medications
- Mosquito elimination
- Requires a combination of preventing
  - High human population density
  - High anopheles mosquito population density
  - High rates of transmission from humans to mosquitoes and from mosquitoes to humans

Zika virus

- Caused by, primarily, through the bite of an infected mosquito

- Symptoms
  - No symptom or mild symptom
  - Fever, rash, joint pain, and red eyes
  - Other symptoms: muscle pain and headache

- Lasts for several days to a week

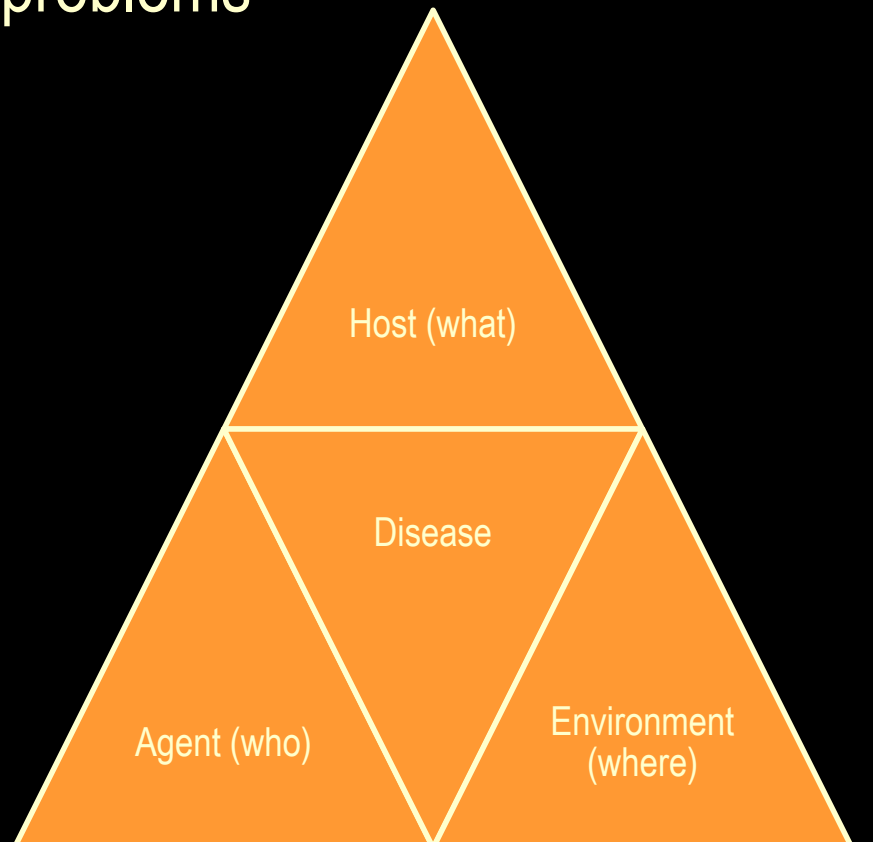
- Transmission
  - Through mosquito bites
  - From mother to child
  - Through sex
  - Through blood transfusion
  - Through laboratory exposure
  - or can be spread by a person infected with Zika to his or her sex partners
- Once a person has been infected, is likely to be protected from future infections

Prevention & what to do

- A blood or urine test can confirm Zika infection
- No specific medicine
- Avoid sexual transmission
- Use mosquito nets
- What to do
  - Get plenty of rest
  - Drink fluids to prevent dehydration
  - Take medicine such as acetaminophen to reduce fever and pain
  - Do not take aspirin

Epidemiology & triangle

- The study of the distribution and determinants of health-related states or events
- The application of this study to the control of diseases and other health problems



Emerging & re-emerging disease

- **Emerging infectious diseases**
  - Have not occurred in humans before
  - Have occurred previously but affected only small numbers of people in isolated places (AIDS and Ebola hemorrhagic fever are examples)
  - Have occurred throughout human history but have only recently been recognized as distinct diseases due to an infectious agent
- **Re-emerging infectious diseases**
  - Once were major health problems globally or in a particular country, and then declined dramatically, but are again becoming health problems for a significant proportion of the population (malaria and tuberculosis are examples)

How to protect

- Immunity
- Vaccination
- Safe water
- Food safety
- Sewage treatment & disposal
- Animal control
- Awareness raising
- Behavioral change