

The background of the slide is a microscopic image of a blood smear. It shows numerous red blood cells, which are roughly circular and pinkish. Inside many of these cells, there are small, purple-stained structures, which are malaria parasites in various stages of their life cycle. Some parasites appear as simple dots, while others show more complex, ring-like or crescent shapes. The overall appearance is that of a typical Giemsa-stained blood smear used for diagnosing malaria.

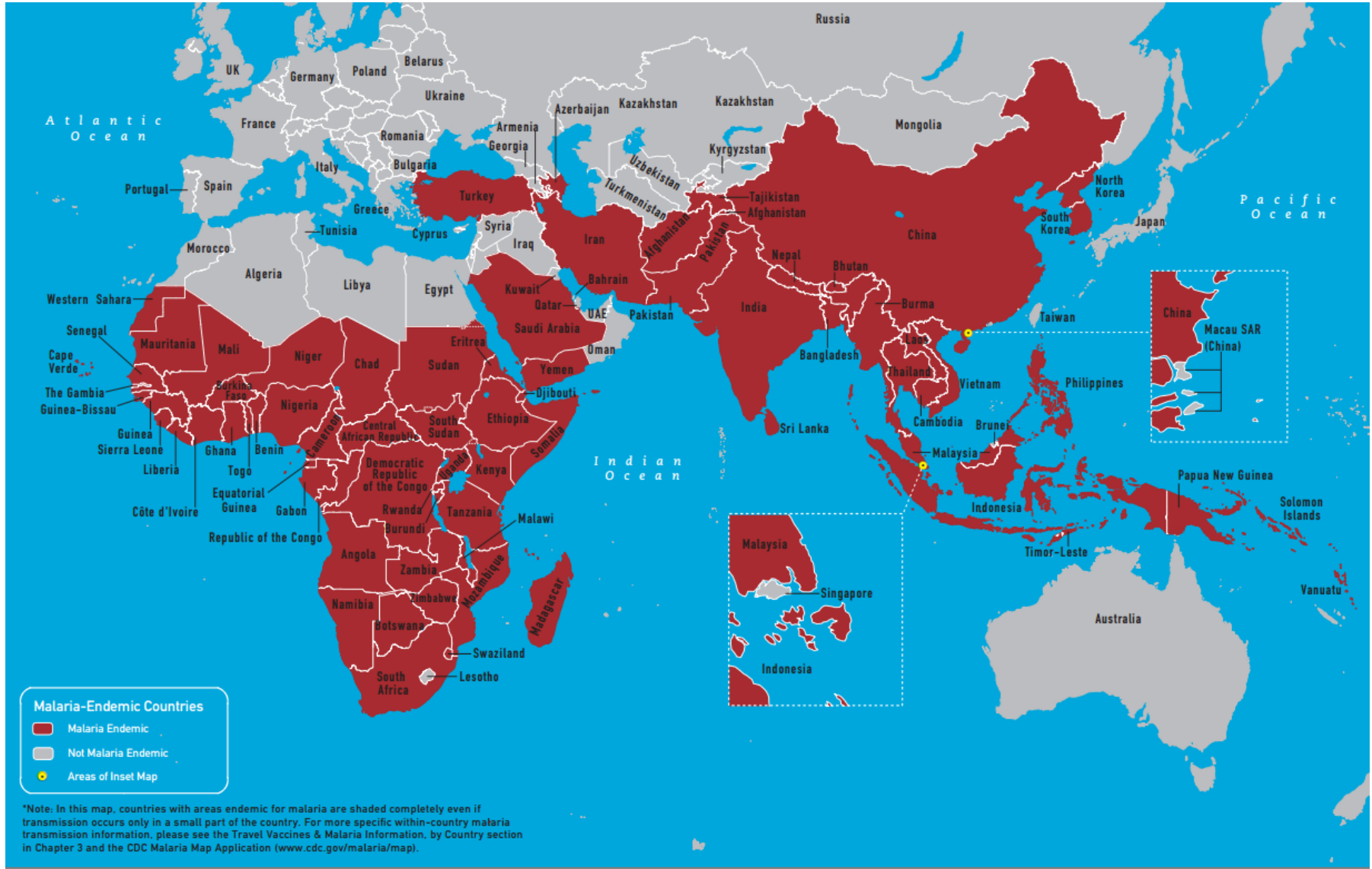
Malaria

**An Overview of
Life-cycle, Morphology and
Clinical Picture**

Malaria Species

- Five species of malaria infect humans:
 - *Plasmodium falciparum*
 - *Plasmodium vivax*
 - *Plasmodium ovale*
 - *Plasmodium malariae*
 - *Plasmodium knowlesi*

Malaria –Endemic Countries



Malaria –Endemic Countries



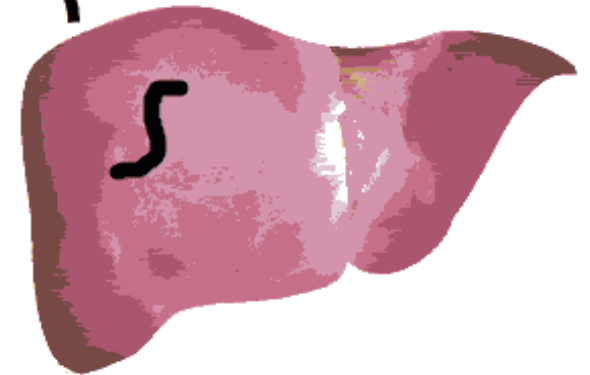
Sporozoites in
mosquito saliva



Mosquito bites
uninfected human

Mosquito bites
infected human

Sporozoites enter
bloodstream and
migrate to liver,
infecting hepatocytes



Symptoms
occur

Merozoites released,
infect erythrocytes
(fever results from
escape + reinfection of
Merozoites)



Erythrocytes become
"sticky" (PfEMP)

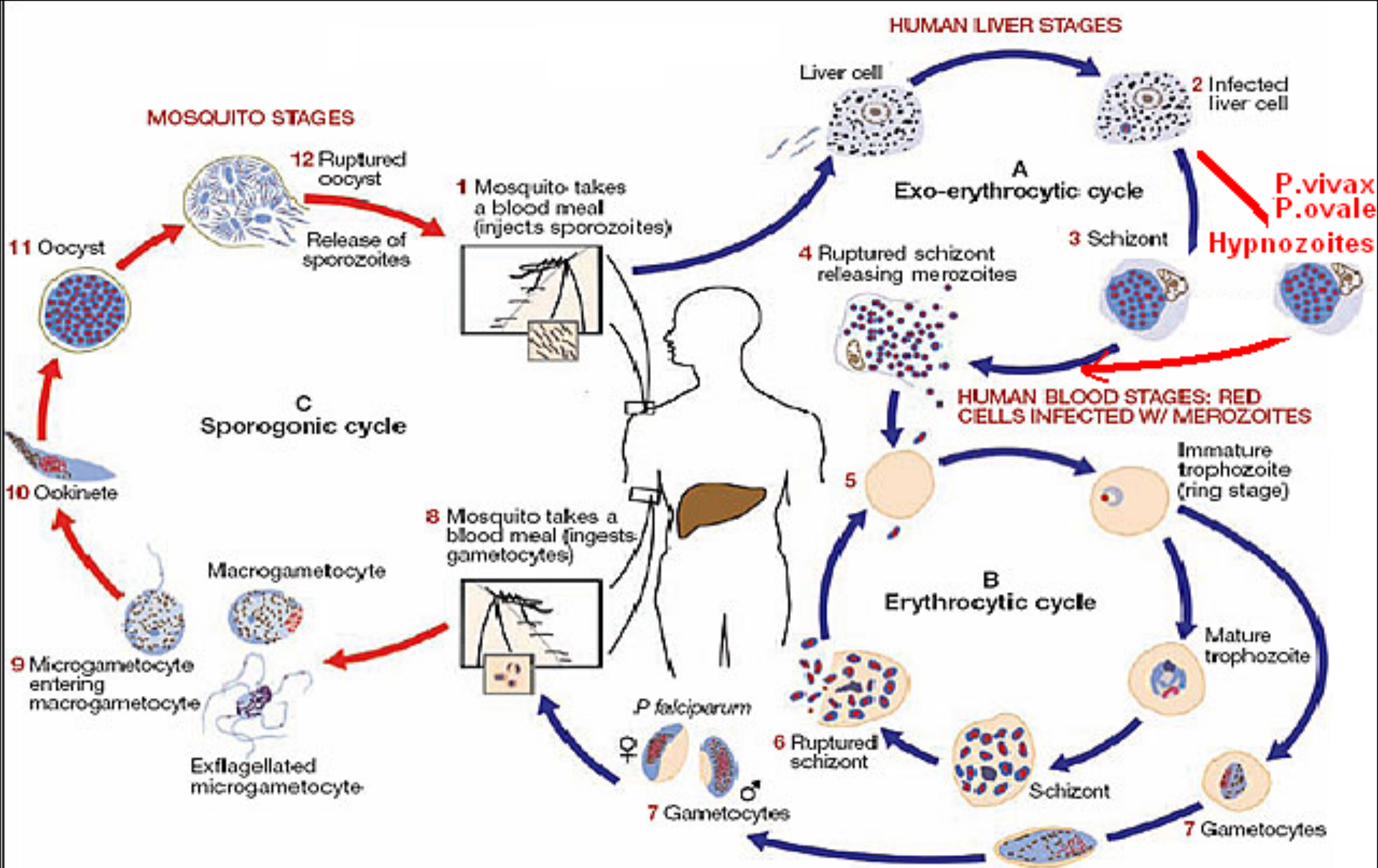
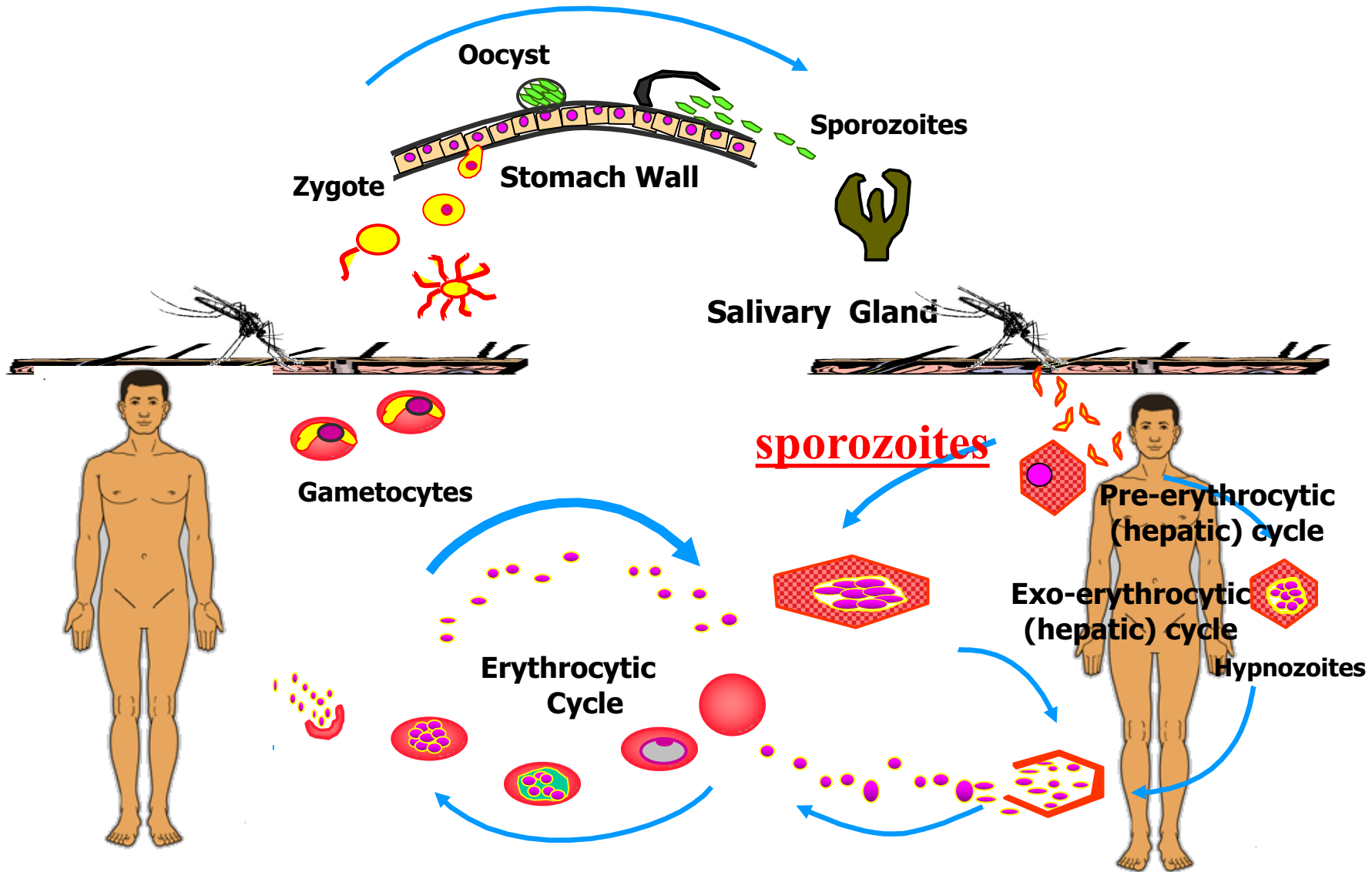
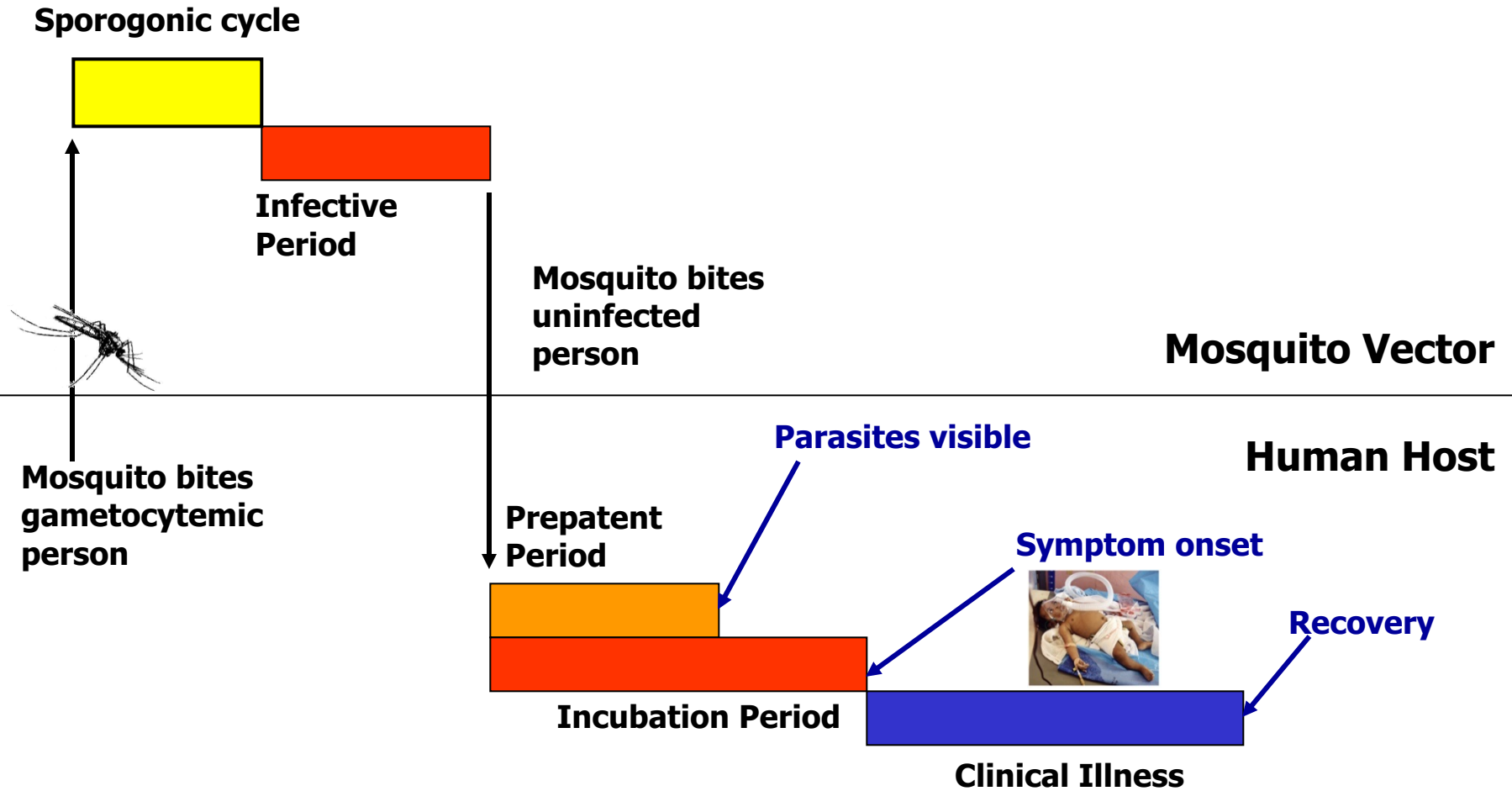


Figure 1—Malaria parasite life cycle. A malaria-infected female Anopheles mosquito inoculates sporozoites into the human host. Sporozoites infect liver cells and mature into schizonts, which rupture and release merozoites that infect red blood cells. Ring-stage trophozoites mature into schizonts, which rupture, releasing merozoites. Some parasites differentiate into sexual erythrocytic stages (gametocytes). Parasites in the blood are responsible for the clinical manifestations of the disease. Adapted from the CDC.

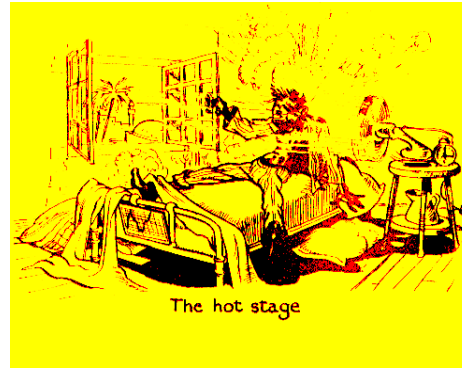
LIFE CYCLE OF MALARIA



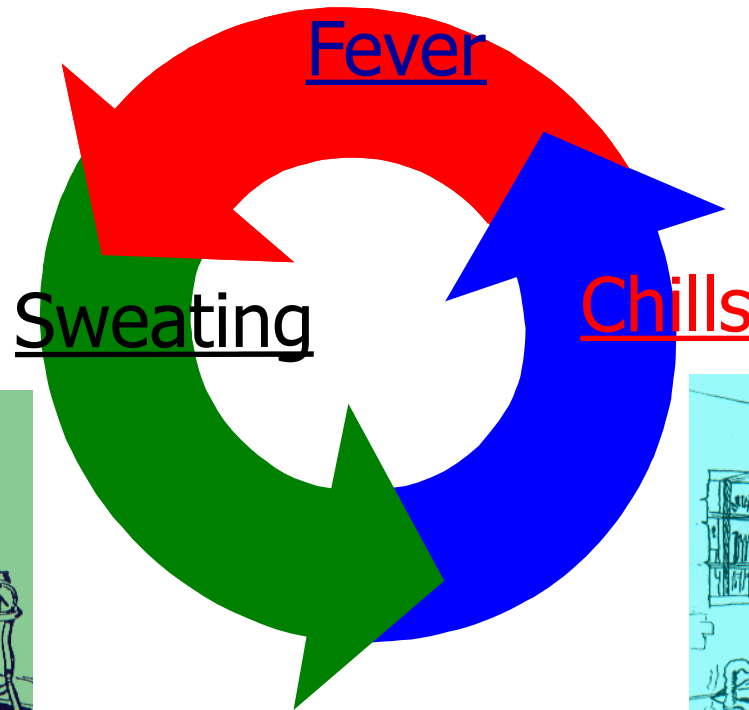
Components of the Malaria Life Cycle



CLINICAL
SIGNS &
SYMPTOMS
OF MALARIA



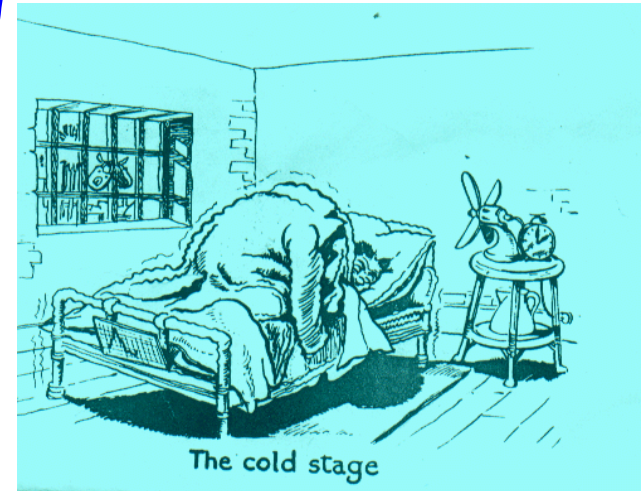
The hot stage



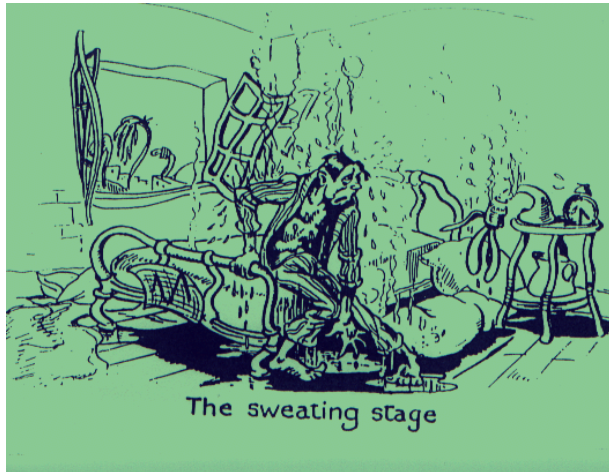
Fever

Chills

Sweating

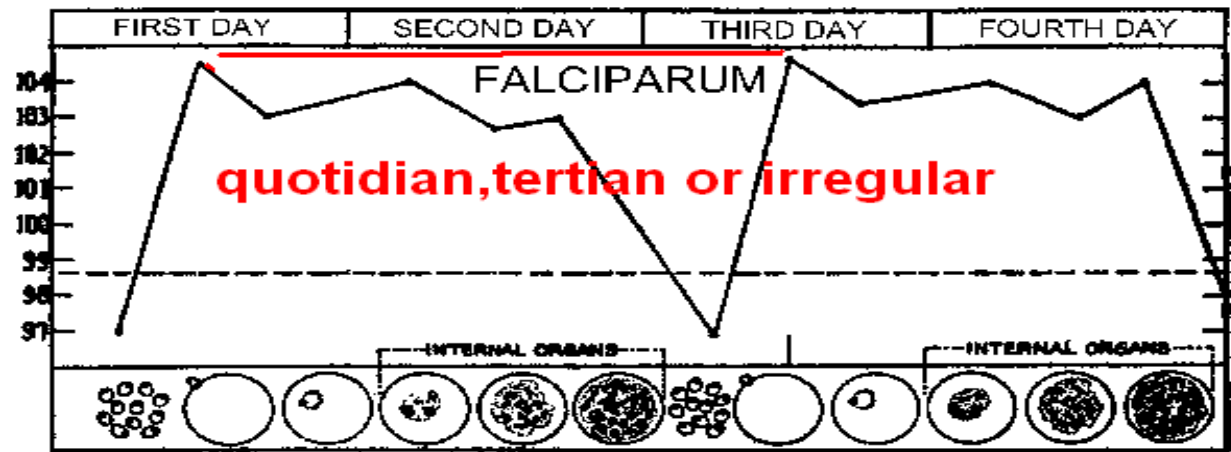


The cold stage

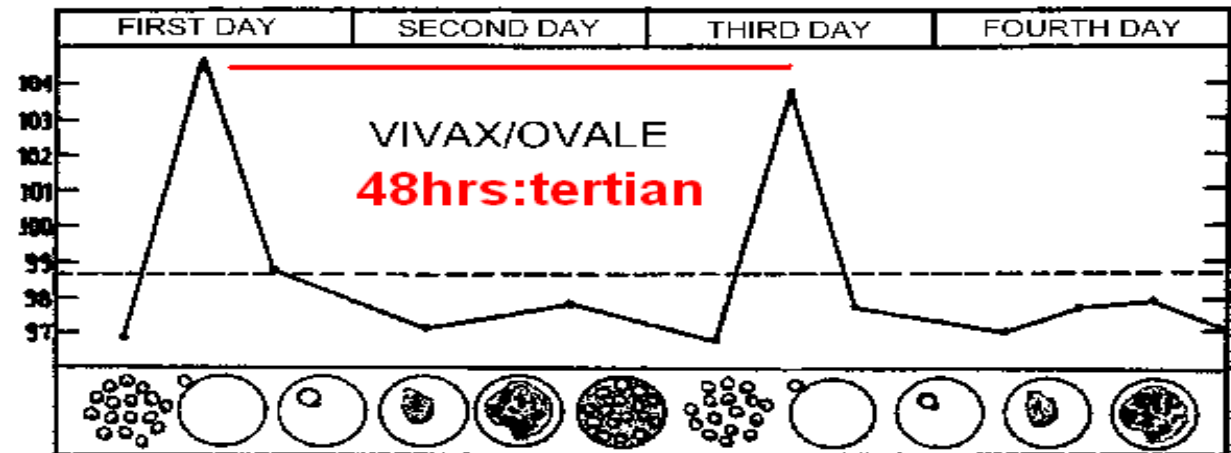


The sweating stage

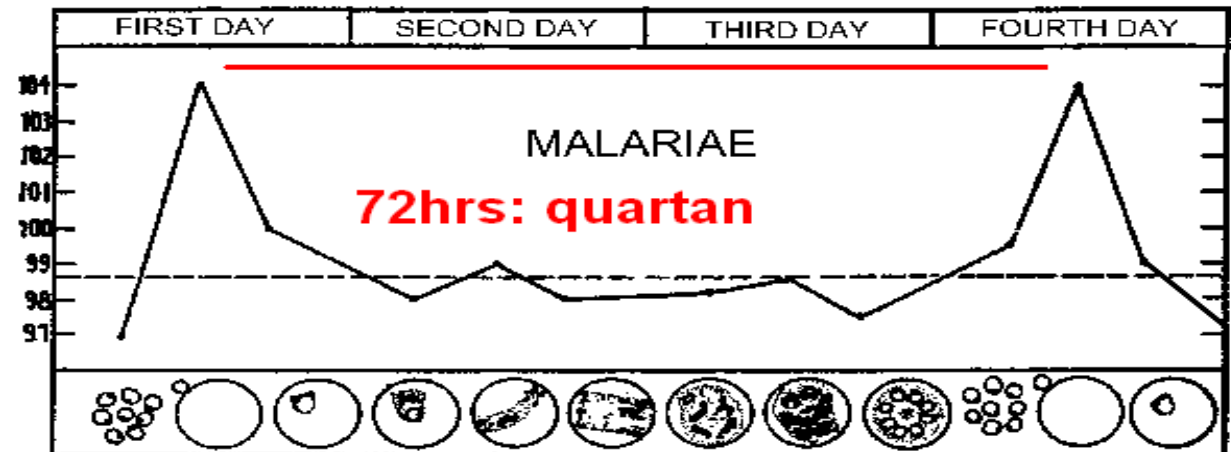
Plasmodium
falciparum:



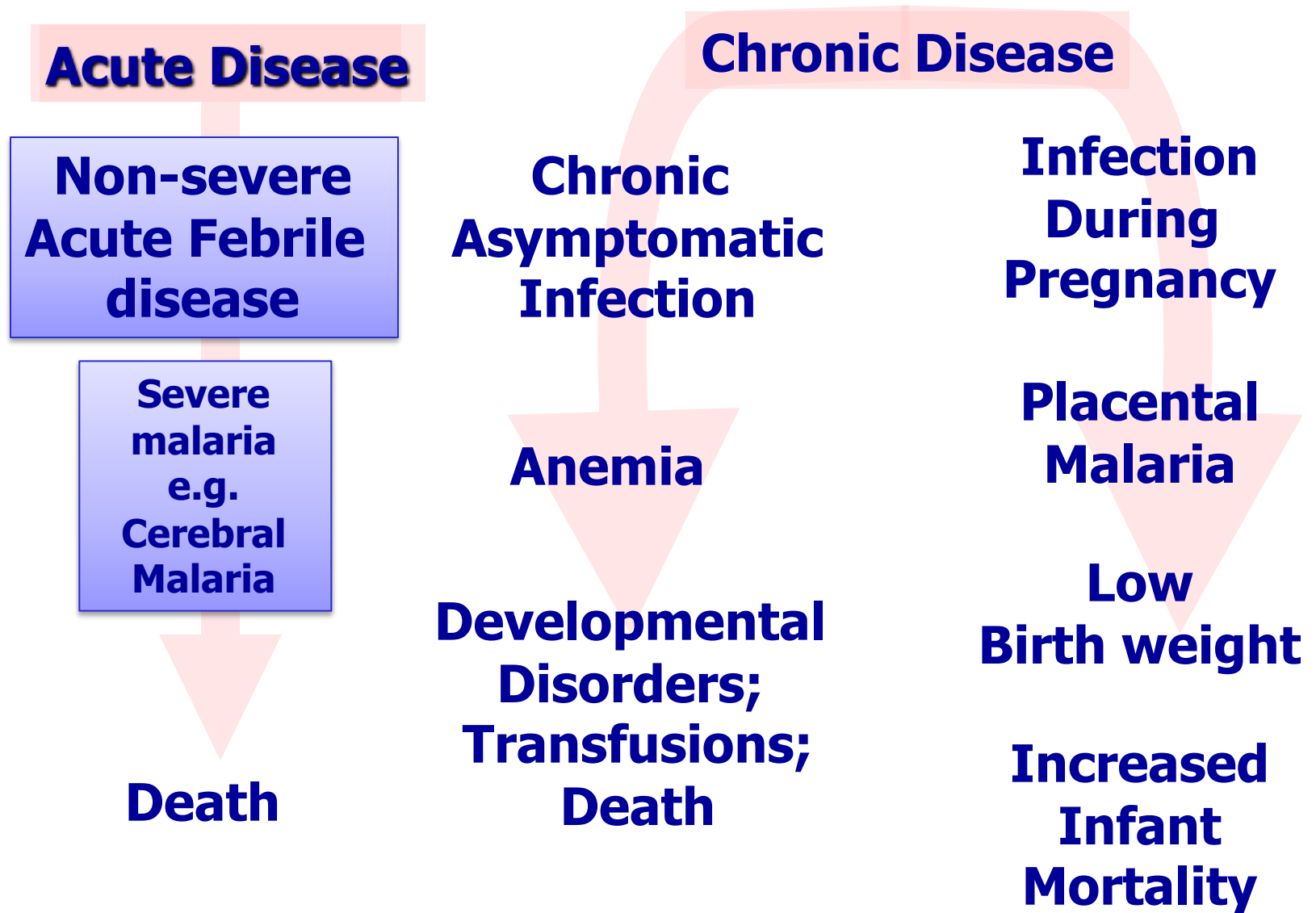
Plasmodium
vivax,
Plasmodium
ovale



Plasmodium
malariae:



CLINICAL PICTURE



Definition

- Severe malaria is defined as symptomatic malaria in a patient with *P. falciparum* with one or more of the following complications:
 - Cerebral malaria (unrousable coma not attributable to other causes).
 - Generalized convulsions (> 2 episodes within 24 hours)
 - Severe normocytic anaemia (Ht<15% or Hb < 5 g/dl)
 - Hypoglycemia (blood glucose < 2.2 mmol/l or 40 mg/dl)
 - Metabolic acidosis with respiratory distress (arterial pH < 7.35 or bicarbonate < 15 mmol/l)
 - Fluid and electrolyte disturbances
 - Acute renal failure (urine <400 ml/24 h in adults; 12 ml/kg/24 h in children)
 - Acute pulmonary edema and adult respiratory distress syndrome
 - Abnormal bleeding
 - Jaundice
 - Haemoglobinuria
 - Circulatory collapse, shock, septicaemia (algid malaria)
 - Hyperparasitaemia ($\geq 10\%$ in non-immune; $\geq 20\%$ in semi-immune)

Definition

- *Uncomplicated malaria is defined as:*

Symptomatic infection with malaria parasitemia without signs of severity and/or evidence of vital organ dysfunction.

Complications of malaria:

Cerebral malaria



Opisthotonos in an unrousably comatose child with cerebral malaria. The cerebrospinal fluid cell count was normal

Malarial Paroxysm

cold stage

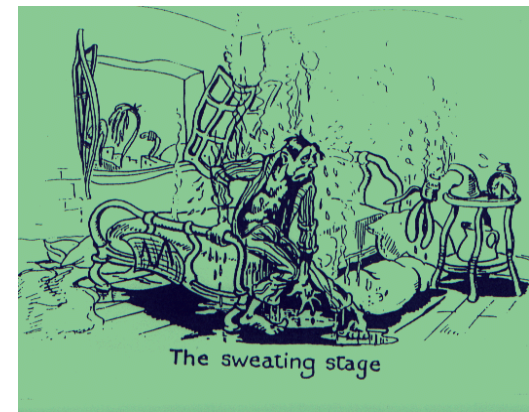
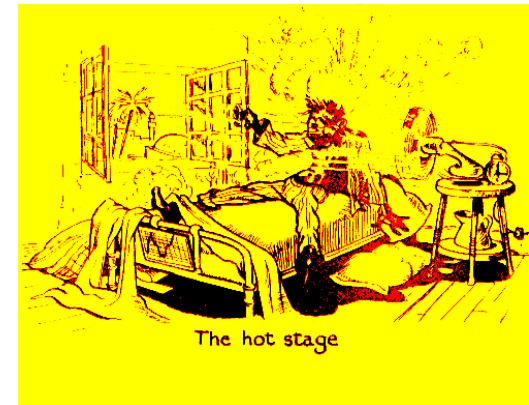
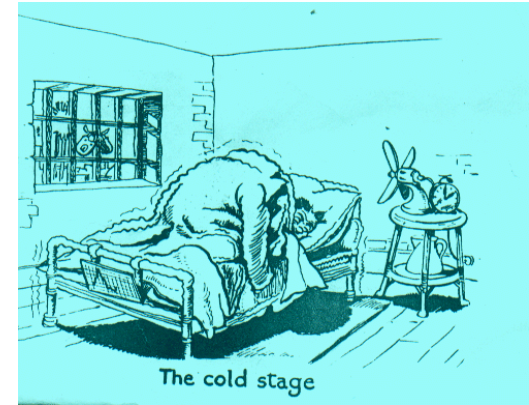
- feeling of intense cold
- vigorous shivering
- lasts 15-60 minutes

hot stage

- intense heat
- dry burning skin
- throbbing headache
- lasts 2-6 hours

sweating stage

- profuse sweating
- declining temperature
- exhausted and weak → sleep
- lasts 2-4 hours



PATHOGENESIS OF MALARIA

PARASITE DEVELOPMENT IN RBC

(P. falciparum)

SURFACE CHANGES IN RBC

Adherence of parasitized rbc to endothelium

Disseminated intravascular coagulation

Localized decreased microcirculation

METABOLISM OF HEMOGLOBIN

Hemozoin formation

Fe store depletion

Anemia

LYSIS OF INFECTED CELLS

Stroma

Splenomegaly

Auto Ab?

Increased destruction normal rbc

Hemoglobin

Hemoglobinemia

(P. falciparum)

Hemoglobinuria (Black water fever)

Antigen

Fever

+ Antibody

(P. malariae)

Nephritis

Tissue anoxia

Adrenal

Shock

Bacterial sepsis

Hyperpyrexia

Cerebral

Coma

Gastrointestinal

Dysentery

Hepatic

Jaundice

Pulmonary

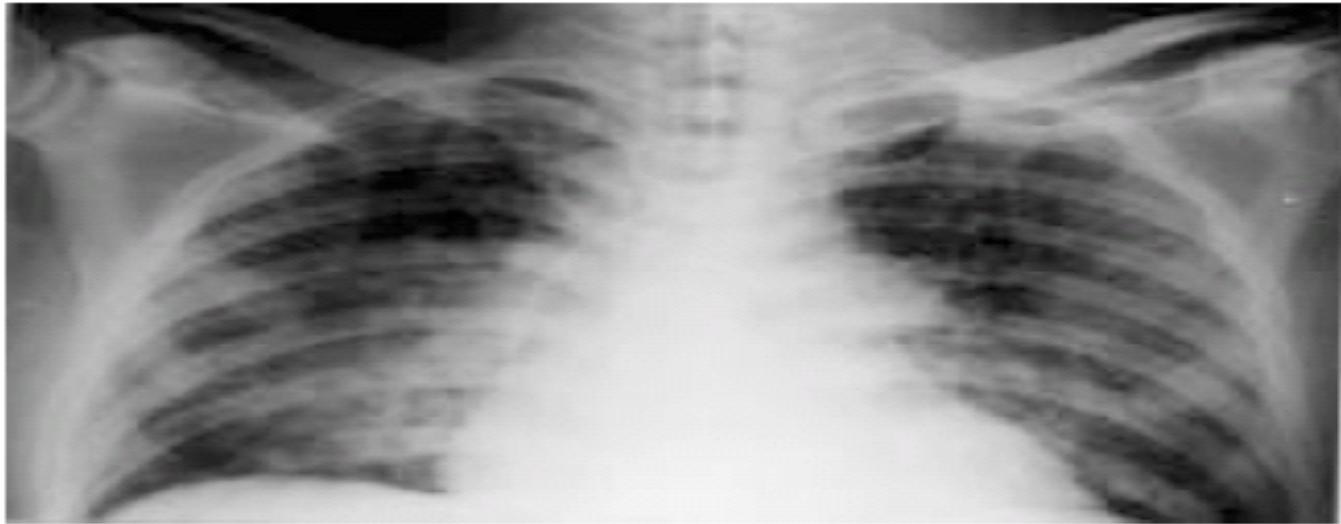
Edema

Renal

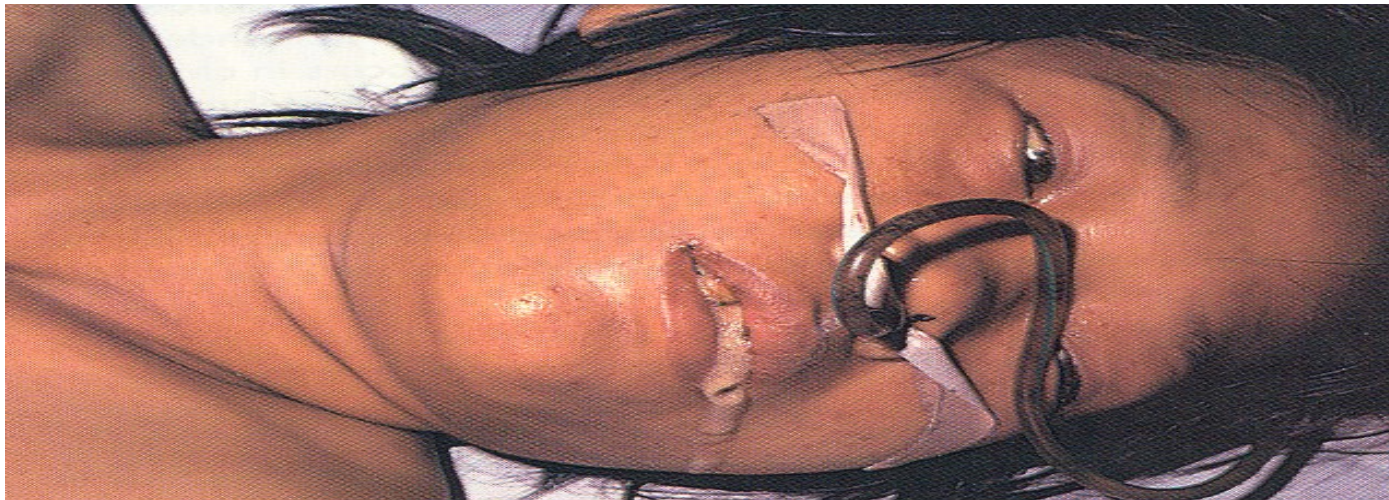
Anuria

Complications of malaria:

Pulmonary oedema



© D. A. Warrell



Complications of malaria: anaemia



**Child with severe
malaria anaemia and
no other malaria
complication**

Child with severe malaria anaemia in conjunction with acidosis and respiratory distress



Malarial haemoglobinuria



Clinical Picture:

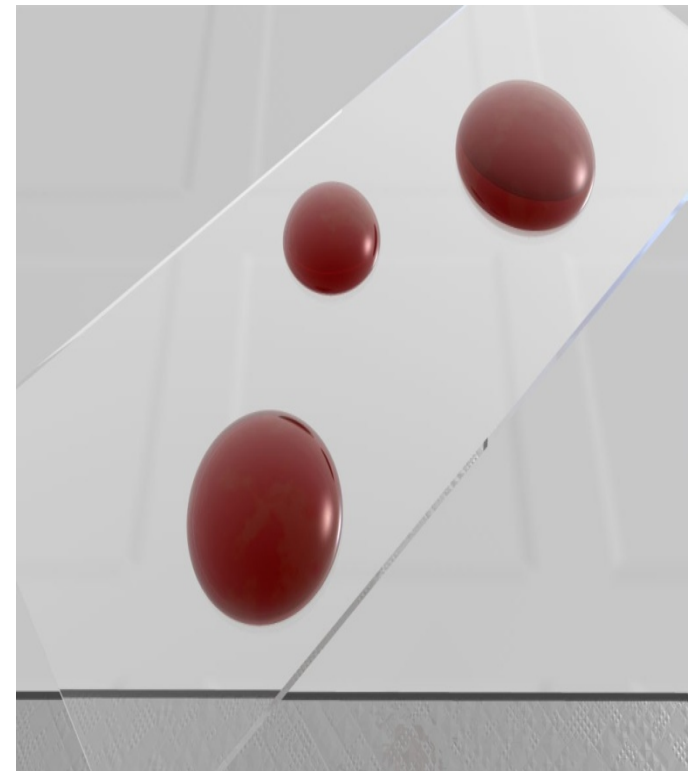
Haemoglobinuria associated with malaria (“blackwater fever”) is uncommon and malarial haemoglobinuria usually presents in adults as severe disease with anemia and renal failure.



Common methods for parasitological diagnosis of malaria

The two common methods in use:

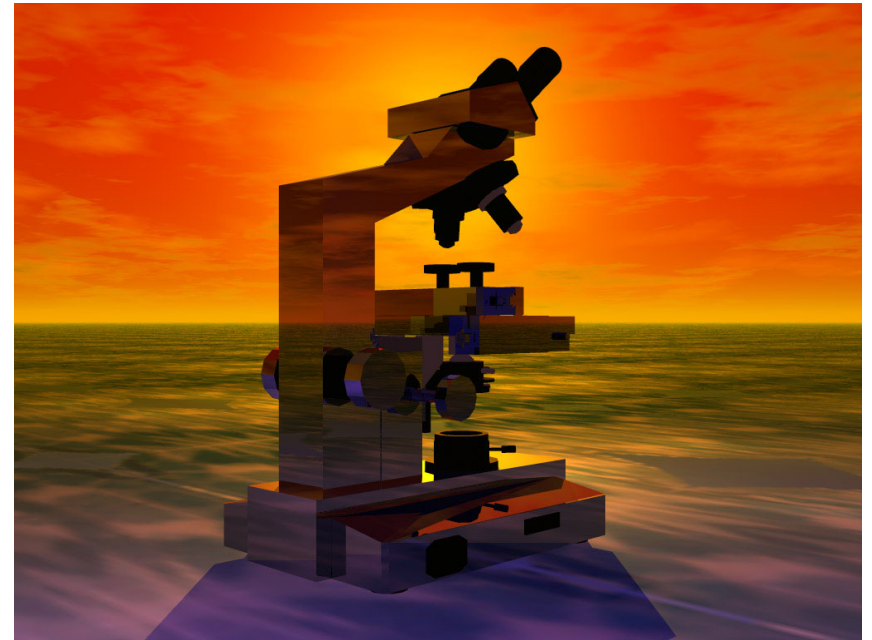
- 1:** Light microscopy
- 2:** Rapid diagnostic tests (RDTs).



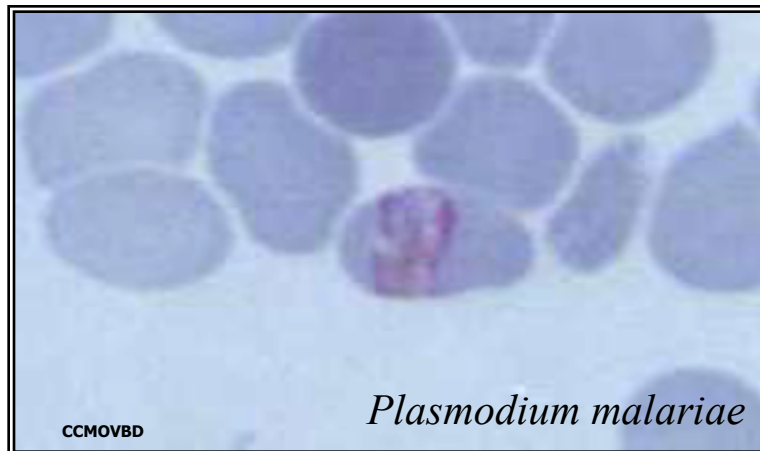
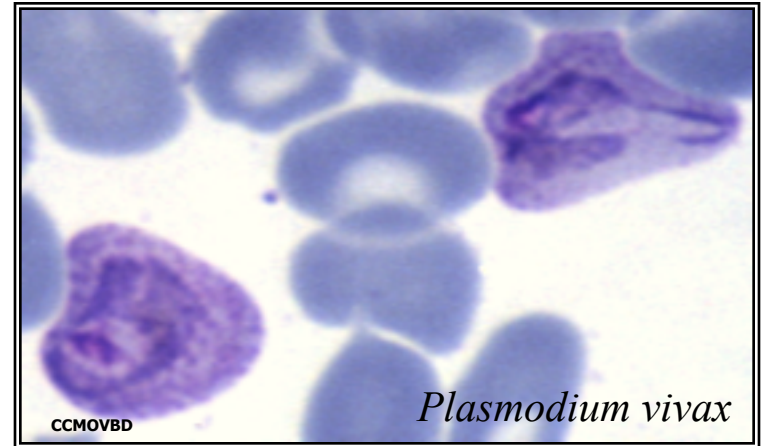
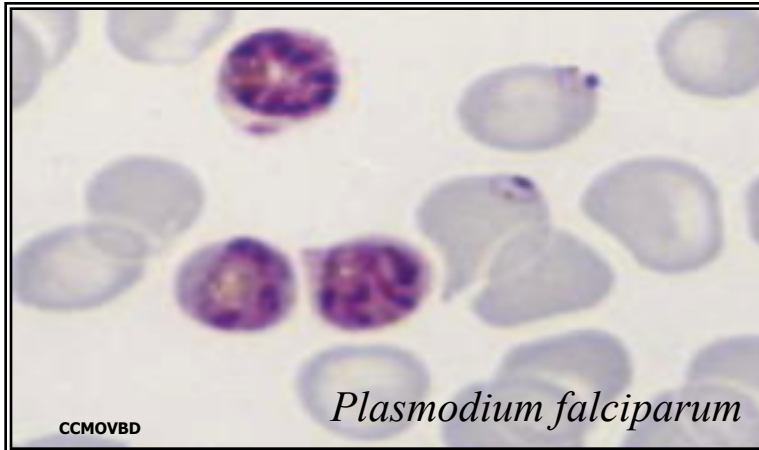


Microscopy is the gold standard for diagnosis of malaria

- Parasite density
- Species diagnosis
- Monitoring response to treatment



Laboratory diagnosis of malaria

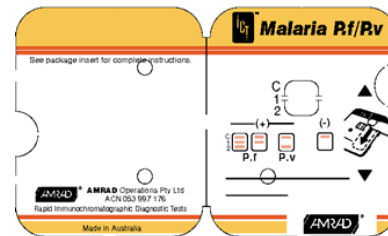


Laboratory diagnosis of malaria

Rapid diagnostic tests detect malaria antigens

The products come in a number of formats:

- Plastic cassette
- Card
- Dipstick
- Hybrid cassette-dipsticks

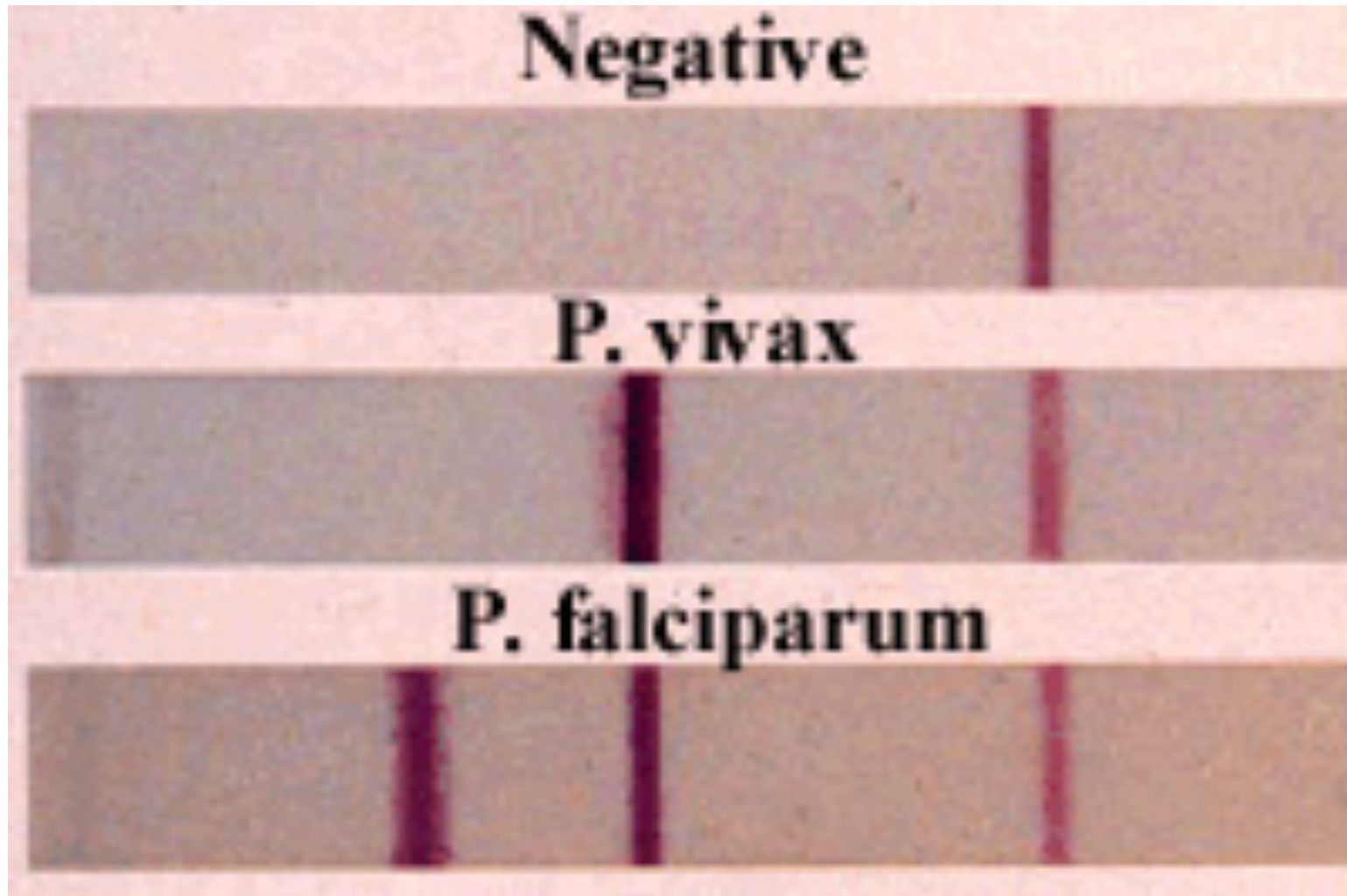


Rapid diagnostic tests detect malaria antigens

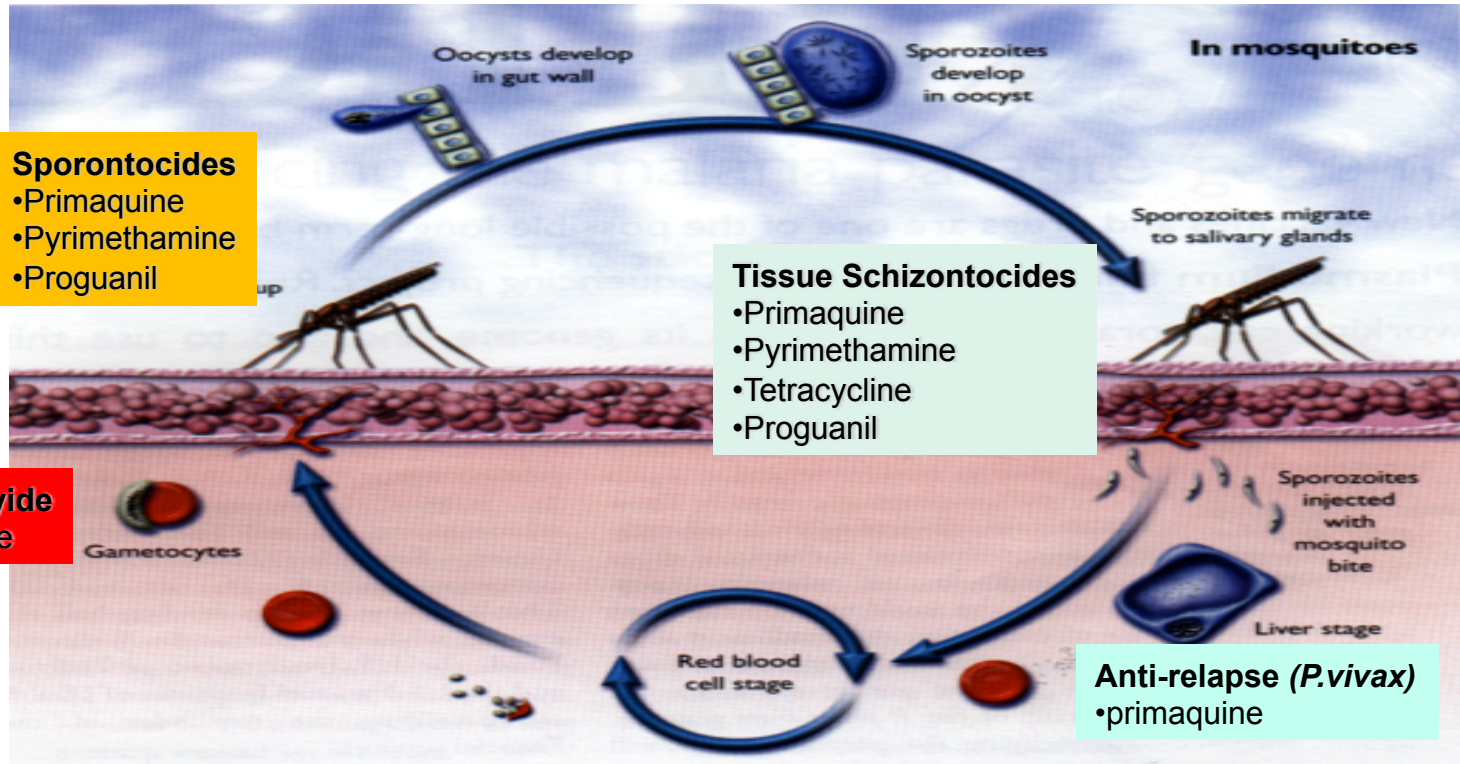
**Plastic cassette
format of RDT**



Rapid diagnostic tests detect malaria antigens



ACTION OF ANTIMALARIAL DRUG IN THE DIFFERENT LIFE STAGES OF THE MALARIA PARASITE



Wellcome Trust (Modified)