


# Malaria

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## Definition:

Malaria is a parasitic infection caused by Plasmodium species, transmitted via the bite of female Anopheles mosquitoes. Humans are the only natural reservoir. 

## Global Burden (2020, WHO):

- Cases: >200 million
- Deaths: >600,000
- Endemic in: Asia & Africa (but global travel spreads infection)

## Important Species:

Plasmodium Species	Clinical Significance	Fever Cycle	Notes

P. falciparum	Severe, potentially fatal	48 h	Cerebral malaria, blackwater fever
P. vivax	Mild	48 h	Relapses due to hypnozoites in liver
P. ovale	Mild	48 h	Relapses possible
P. malariae	Mild	72 h	Chronic infections possible
P. knowlesi	Mild-severe	24 h	Zoonotic (monkeys → humans)

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### Life Cycle of Plasmodium (P. falciparum)


#### Flowchart

Mosquito bite → Sporozoites enter blood → Travel to liver → Bind to hepatocytes (via thrombospondin-related & circumsporozoite proteins) → Enter hepatocytes →

Differentiate into merozoites → Hepatocyte ruptures → Merozoites released → Invade RBCs (bind sialidated glycophorin)

- In RBCs → Become trophozoites
- Some → gametocytes (sexual stage, infect mosquitoes)
- Most → schizonts → RBC lysis → merozoite release → Cycle repeats

Special Note:

- PfEMP1 expression on infected RBCs → adheres to endothelial cells (ICAM-1, VCAM-1, CD36) → microvascular obstruction
- In cerebral malaria, this leads to brain vessel occlusion, especially in children 

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## Morphology & Hemolysis

- RBCs containing trophozoites show species-specific appearances on stained blood smears

- RBC rupture → hemolytic anemia
  - Hemoglobin breakdown → heme pigment → discoloration of spleen, liver, lymph nodes, bone marrow
  - Host immune response → mononuclear phagocyte hyperplasia → massive splenomegaly (occasionally hepatomegaly)
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## Clinical Features

Classic triad:

1. Fever & chills (episodic, matching merozoite release cycles)
2. Hemolytic anemia
3. Splenomegaly

Fever intervals by species:

- *P. knowlesi* → 24 h
- *P. vivax* / *P. ovale* / *P. falciparum* → 48 h

- *P. malariae* → 72 h

Severe Complications (mostly *P. falciparum*):

- Cerebral malaria → convulsions, coma, death
- Blackwater fever → massive intravascular hemolysis, hemoglobinemia, hemoglobinuria, jaundice, renal failure

Other features:

- Chronic anemia
- Hypersplenism
- Relapses in *P. vivax* & *P. ovale* due to liver hypnozoites



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## Management & Prevention

Treatment:

- Prompt antimalarial therapy (species-specific)
- Watch for drug-resistant *P. falciparum*

## Prevention:

- Mosquito control: remove stagnant water, insecticide-treated bed nets 
  - Chemoprophylaxis: for travelers to endemic areas
  - Vaccination: partial protection from sporozoite antigen vaccines 
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## Quick Exam Flowchart — Malaria Pathogenesis

Mosquito bite → Sporozoites → Liver infection →  
Merozoite release → RBC invasion  
→ Trophozoites →

- Schizonts → RBC lysis → hemolytic anemia
- Gametocytes → Taken up by mosquito → Life cycle continues

Severe malaria → PfEMP1 → RBC adhesion → Capillary obstruction → Cerebral malaria / Organ ischemia

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-> The End <-