Malaria

By

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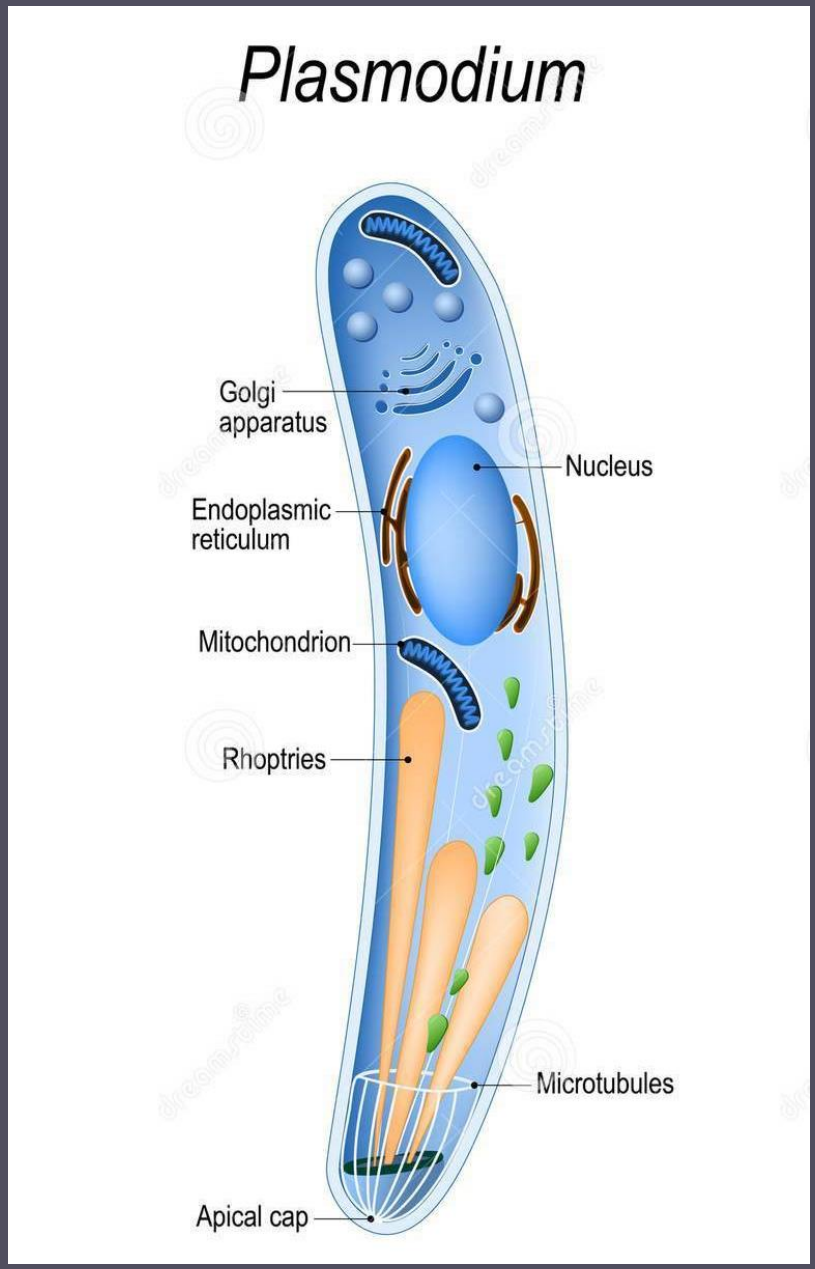
Introduction

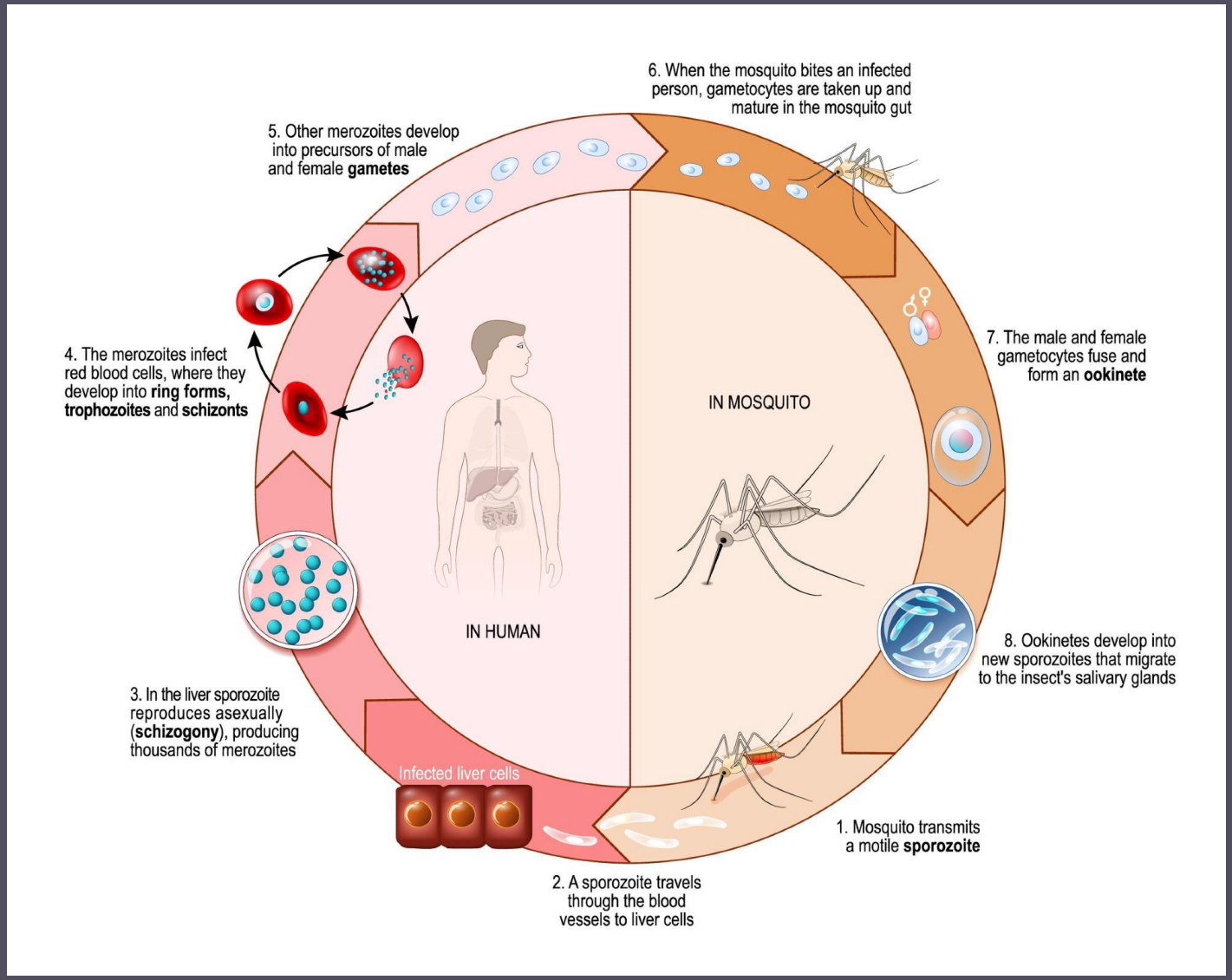
- Malaria is a mosquito-borne disease caused by a parasite *Plasmodium*.
- Malaria are spread to people through the bites of infected female Anopheles mosquitoes
- There are 5 parasite species that cause malaria in humans, and 2 of these species – P. falciparum (African continent) and P. vivax (outside of sub-Saharan Africa) – pose the greatest threat.
- In 2020 an estimated 241 million cases of malaria occurred worldwide and 627,000 people died, mostly children in sub-Saharan Africa.

Plasmodium

Plasmodium parasites were first identified in the late 19th century by Charles Laveran.
Over the course of the 20th century, many other species were discovered in various hosts and classified, including five species that regularly infect humans: P. vivax, P. falciparum, P. malariae, P. ovale, and P. knowlesi.



Plasmodium Life Cycle



Biology of Malaria

- All the clinical symptoms associated with malaria are caused by the asexual erythrocytic or blood stage parasites.
- When the parasite develops in the erythrocyte, numerous known and unknown waste substances such as hemozoin pigment and other toxic factors accumulate in the infected red blood cell.
- These are dumped into the bloodstream when the infected cells lyse and release invasive merozoites.
- The hemozoin and other toxic factors such as glucose phosphate isomerase (GPI) stimulate macrophages and other cells to produce cytokines and other soluble factors which act to produce fever.

Biology of Malaria

- Plasmodium falciparum-infected erythrocytes, particularly those with mature trophozoites, adhere to the vascular endothelium of venular blood vessel walls and do not freely circulate in the blood.
- When this sequestration of infected erythrocytes occurs in the vessels of the brain it is believed to be a factor in causing the severe disease syndrome known as cerebral malaria, which is associated with high mortality.

Incubation period

- Following the infective bite by the Anopheles mosquito, a period of time (the "incubation period") goes by before the first symptoms appear.
- The incubation period in most cases varies from 7 to 30 days.
- The shorter periods are observed most frequently with P. falciparum and the longer ones with P. malariae.

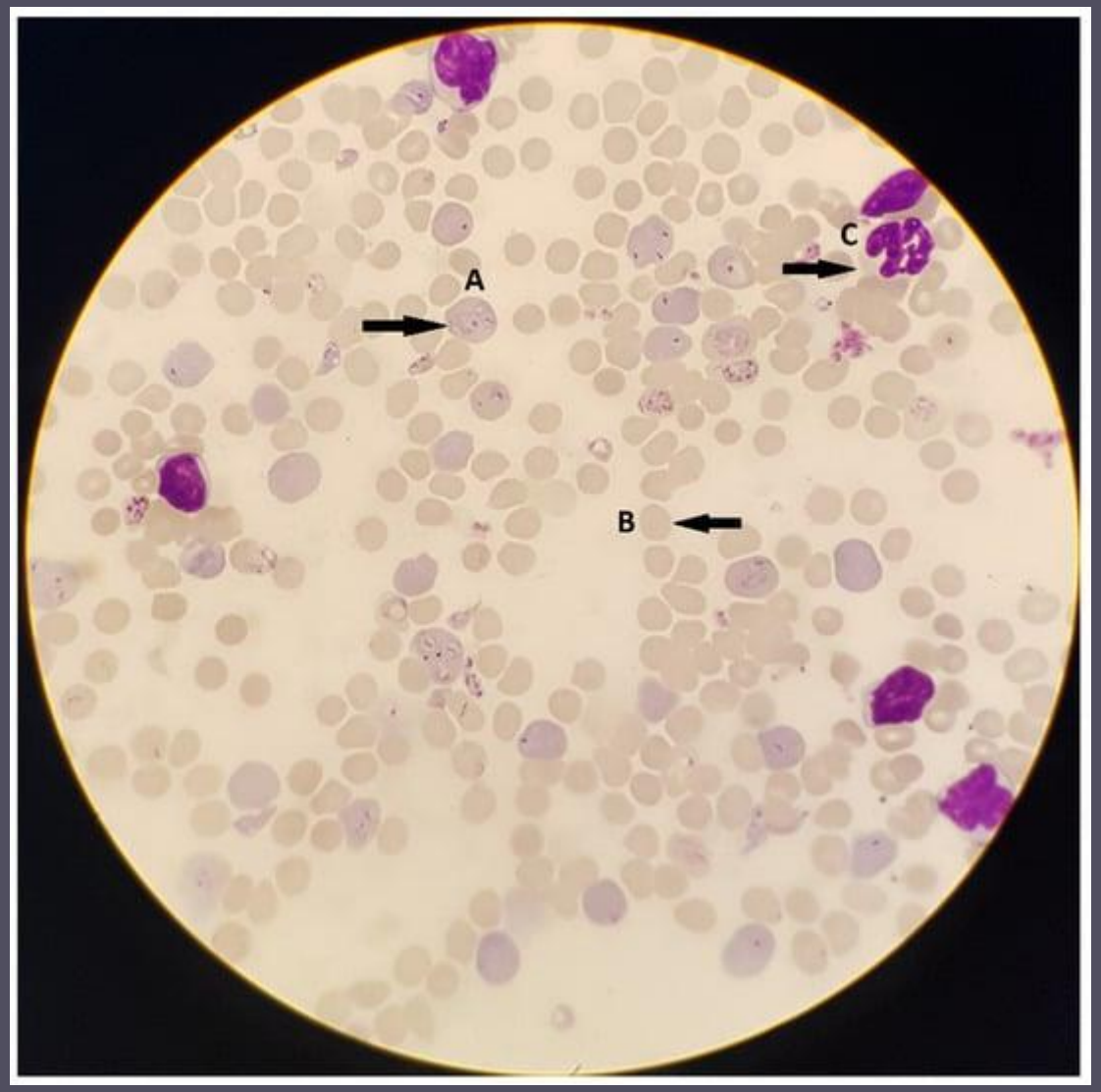
INCUBATION PERIOD OF THE PARASITE

Species	Incubation period
P. Falciparum	7-14 days
P. Vivax	12-17 days
P. Ovale	9-18 days
P. Malaria	13-14 days

Diagnosis

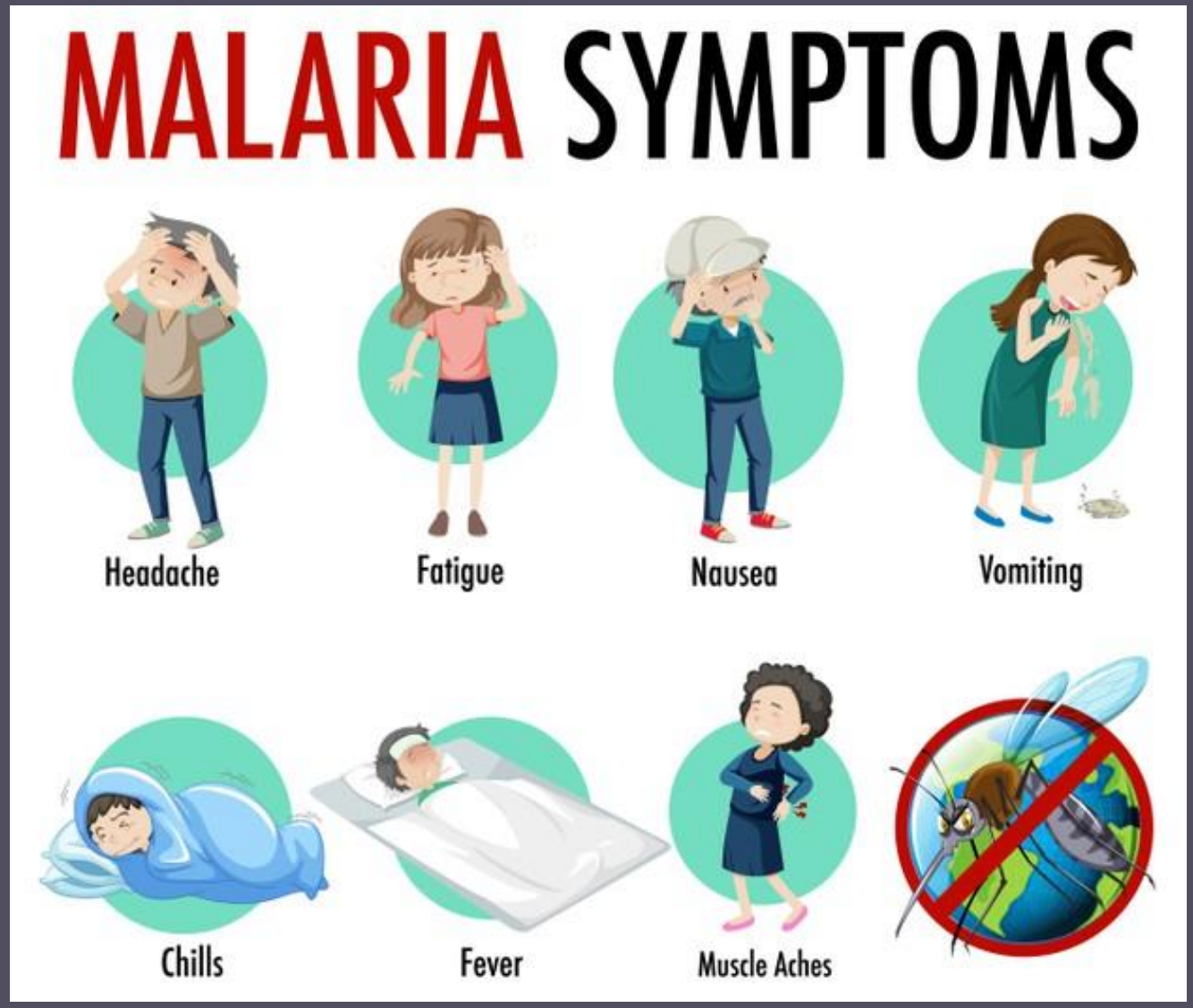
Method	Microscopy	RDT	PCR
Target	N/A	pHRP-2, LDH, Aldolase	18S rRNA
Sensitivity	95% [1]	85% to 94.8%	98% to 100%
Specificity	98% [1]	95.2% to 99%	88% to 94%
Limit of detection	50–200 parasites per µL of blood	50–100 parasites per µL of blood	0.5–5 parasites per µL of blood
Advantages	Identification of parasite morphologies, species and stage	Fast and easy to use	Low limit of detection making it easier to detect low parasitemia, High throughput
Limitations	Requires trained personnel and microscopes	Mutation in pHRP-2 leading to false negatives, Unable to quantify parasitemia	Needs expensive instrument and is not able to quantify parasitemia
Cost per test	$0.12–$0.40	$0.85	$7–$8
Time	60 min	15–20 min	2 h
References	[11,12,13]	[11,12,13,20]	[11,21]

Diagnosis

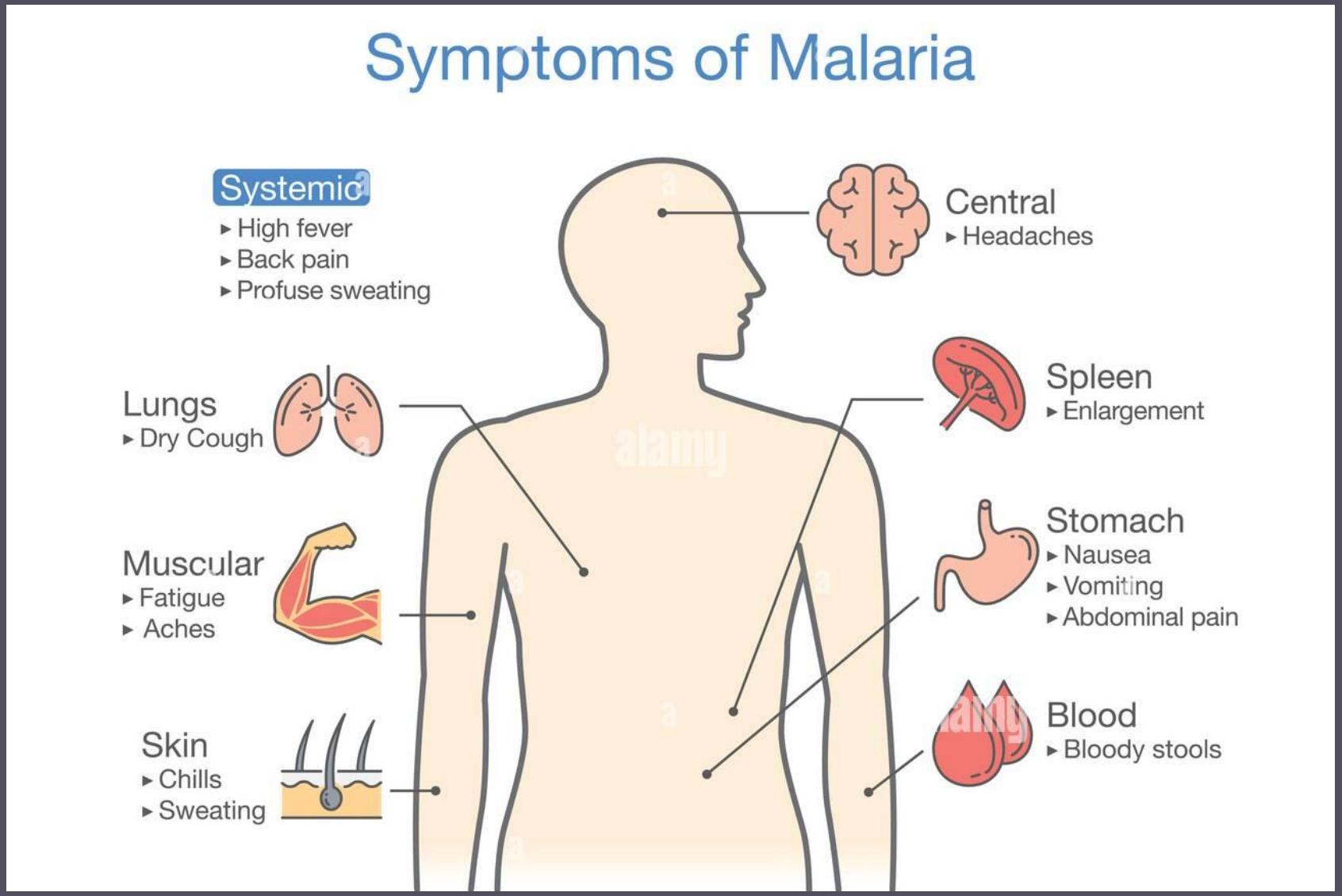


Microscopy of a thin smear P. falciparum infected erythrocytes stained with Giemsa. (A) A red blood cell infected with two malaria parasites in the "ring" stage as seen under a microscope at 100× oil immersion. (B) A normal uninfected red blood cell. (C) A normal leukocyte.

Symptoms


MALARIA SYMPTOMS
Headache
Fatigue
Nausea
Vomiting
Chills
Fever
Muscle Aches

Symptoms


Symptoms of Malaria
Systemic
▸ High fever
▸ Back pain
▸ Profuse sweating
Central
▸ Headaches
Lungs
▸ Dry Cough
Spleen
▸ Enlargement
Muscular
▸ Fatigue
▸ Aches
Stomach
▸ Nausea
▸ Vomiting
▸ Abdominal pain
Skin
▸ Chills
▸ Sweating
Blood
▸ Bloody stools

Prevention

Vector control

- Preventing infection and reducing disease transmission.
- insecticide-treated nets (ITNs) and indoor residual spraying (IRS)

Preventive chemotherapies

- Antimalarial medicines

Vaccine

- Since October 2021, WHO also recommends broad use of the RTS,S/AS01 malaria vaccine among children living in regions with moderate to high P. falciparum malaria.

Thankyou