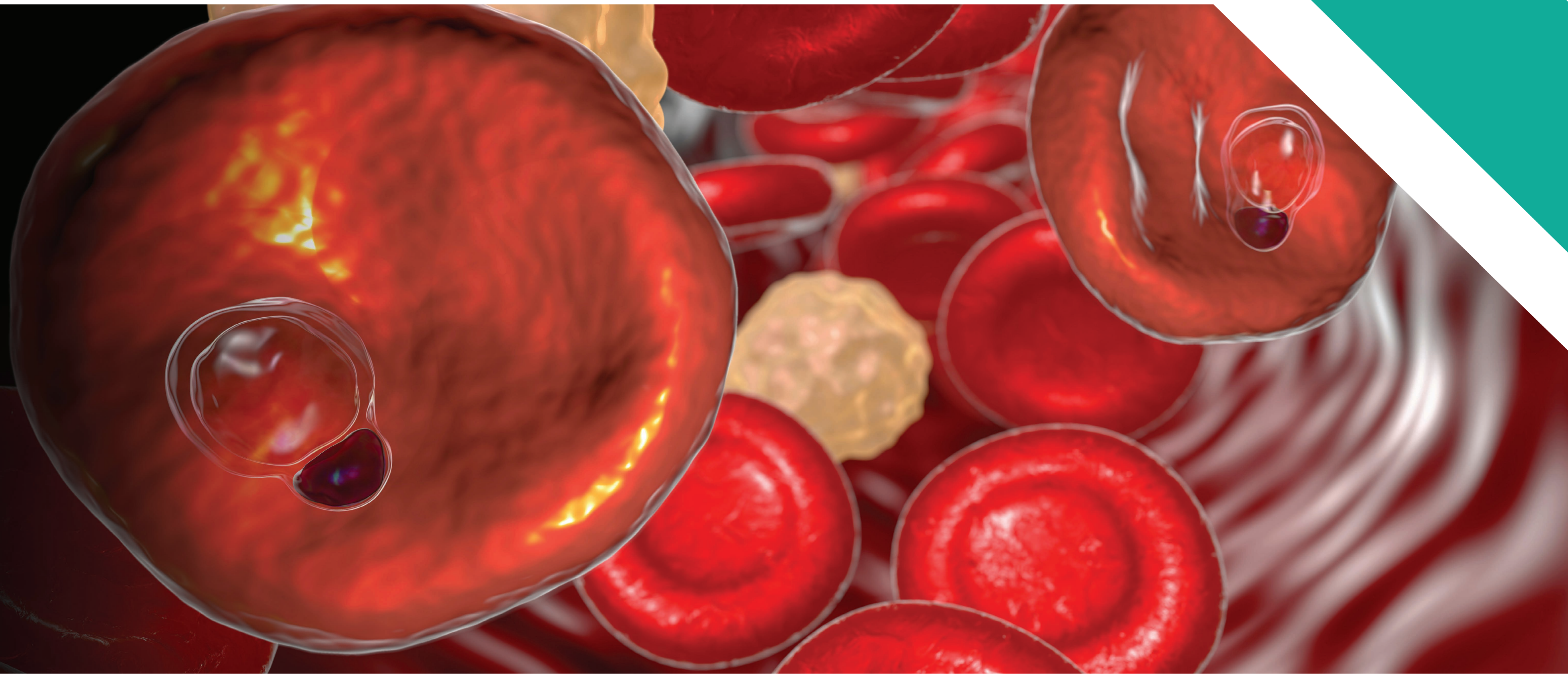


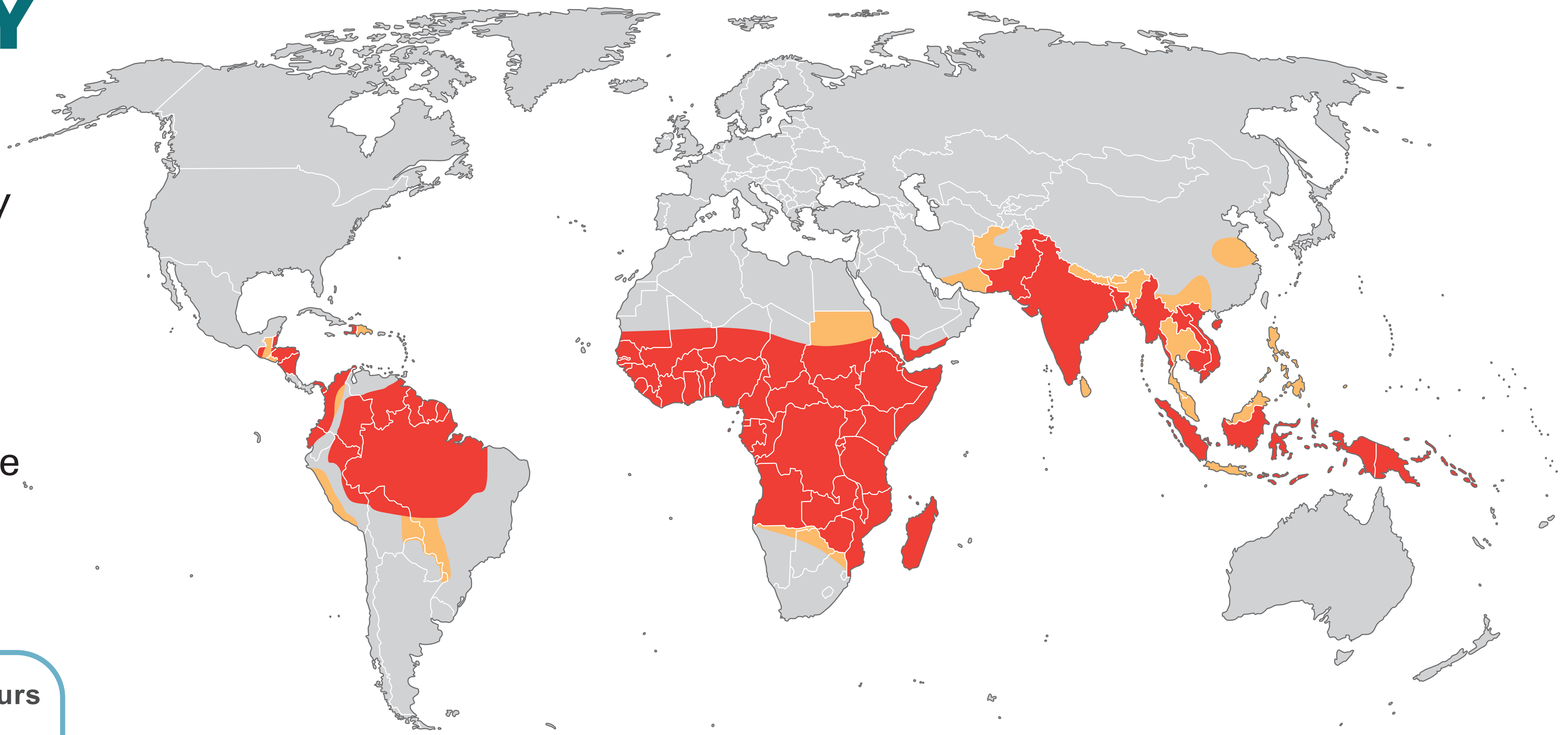
# WHERE IS MALARIA FOUND?



## GLOBALLY

The distribution of malaria depends mainly on climatic factors such as temperature, humidity, and rainfall.

Thus, in tropical and subtropical areas, where *Anopheles* mosquitoes can survive.



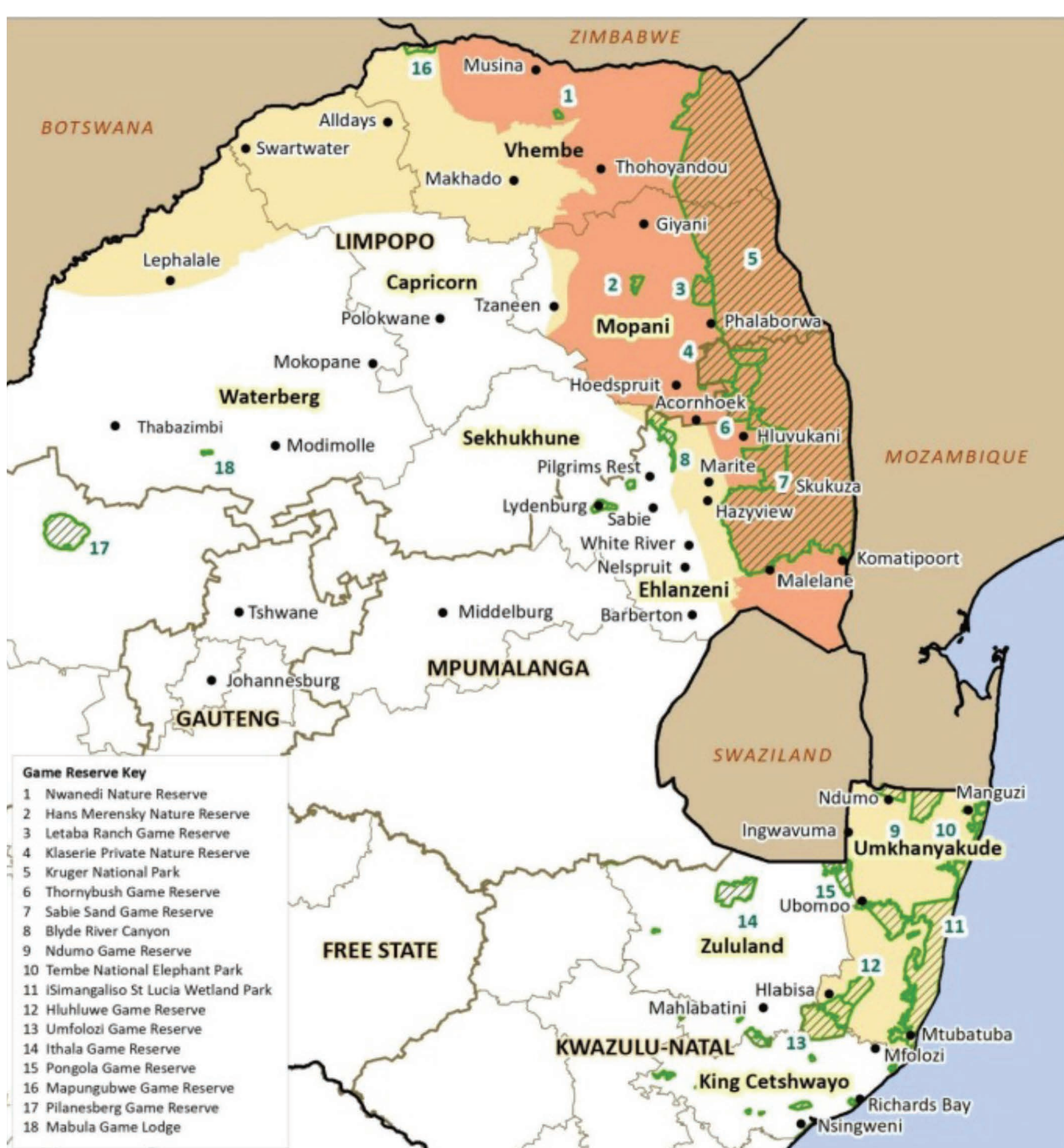
- malaria transmission occurs
- limited risk
- no malaria

This map shows of the parts of the world where malaria transmission occurs.

## LOCALLY

**IN SOUTH AFRICA, MALARIA IS MAINLY TRANSMITTED ALONG THE BORDER AREAS**

**10%** of the population in South Africa (approximately **4.9 million** persons) is at risk of contracting malaria. Some parts of **Limpopo, Mpumalanga and KwaZulu-Natal** are endemic for malaria.



**Low Risk**  
Only non-drug measures to prevent mosquito bites are recommended from September to May

**Moderate Risk**  
Antimalarial drugs are recommended from September to May for all travellers

**Malaria Risk does exist in neighbouring countries**  
For further information, please consult the WHO travel health guidelines.



**Malaria transmission in South Africa is seasonal**, with malaria cases starting to rise in October, peaking in January and February, and waning towards May.

# HOW DOES MALARIA SPREAD?

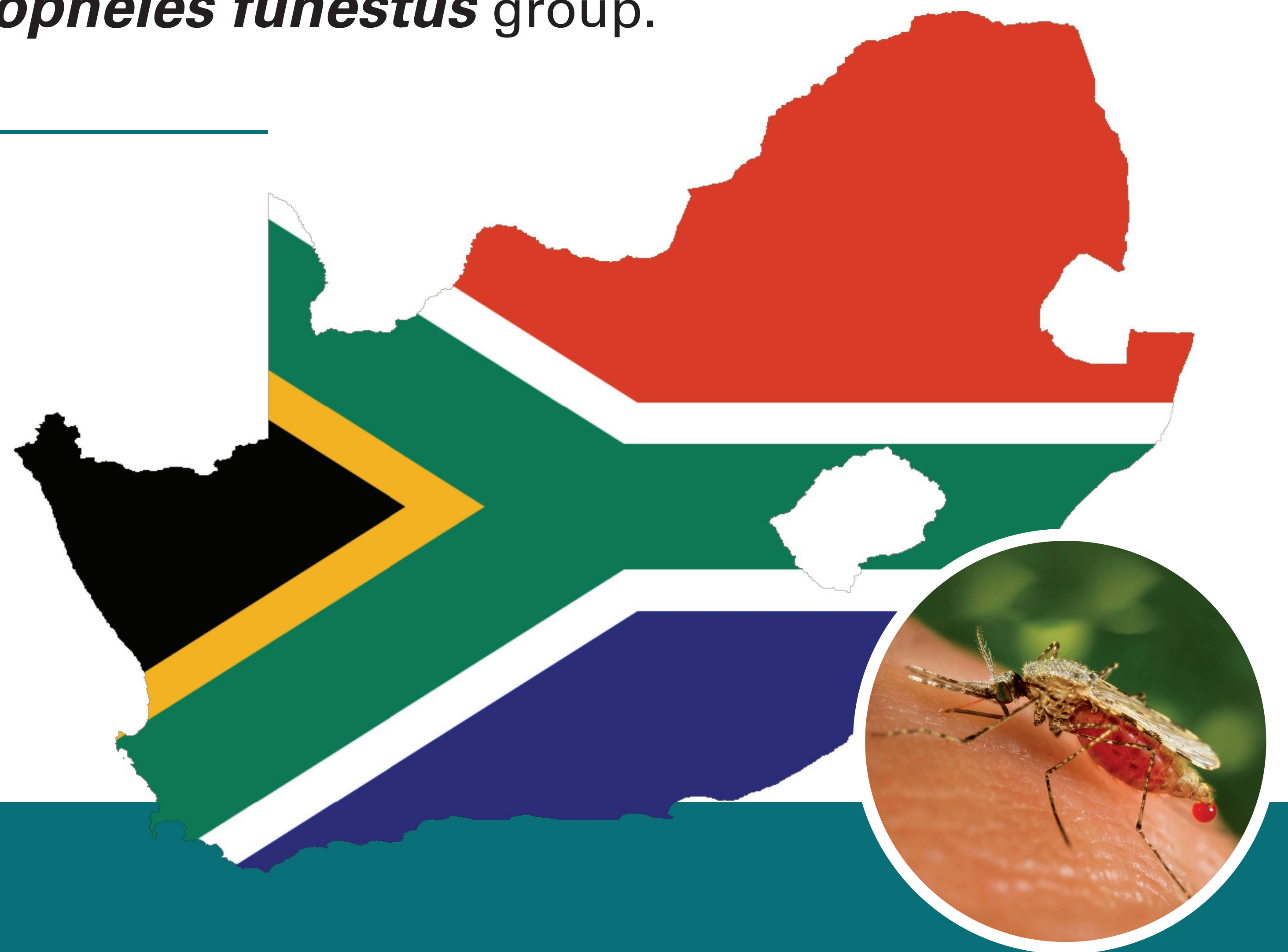
## MOST COMMONLY BY THE BITE OF AN INFECTED FEMALE *ANOPHELES* MOSQUITO

Only *Anopheles* mosquitoes can transmit malaria. However, not all *Anopheles* mosquitoes are malaria vectors, and not all vector species transmit malaria equally well.



The major vector species of African malaria are members of the *Anopheles gambiae* complex and *Anopheles funestus* group.

In South Africa, the major vector species is *Anopheles arabiensis*. Potential secondary vectors are *Anopheles merus*, *Anopheles parensis*, and *Anopheles vaneedeni*.



The above listed vector species are closely associated with human communities and show variable behaviours; biting and resting both indoors and outdoors, and feeding on both humans and animals.

## IN RARE CASES, MALARIA IS TRANSMITTED THROUGH:



01

blood  
transfusion



02

contaminated  
needles/syringes



03

organ  
transplant



04

from a mother to her unborn  
infant ("congenital" malaria)

# HOW IS THE MALARIA VECTOR CONTROLLED?



One of the most effective ways to reduce malaria incidence and transmission is to **reduce the population of its main vector**, the *Anopheles* mosquito (adult and larval stages).

1

## INDOOR RESIDUAL SPRAYING (IRS)



A spray technician applies residual insecticide inside a home from a rural village, Katima Mulilo, Namibia

- ✓ Many malaria vectors are considered “endophilic”; meaning the mosquito vectors rest inside houses after taking a blood meal.
- ✓ IRS involves coating the walls/ surfaces of a house with an insecticide.
- ✓ For several months, the insecticide will kill mosquitoes that come in contact with these surfaces.
- ✓ By killing mosquitoes after they have fed, transmission of infection to other persons is prevented.
- ✓ To be effective, IRS must be applied to a very high proportion of households in an area (usually >80%).

2

## INSECTICIDE-TREATED BED NETS (ITN)



The use of long lasting insecticide treated nets each night is one of the most effective ways to prevent malaria, Vanuatu

- ✓ Treated bed nets form a protective barrier from mosquitoes to the people sleeping under them.
- ✓ The insecticides used for treating bed nets repel and kill mosquitoes, reducing the number that enter the house and attempt to feed on people inside.
- ✓ When high community coverage is achieved ( $\geq 50\%$ ), the number and life span of mosquitoes is reduced. This protects members of the larger community, regardless of whether they are using a bed net.

# HOW IS THE MALARIA VECTOR CONTROLLED?



Malaria vector researchers investigate potential mosquito breeding sites for the presence of *Anopheles* larvae in Malahlapanga, Kruger National Park, South Africa

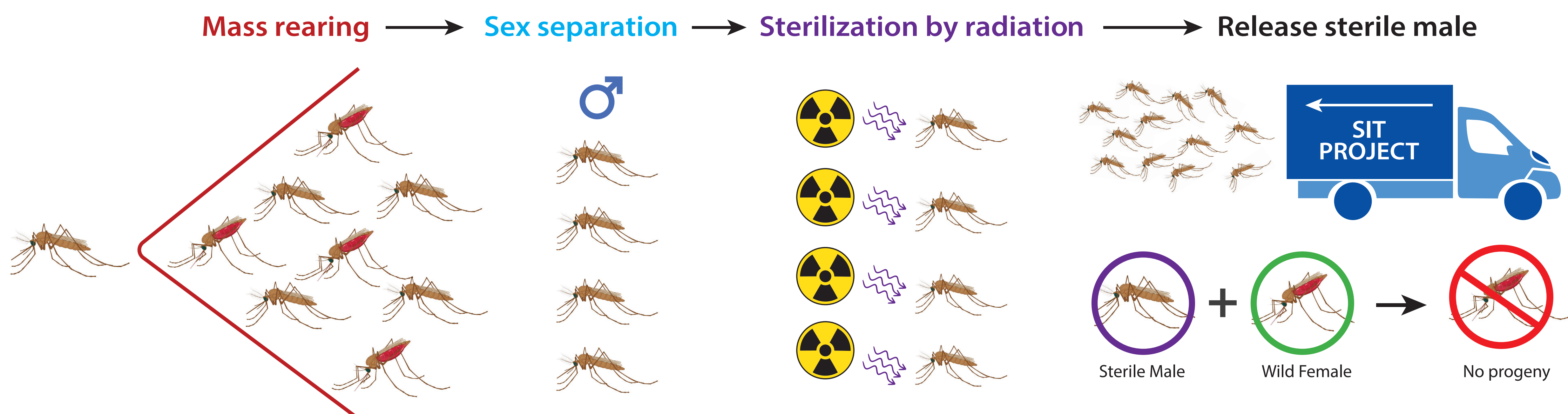
## 3 LARVAL SOURCE MANAGEMENT

- ✓ Mosquitoes breed in water so can be controlled through careful water management.
- ✓ Larval habitats may be destroyed by filling depressions that collect water, or draining swamps or marshy areas to remove standing water.
- ✓ For some mosquito species, habitat elimination is not possible. In this case, chemical insecticides can be applied directly to the larval habitats.

## NEW INNOVATIONS

### Sterile Male Release

Introducing sterile male mosquitoes into an area has been successfully applied in several small-scale areas. However, the need for large numbers of mosquitoes for release makes this approach impractical for most areas.



### Genetic Modification of Malaria Vectors

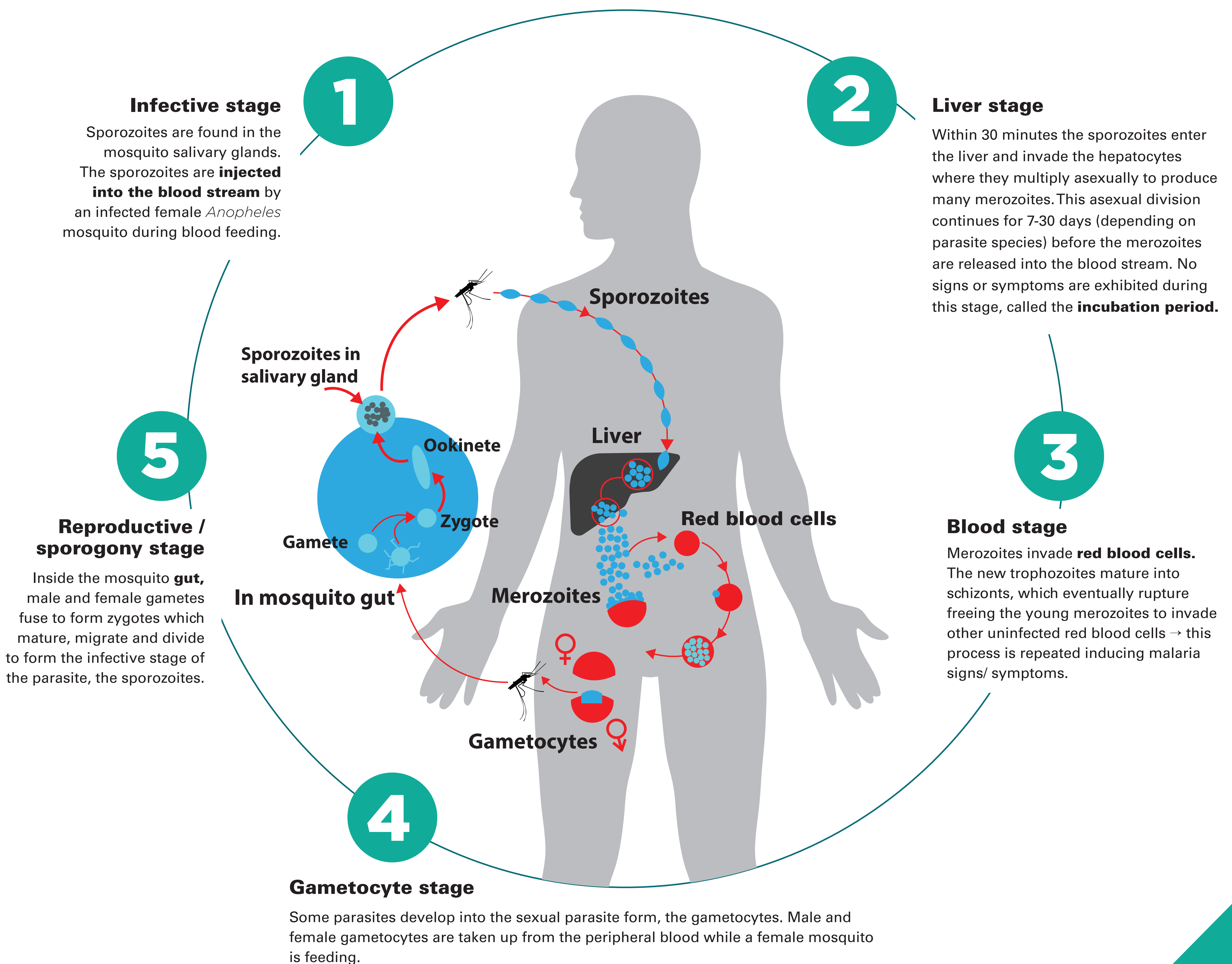
Genetic modification aims to develop mosquitoes that are not susceptible to the parasite. This approach is still years from application in field settings, though there have been remarkable technological advances in recent years.



# MALARIA LIFE CYCLE

Malaria is a disease CAUSED BY SINGLE-CELLED PARASITES that have a life cycle **REQUIRING 2 HOSTS** – a mosquito vector, and a vertebrate host

## 5 DISTINCT LIFE CYCLE STAGES



# WHICH MALARIA PARASITES INFECT HUMANS?



Parasites of five different ***Plasmodium species*** are responsible for human malarial infections:

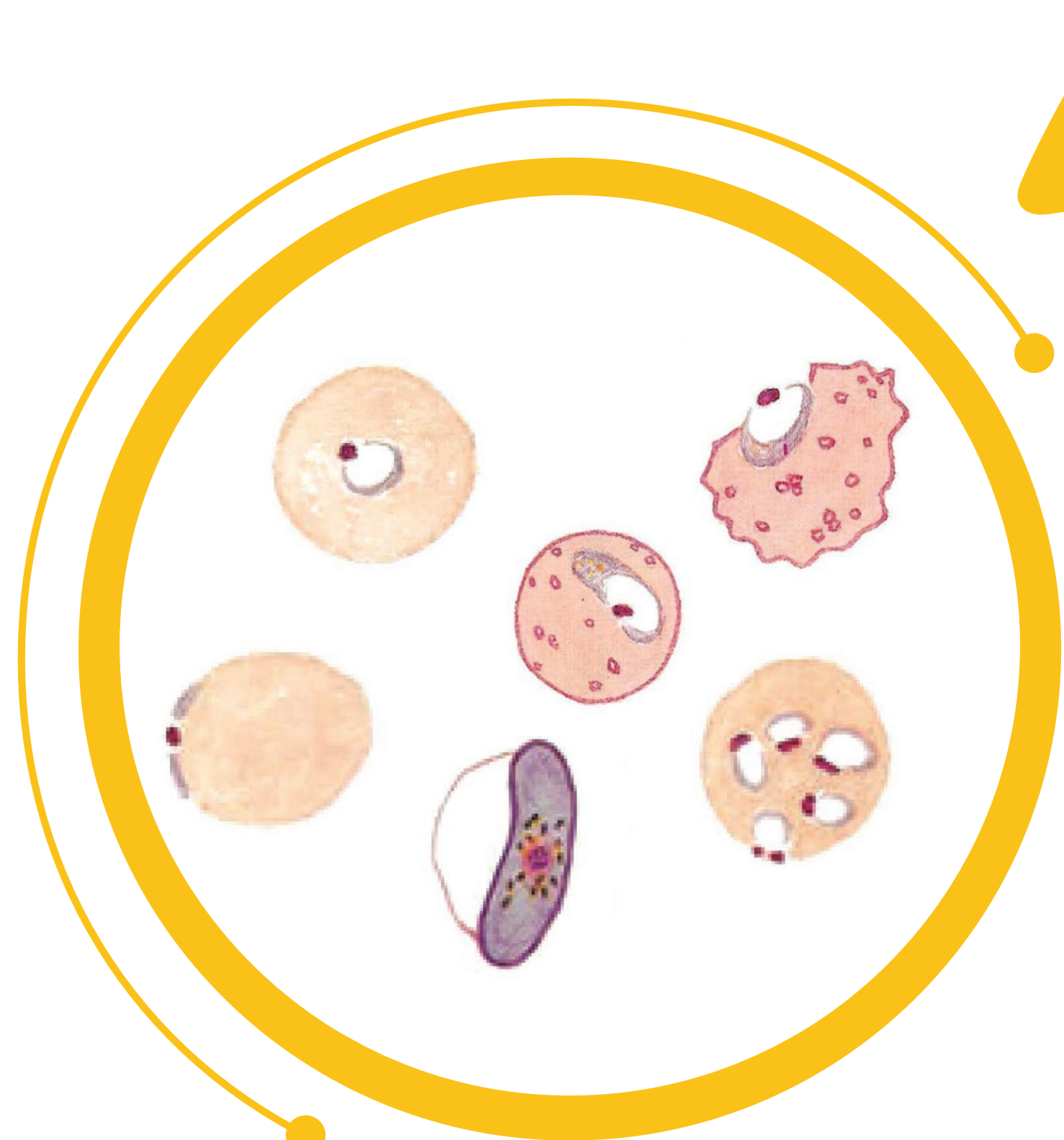
01 *P. falciparum*

02 *P. vivax*

03 *P. ovale*

04 *P. malariae*

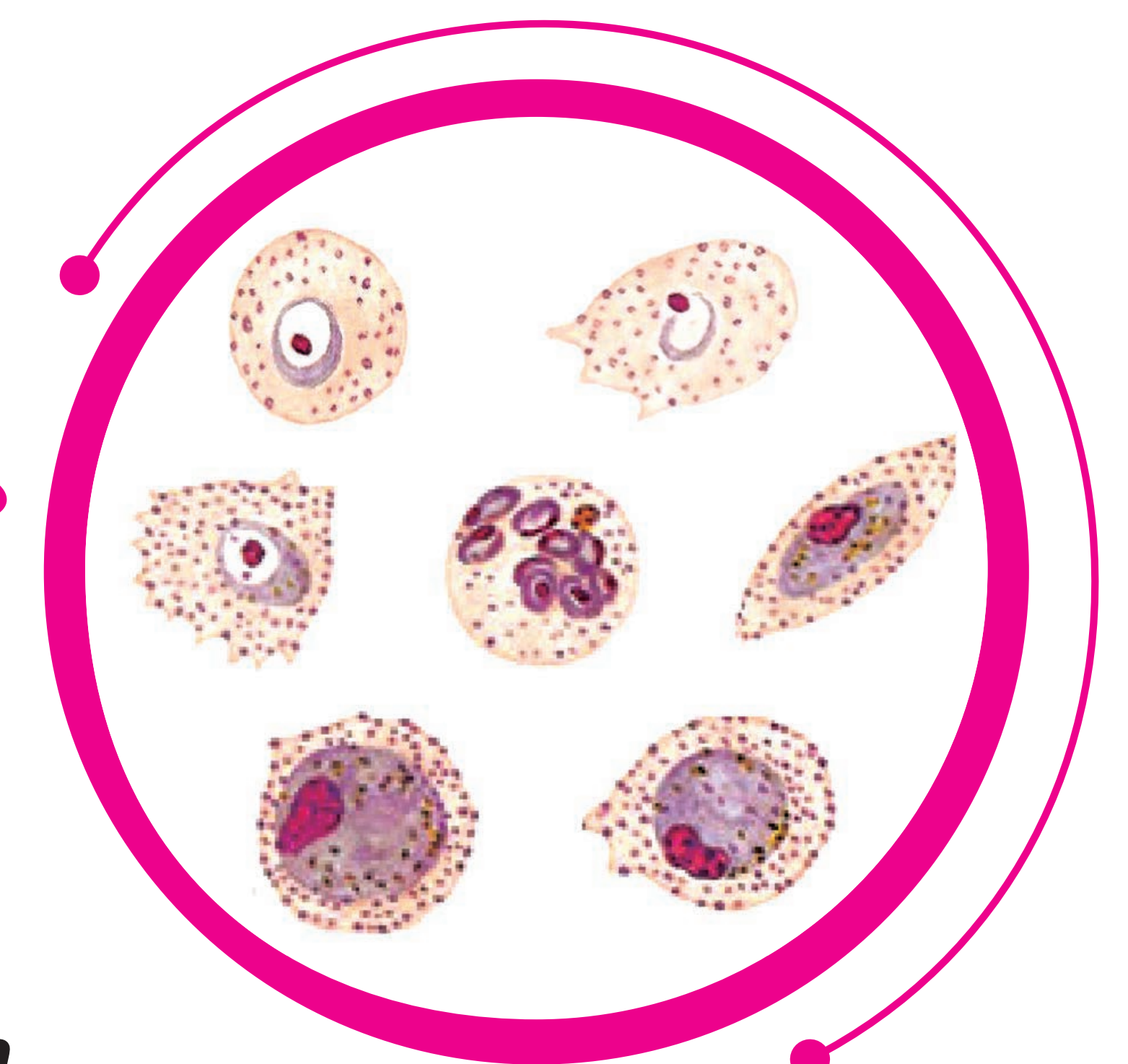
05 *P. knowlesi*



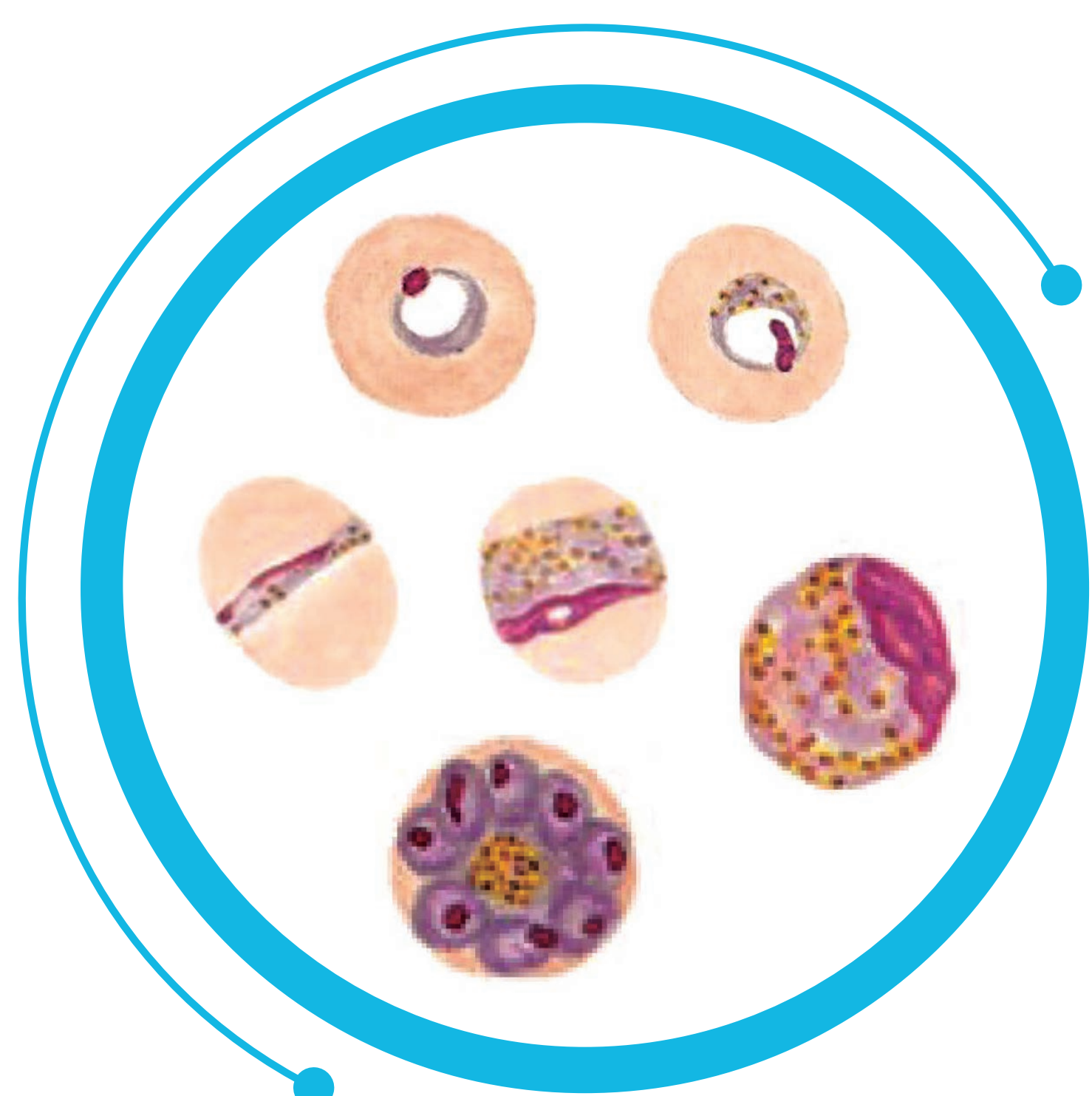
***Plasmodium falciparum***

The most virulent, ***Plasmodium falciparum***, is unfortunately also the most prevalent in Africa.

***Plasmodium vivax*** parasites have the widest geographic distribution of all the human malaria species and, together with ***Plasmodium ovale*** infections, are associated with relapsing (recurring) malaria.



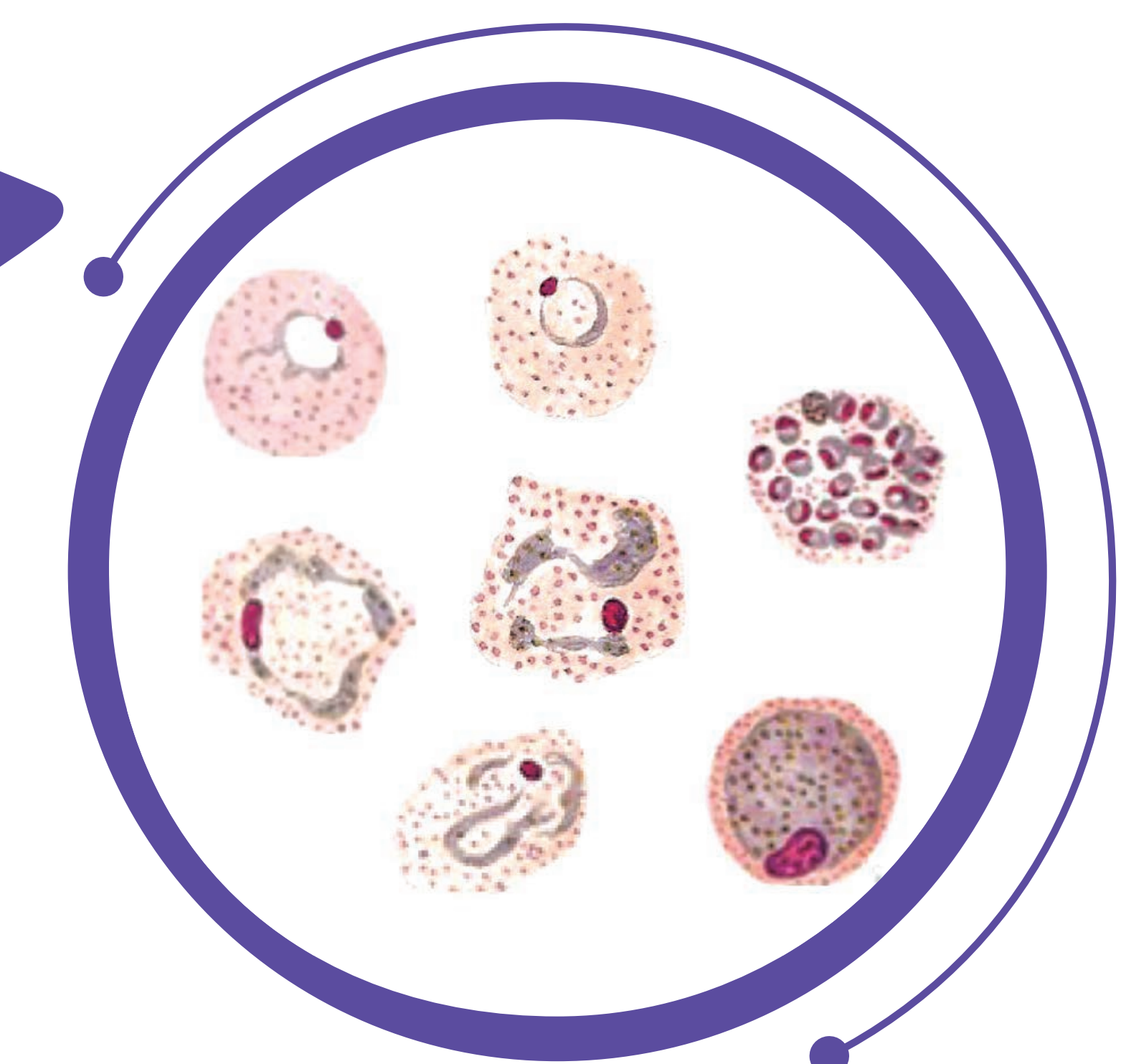
***Plasmodium vivax***



***Plasmodium malariae***

Under a microscope ***Plasmodium malariae*** and ***Plasmodium knowlesi*** look very similar. However the disease is usually milder in ***Plasmodium malariae***.

In 2010 ***Plasmodium knowlesi***, a monkey malaria parasite, was recognised as the fifth human malaria parasite species following the discovery in Malaysians. It is still only reported in Southeast Asia.



***Plasmodium ovale***

**Microscopic identification** is the gold standard method for **identifying the species of malaria present on stained blood films**. Well-trained microscopists are able to differentiate species based on their morphological characteristics.

# MALARIA PARASITE COUNTS

The most virulent malaria parasite, *Plasmodium falciparum* is unfortunately also the most prevalent in Africa.

This parasite species multiplies rapidly, invading and destroying red blood cells, causing severe anaemia.

If left **untreated** the infection generally **progresses to severe malaria**, which often is fatal as it is associated with central nervous system shutdown and major organ failure.



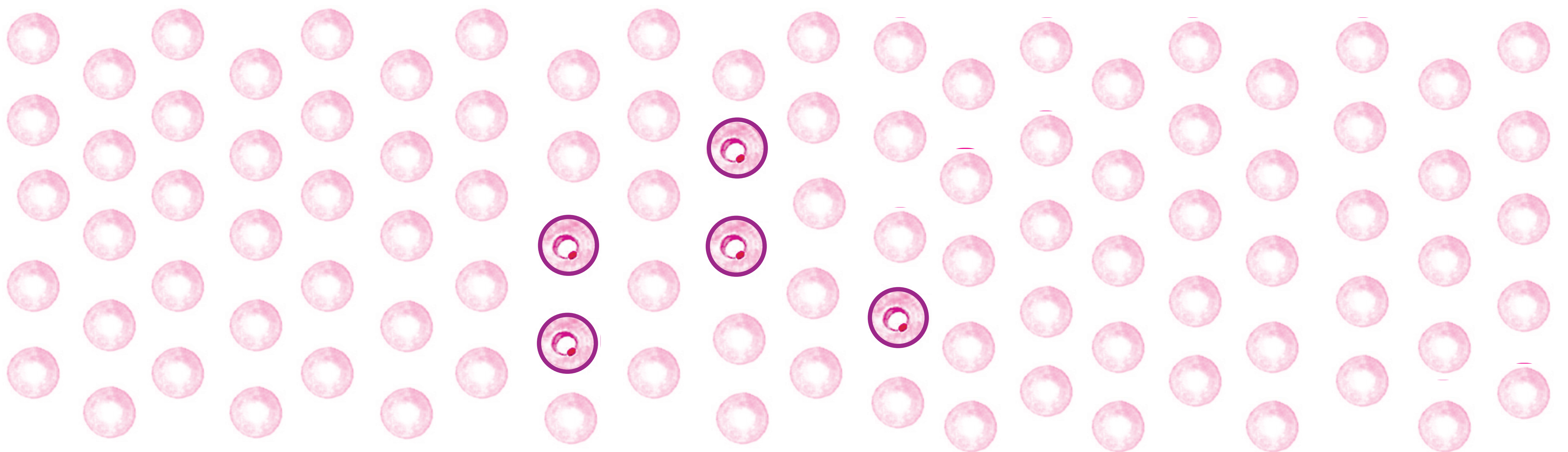
It is important to **DETERMINE THE PARASITE LOAD** with *Plasmodium falciparum* infections to:

1. Determine severity of infection and
2. to monitor treatment efficacy.

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PARASITE LOAD MAY BE EXPRESSED AS A PERCENTAGE OF INFECTED RED BLOOD CELLS OR PARASITES PER MICROLITRE OF BLOOD.

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Approximately **≥5% infection is considered severe malaria**, this is about **250,000 parasites** per microliter of blood.

# WHAT ARE THE SIGNS & SYMPTOMS OF MALARIA?

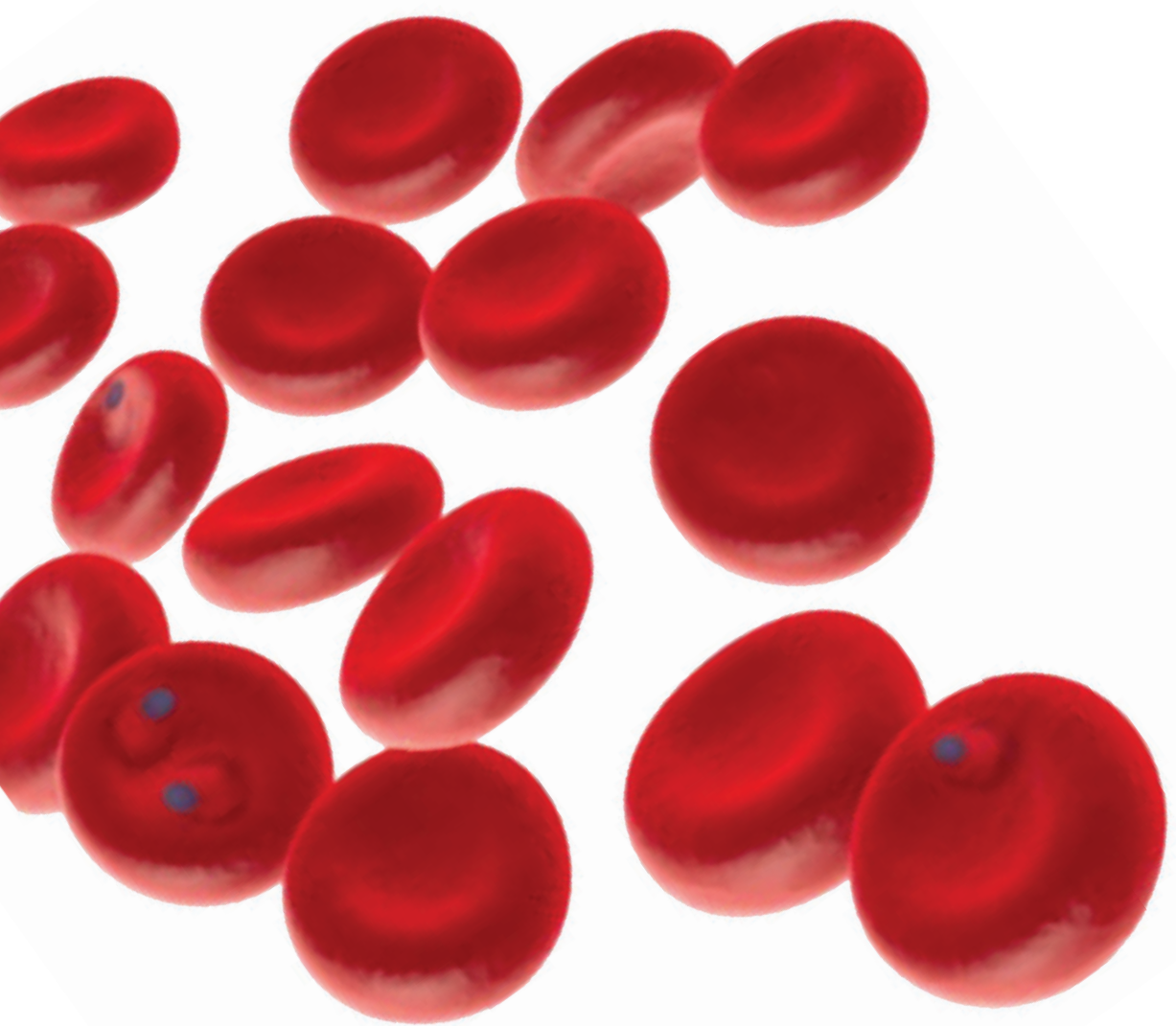


Signs and symptoms of malaria are initially **NON-SPECIFIC**.

It is **recommended that anyone with a 'flu-like illness be tested** for malaria after visiting a malaria risk area (irrespective of malaria season, transmission intensity or chemoprophylaxis use).

**SEVERE MALARIA** is a medical emergency.

Without treatment, the clinical picture may deteriorate rapidly. **Severe malaria carries a 10-40% case fatality rate in spite of treatment.**



## MALARIA SYMPTOMS

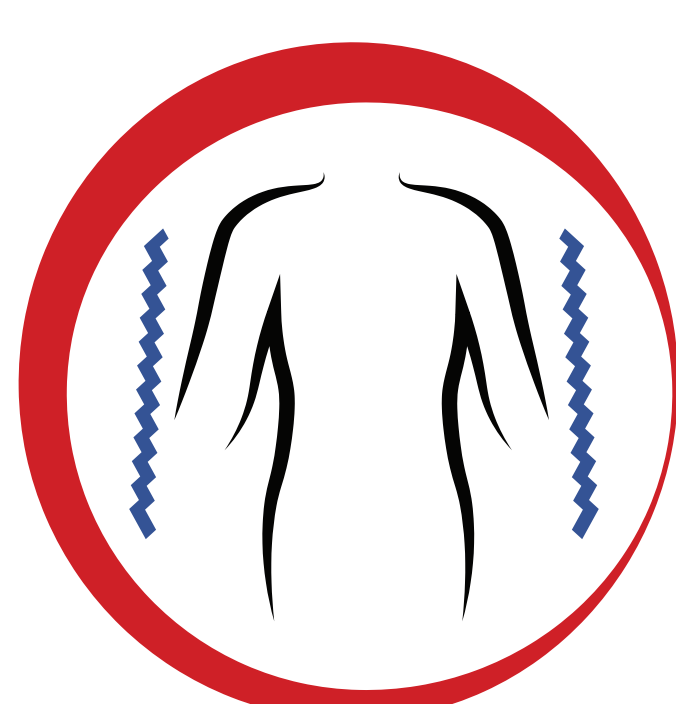
### UNCOMPLICATED



Fever (>37.5 °C)



Headaches



Rigors  
(cold shivers/hot  
sweats)



Joint/muscle  
pains



Diarrhoea,  
nausea and  
vomiting



Loss of appetite;  
inability to feed in  
babies



Dizziness,  
sore throat



Muscle weakness  
and lethargy,  
particularly in  
young children

### SEVERE (COMPLICATED) MALARIA

1. Impaired consciousness
2. Inability to sit or stand up straight
3. Multiple convulsions
4. Respiratory distress
5. Circulatory collapse
6. Jaundice
7. Pulmonary oedema
8. Haemoglobinuria
9. Acute respiratory distress syndrome (ARDS)



# HOW DO I PREVENT AND TREAT MALARIA?



## PREVENTION



Try to minimise mosquito bites, by using insect repellents, bed nets, wearing long sleeved clothes & socks after sunset.



Antimalarial medicines (chemoprophylaxis) can also be used.

Consult a health-care provider as guidelines should be followed.

## TREATMENT

### CONFIRM DIAGNOSIS AND ASSESS SEVERITY

#### Uncomplicated malaria

Mild symptoms  
Ambulant  
Normal mental function  
No repeated vomiting  
No jaundice, and no other features of severe malaria

#### Uncomplicated malaria caused by:

- *P. falciparum*, *P. malariae* or *P. knowlesi*  
artemether-lumefantrine (Coartem®) or, if Coartem® is not available, oral quinine plus either doxycycline or clindamycin
- *P. ovale* or *P. vivax* or mixed infections of *P. falciparum* plus *P. vivax* or *P. ovale*: artemether-lumefantrine followed by primaquine
- If unsure of species, treat as for *P. falciparum*

#### Severe malaria

Impaired consciousness  
Jaundice  
Multiple convulsions  
Respiratory distress  
Circulatory collapse

#### Severe malaria (usually *P. falciparum*)

IV artesunate or, if not available, IV quinine.  
Once able to tolerate oral treatment follow with:  
artemether-lumefantrine (Coartem®) or, if Coartem® is not available, quinine (plus doxycycline or clindamycin)



# IS THERE A VACCINE FOR MALARIA?



**YES, there  
is one  
vaccine**

The **RTS,S vaccine** has been approved for use; and there are many others being developed.

## 2019-2020

### RTS,S MALARIA VACCINE EVALUATION PILOTS AND MAIN RESULTS



Significantly reduces malaria and life-threatening severe malaria (by about 30%). Since 2019, delivered in childhood vaccination in three country-led pilots.

IN 2+ YEARS

**2.4 million+** DOSES

**830K+** CHILDREN  
VACCINATED

Estimated to be cost-effective  
in areas of moderate to high  
malaria transmission

**30 years**

of research and  
development

The RTS,S vaccine  
can be delivered  
through the existing  
platform for childhood  
vaccination that  
reaches more than  
80% of children.

## 2021

On 6 October 2021, WHO recommended that the **RTS,S malaria vaccine** be used for the prevention of *P. falciparum* malaria in children living in **regions with moderate to high transmission**.

**SOUTH AFRICA DOES NOT FALL IN THIS CATEGORY.**

# HOW IS MALARIA DIAGNOSED IN THE LAB?



**MICROSCOPY** of Giemsa-stained blood films and **RAPID DIAGNOSTIC TESTS (RDTs)** are the routinely used methods to diagnose malaria in the laboratory.



## MICROSCOPY

### ADVANTAGES

- Quick diagnosis
- Very inexpensive
- Parasites can be quantified

### DISADVANTAGES

- Less sensitive
- Subjective
- Expert microscopist needed



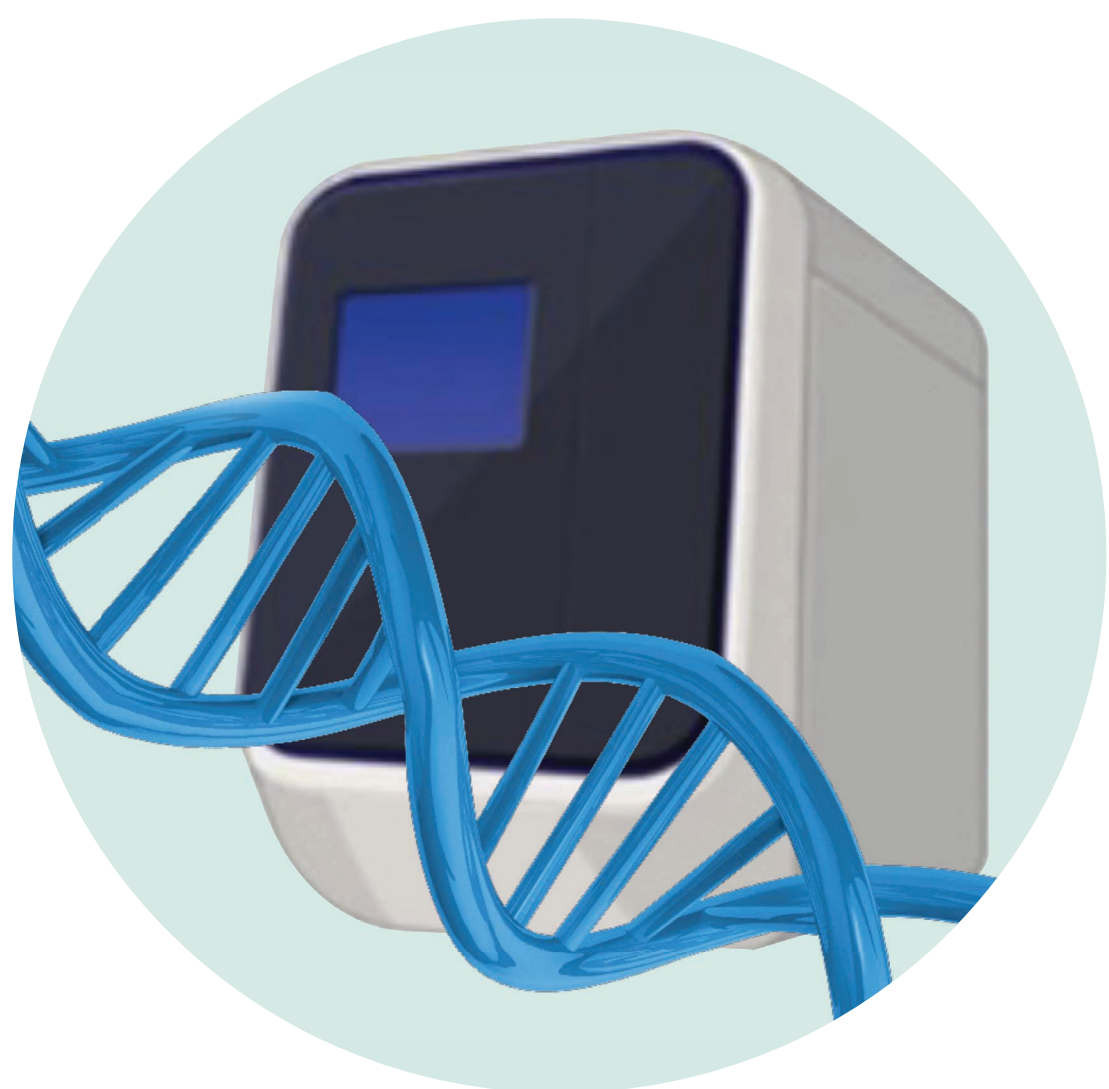
## RAPID DIAGNOSTIC TEST (RDT)

### ADVANTAGES

- Very quick diagnosis
- Inexpensive
- Suitable for use in the field
- No special equipment needed

### DISADVANTAGES

- Less sensitive
- Cannot identify all species
- Parasites cannot be quantified



Malaria PCR should be requested in certain instances such as when microscopy and RDT results do not correlate, microscopy and RDT are negative but malaria is still suspected or confirmation of species identification is needed.

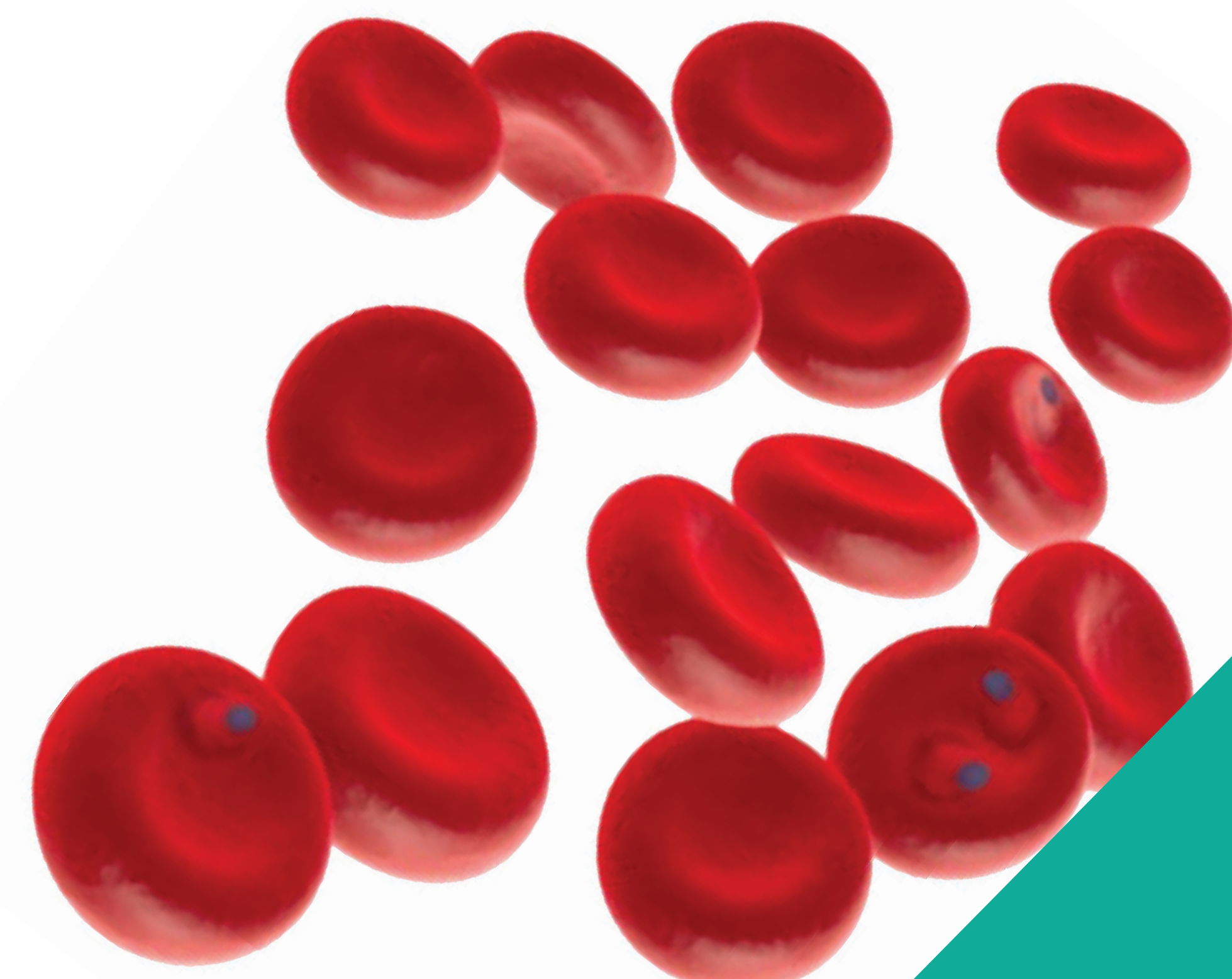
## POLYMERASE CHAIN REACTION (PCR)

### ADVANTAGES

- Highly sensitive
- More specific (species identification)

### DISADVANTAGES

- Expensive
- Time consuming



# MALARIA LIFE CYCLE

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## 5 DISTINCT LIFE CYCLE STAGES

