Malaria

- **Objectives:**

1- Understand the epidemiology and global burden of malaria
2- Understand the cycle of infection of malaria
3- Define modes of transmission, clinical features, risk factors, community diagnosis and treatment for malaria
(Outline how to take history of Malaria patient, and how to give preventive advise) OSCE
4- Enlist the factors responsible for antimalarial drug resistance
5- Understand the role and measures taken by WHO to combat the burden of Malaria globally
6- Enlist the global measures of prevention and elimination for Malaria
7- Understand the epidemiology and risk factors related to Malaria in KSA

- **Resources :**
Slides.
Doctor's notes.

[Colors index : Important | Notes | Slides | Extra | Dr notes]

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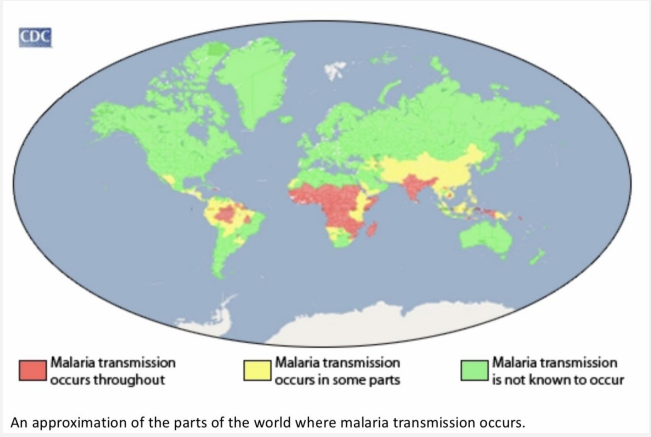
Malaria

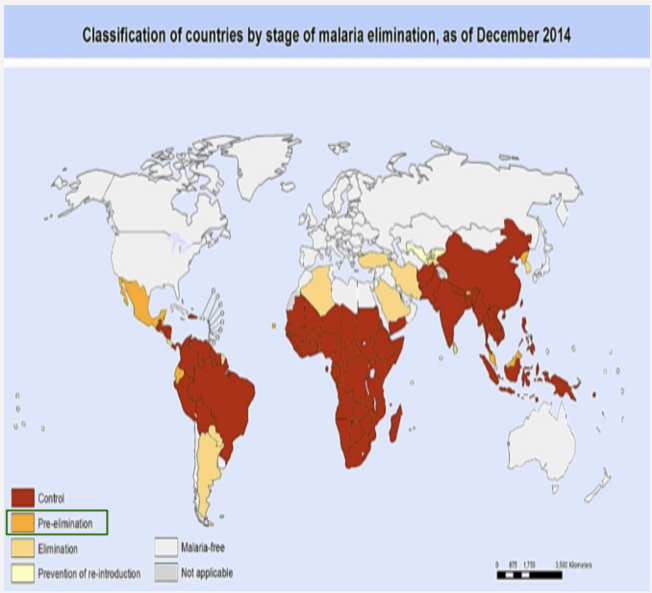
- Malaria is a life-threatening disease caused by Plasmodium parasites that are transmitted to people through the bites of infected mosquitoes.
- Malaria is responsible for approximately 1-3 million deaths per year. Fatal if not treated

Epidemiology:

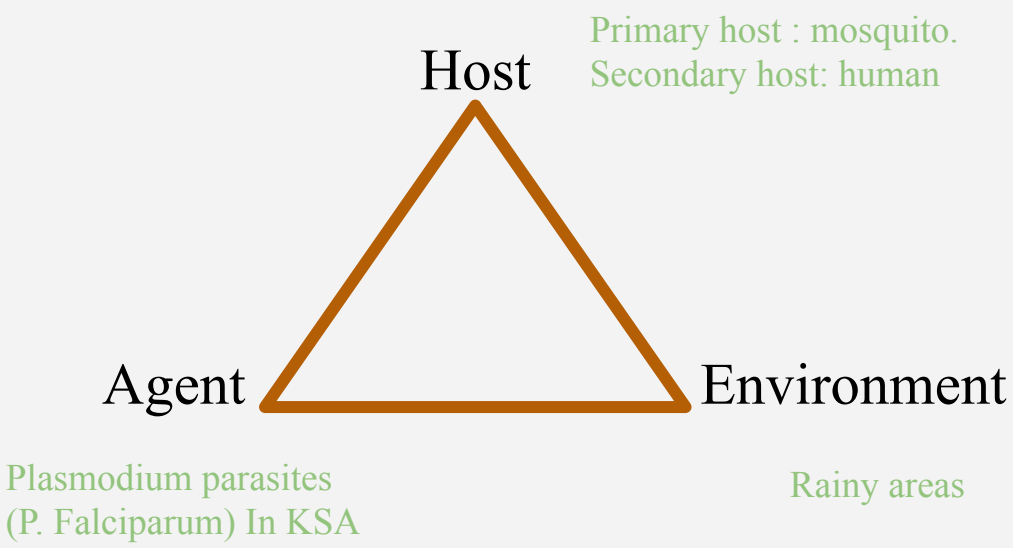
- In 2016, there were 216 million cases and 445,000 deaths caused by malaria worldwide.
- Between 2000 and 2015, malaria incidence fell by 37% globally.
- During the same period, malaria mortality rates decreased worldwide by 60% among all age groups, and by 65% among children under 5.
- In 2014, 13 countries reported zero cases of the disease and 6 countries reported fewer than 10 cases.



An approximation of the parts of the world where malaria transmission occurs.



Analytical Epidemiology Triad:



Primary host : mosquito.
Secondary host: human

Plasmodium parasites
(P. Falciparum) In KSA

Rainy areas

Malaria

Malaria in Saudi Arabia:

- Areas at the southern region are at risk of malaria transmission, specifically Asir and Jizan. The dominant Malaria parasite in Saudi Arabia is P. Falciparum.
- Saudi Arabia achieved a decrease in malaria cases and case incidence rates of ≥65%.
- Malaria outbreak in 1998, Since then, only a few cases were reported.
- In 2012 , only 82 cases of malaria were reported.
- The proportion of imported malaria has increased from 23% to 99% of total detected cases.

Imported malaria in Saudi Arabia 1999-2010 :

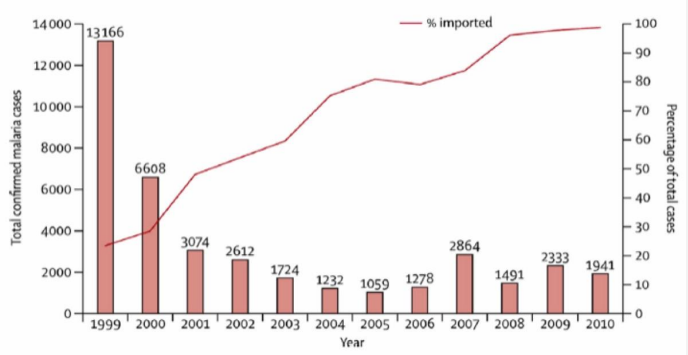
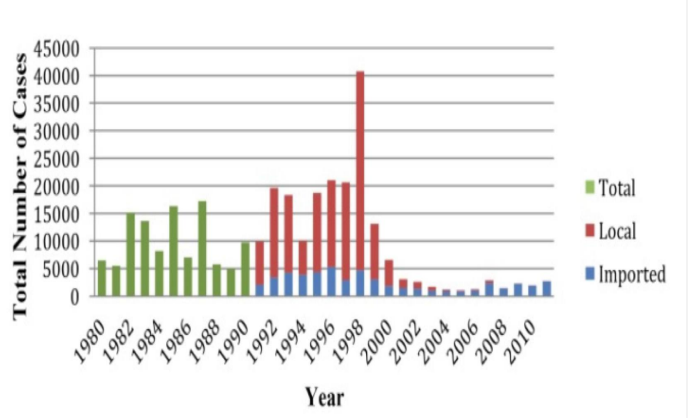


Fig. 1. Indigenous and imported malaria in Saudi Arabia, 1999–2010 (Cotter et al., 2013).

Indigenous cases of malaria Saudi Arabia 2014 :



I. Epidemiological profile

Population (UN Population Division)	2017	%
Number of active foci	64	-
Number of people living within active foci	173.3K	1
Malaria free (0 cases)	32.8M	99
Total	32.8M	

Parasites and vectors	
Major plasmodium species:	Pfalciparum: 97 (%) , Pvivax: 2 (%)
Major anopheles species:	*An. arabiensis, An. sergentii, An. stephensi, An. fluviatilis, An. multicolor*

Reported cases and deaths	
Reported indigenous confirmed cases (health facility):	177
Confirmed cases at community level:	-
Confirmed cases from private sector:	-
Indigenous deaths:	0

Saudi Arabia-World Health Organization

Information for you to know how is the distribution in malaria

Imported malaria:

via asymptomatic travelers from malaria endemic areas, sustains a threat for possible resurgence of local transmission:

Workers	Immigrants	Pilgrims

Plasmodium Parasites

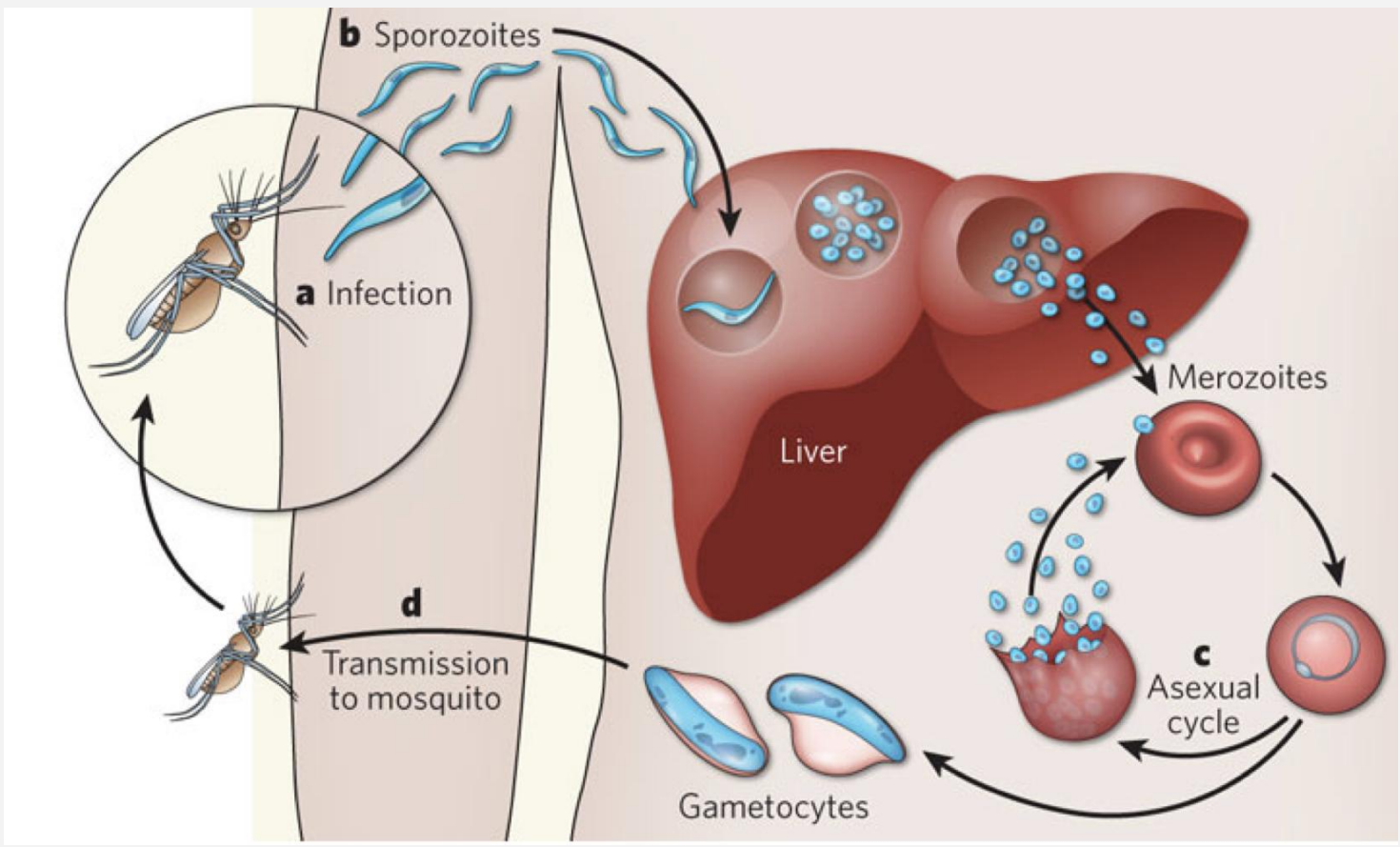
- Five species cause malaria in humans:
  - Plasmodium falciparum
  - P. vivax
  - P. ovale
  - P. malariae
  - P. knowlesi

- P. **falciparum** and P. **vivax** pose the greatest threat.

- **Transmitted** through the bites of infected female Anopheles mosquitoes (vector).

- Other modes of transmission:
  - From mother to unborn child
  - Blood transfusion It is in the blood

Plasmodium Parasites transmission and lifecycle:



The malaria parasite life cycle involves two hosts. During a blood meal, 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 . (Of note, in P. vivax and P. ovale a dormant stage [hypnozoites] can persist in the liver (if untreated) and cause relapses by invading the bloodstream weeks, or even years later.) After this initial replication in the liver (exo-erythrocytic schizogony), the parasites undergo asexual multiplication in the erythrocytes (erythrocytic schizogony). Merozoites infect red blood cells . The ring stage trophozoites mature into schizonts, which rupture releasing merozoites . Some parasites differentiate into sexual erythrocytic stages (gametocytes) . Blood stage parasites are responsible for the clinical manifestations of the disease. The gametocytes, male (microgametocytes) and female (macrogametocytes), are ingested by an Anopheles mosquito during a blood meal . The parasites' multiplication in the mosquito is known as the sporogonic cycle . While in the mosquito's stomach, the microgametes penetrate the macrogametes generating zygotes . The zygotes in turn become motile and elongated (ookinetes) which invade the midgut wall of the mosquito where they develop into oocysts . The oocysts grow, rupture, and release sporozoites, which make their way to the mosquito's salivary glands. Inoculation of the sporozoites into a new human host perpetuates the malaria life cycle.

Clinical features

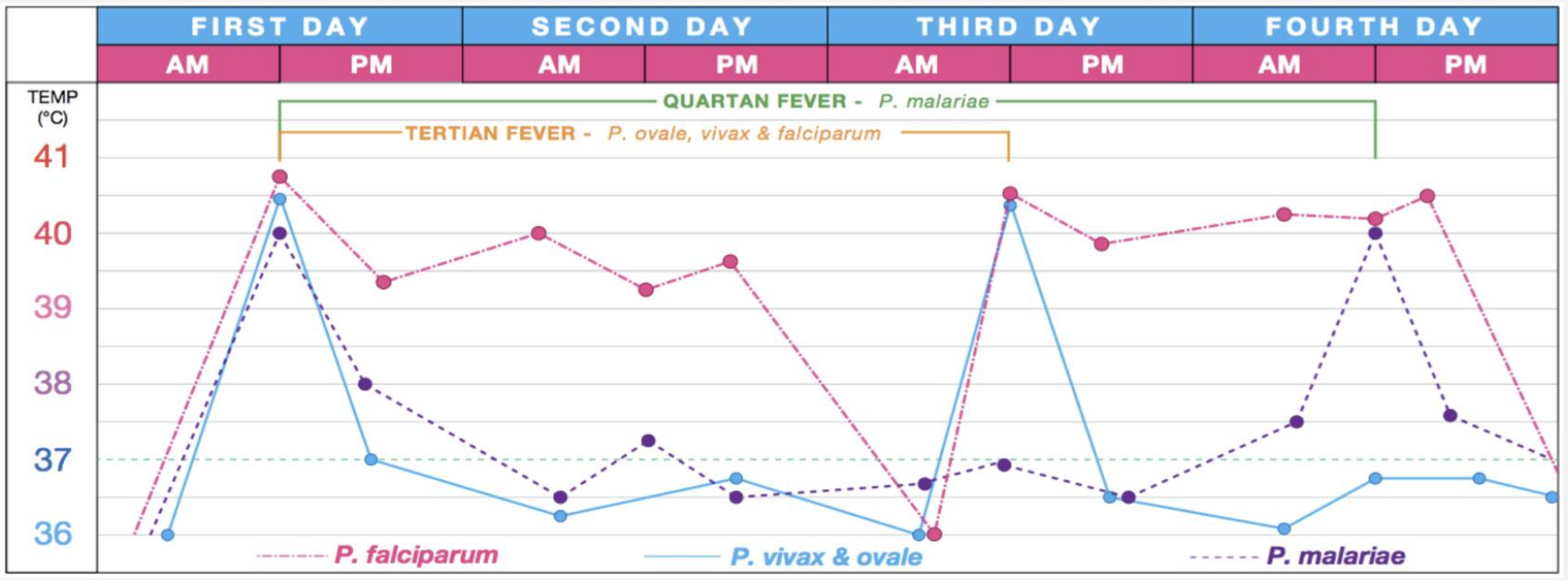
Symptoms

- Early Symptoms
  - Fever
  - Headache
  - Chills

If not treated early might progress to

- Severe illness
  - Severe anemia
  - Respiratory distress
  - Cerebral malaria
  - Multiorgan failure

Paroxysmal fever It has a pattern



- Cold stage : lassitude, headache, nausea, chills. (¼ -1 h) skin cold then hot
- Hot stage: skin hot and dry (2 -6 h)
- Sweating stage: fever subsides, sweating (2 -4 h)

In OSCE ask about:
1- History of Mosquito bites
2- Symptoms
3- Fever (describe)
Senario: he traveled to jazan to meet his family

Risk Factors

- **No or little immunity against the disease** in areas with high transmission
- **Young children,** who have not yet developed partial immunity to malaria
- **Pregnant women,** whose immunity is decreased by pregnancy.
- **Travelers or migrants** coming from areas with little or no malaria transmission, who lack immunity.
- People with low immunity such as HIV patients
- Poverty
- Environmental: rain seasons

Malaria

History of Malaria patient and preventive advise

OSCE

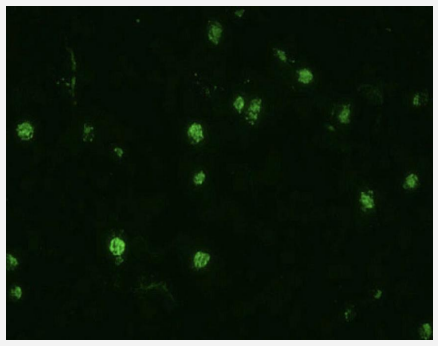
- Proper History (name , occupation …)
- Risk factors
- Clinical features (headach , fever , chills)
- Fever characteristics
- Treatment
- Prophylaxis
- Control No vaccine

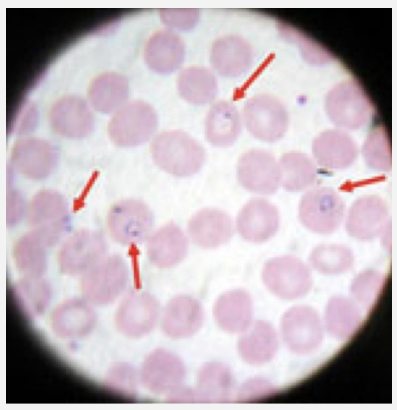
Immunity against malaria (protection)

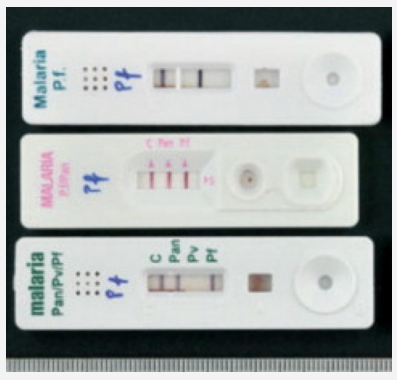
Genetic Factors	Biologic characteristics present from birth can protect against certain types of malaria: (having the sickle cell trait)
Acquired Immunity	Newborns in endemic areas will be protected during the first few months by maternal antibodies.
Repeated attacks of malaria	

Diagnosis

- **Microscopy:** thin film, thick film.
- **Serology:** two weeks after infection.
- **Rapid diagnostic test (RDT)**







Malaria

Community diagnosis

For you to know

- Pre-eradication: spleen rate, parasite rate,…..
- Eradication: microscopic diagnosis
  - Parasite incidence
  - Blood examination rate
- Vector indices
  - Human blood index (proportion of blood meals)
  - Sporozite rate (Oocyst Rates obtained using DNA extracted either from heads thoraxes or abdomens of females)
  - Mosquito density
  - Man biting rate ((of Anopheles species in seasons)
  - Inoculation rate (is a measure of exposure to infectious mosquitoes)

Treatment

Choice of treatment line depends on:

- Type of plasmodium species and stages of malaria parasites.
- Clinical status of patient: Uncomplicated or Severe, or pregnancy.
- Drug sensitivity of the infected parasite (area)
- Previous exposure to anti-malarial drugs.

Artemisinin combination therapy (ACT): (3days)

They will ask about treatment in OSCE

Monotherapy is not recommended for malaria treatment to prevent drug resistance.
For uncomplicated malaria:

- First line: (ARTESUNATE + SP); alternative (ARTESUNATE + MEFLOQUINE)
- Second Line: (ARTEMETHER + LUMEFANTRINE)
- Third Line : (oral QUININE + DOXYCYCLINE)

A single dose of Primaquine is added to the first day as a gametocidal medication.

Primaquine is contraindicated in:

G6PG deficiency	Children <6m	Pregnancy	Hypersensitivity
	lactating mothers for babies <6m		

Malaria

Treatment failure

- Failure to resolve or recurrence of fever or parasitemia:

Early	1-3 days of treatment
Late	4 days - 6 weeks after treatment

- Causes:
  - Low or incomplete doses
  - Poor adherence to treatment
  - Abnormal individual pharmacokinetics
  - Drug resistance

Antimalarial drug resistance

The ability of the parasite to survive and/or multiply despite the administration and absorption of medication.

Reason: Exposure of the parasite to insufficient amount of the drug.

- Low dose prescribed
- Lesser amount dispensed
- Incomplete treatment
- Vomiting
- Low absorption

Malaria Control

WHO efforts in malaria control

Global technical Strategy for Malaria 2016–2030

1. Ensure universal access to malaria prevention, diagnosis and treatment.
2. Accelerate efforts towards elimination and attainment of malaria- free status.
3. Transform malaria surveillance into a core intervention.

The main way to reduce malaria transmission at a community is **vector control**, by:

Decrease human-mosquito contact	Destruction of adult mosquitoes	Destruction of larvae	OSCE
Environmental control	Chemoprophylaxis	Vaccination	

Decrease human-mosquito contact	• Insecticide-treated mosquito nets (ITNs) • For all at-risk persons • Provision of free LLINs • Everyone sleeps under a LLIN every night. • Insect repellant to skin and clothing
Destruction of adult mosquitoes	• Indoor spraying with residual insecticides • At least 80% of houses in targeted areas are sprayed • Protection depends on type of insecticide.
Destruction of mosquito larvae	Larviciding of water surfaces, intermittent irrigation, biological control
Source reduction	• Environmental sanitation • water management • drainage
Social participation	• Health education • community participation
Chemoprophylaxis	• To travelers • Pregnant women • Infants in endemic areas • Seasonal chemoprevention
Vaccination	Still under trial

We can't give pregnant women treatment , but chemoprophylaxis allowed

Malaria and Saudi Arabia

Risk factors in Saudi Arabia

- Heavy rainfall season
- Army personnel and employees working at the Southern borders
- Travelers to countries with active malaria transmission
- Pilgrimage from regions with active malaria transmission

Prevention and control of malaria in KSA

The current elimination strategy in Saudi Arabia focuses mainly on:

1. Targeting high risk areas for sustained preventative measures such as (Long lasting insecticide treated nets, Indoor residual spraying)
2. Management of infection through rapid confirmed diagnosis and treatment.
3. Individual case follow up and reactive surveillance with appropriate treatment and vector control.
4. Active case detection at borders with screening and treatment.

Read it

II. Intervention policies and strategies

Intervention	Policies/Strategies	Yes/ No	Year adopted
ITN	ITNs/LLINs distributed free of charge	Yes	1980
	ITNs/LLINs distributed to all age groups	Yes	1980
IRS	IRS is recommended	Yes	1963
	DDT is used for IRS	No	-
Larval control	Use of Larval Control	Yes	2004
IPT	IPT used to prevent malaria during pregnancy	-	-
Diagnosis	Patients of all ages should receive diagnostic test	Yes	-
	Malaria diagnosis is free of charge in the public sector	Yes	1963
Treatment	ACT is free for all ages in public sector	Yes	1963
	The sale of oral artemisinin-based monotherapies (oAMTs)	has never been allowed	-
	Single dose of primaquine (0.25 mg base/kg) is used as gametocidal medicine for P. falciparum	Yes	1985
	Primaquine is used for radical treatment of P. vivax	Yes	-
	G6PD test is a requirement before treatment with primaquine	Yes	1985
	Directly observed treatment with primaquine is undertaken	No	-
	System for monitoring of adverse reaction to antimalarials exists	Yes	1990
Surveillance	ACD for case investigation (reactive)	Yes	1980
	ACD at community level of febrile cases (pro-active)	Yes	1980
	Mass screening is undertaken	No	-
	Uncomplicated P. falciparum cases routinely admitted	No	-
	Uncomplicated P. vivax cases routinely admitted	No	-
	Case and foci investigation undertaken		1990
	Case reporting from private sector is mandatory	No	-

Saudi Arabia–World Health Organization

Malaria and Hajj season

Measures applied before inlet of Pilgrims:	Measures applied during hajj season:
Spray health care facilities pilgrims camps with residual insecticides.	Epidemiology investigation malaria cases (proper diagnosis/treatment).
Surveillance at Hajj Entry ports (suspected cases/ necessary measures).	Secure malaria drugs and treatment policy for all healthcare facilities.

Summary

- Areas at the southern region are at risk of malaria transmission, specifically Asir and Jizan
- The dominant Malaria parasite in Saudi Arabia is P. Falciparum.
- **Transmitted** mainly through the bites of infected female Anopheles mosquitoes (vector)
- Early symptoms are : fever, headache and chills
- Late symptoms are severe anemia, respiratory distress, cerebral malaria and multiorgan failure
- **Paroxysmal fever : 1-** Cold stage : lassitude, headache, nausea, chills. (¼ -1 h) skin cold then hot 2- Hot stage: skin hot and dry (2 -6 h) 3- Sweating stage: fever subsides, sweating (2 -4 h)
- Risk factors : young children, pregnant women and travelers
- Biologic characteristics present from birth can protect against certain types of malaria: (having the sickle cell trait)
- Diagnosis :
  1- light microscopy : A- thick film for sceering B- thin film for diffrent species identification
  2- Rapid diagnostic tests (RDTs)
  3-serology
- Treatment : **Artemisinin combination therapy (ACT): (3days)**
- Monotherapy is not recommended for malaria treatment to prevent drug resistance.

for uncomplicated malaria:

- First line: (ARTESUNATE + SP); alternative (ARTESUNATE + MEFLOQUINE)
- Second Line: (ARTEMETHER + LUMEFANTRINE)
- Third Line : (oral QUININE + DOXYCYCLINE)

- Antimalarial drug resistance due to Low or incomplete doses, vomiting and low absorption
- The main way to reduce malaria transmission at a community is **vector control**, by:
  1- Decrease human-mosquito contact
  2- Destruction of larvae
  3- vaccination
  4- Destruction of adult mosquitoes
  5- environmental control
  6- chemoprophylaxis

.

MCQs

1- Sporozoites when injected into the human skin it migrates to?

A- Hepatocytes.
B- Intestinal wall.
C- Macrophages.
D- Lymphocytes.

2- What is the main organ affected in malaria infection?

A- Liver.
B- kidney.
C- RBCs.
D- intestine.

3- which one of the following has immunity against malaria:

A- sickle cell trait
B- microcytic anemia
C- G6PG deficiency
D- children less than 6

4- the main way to reduce malaria transmission at a community is

A- human control
B- vector control
C- environmental control

Answers : 1- A , 2- C , 3- A , 4- B