

PUBLIC HEALTH REFERENCE SHEET

Malaria



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| Name | <i>Plasmodium falciparum</i> , <i>P. vivax</i> , <i>P. ovale</i> , and <i>P. malariae</i> . |
| Reservoir & Transmission | Humans and some primate and non-human primate species Transmitted via the bite of an infected female <i>Anopheles</i> sp. mosquito |
| Incubation Period | <i>P. falciparum</i> : 9–14 days <i>P. vivax</i> * & <i>P. ovale</i> : 12–18 days <i>P. malariae</i> : 18–40 days Note: *Some <i>P. vivax</i> strains in temperate areas have an incubation period of 6–12 months. |
| Common Symptoms | Fever, chills, sweats, headaches, muscle pains, nausea, vomiting, and fatigue |
| Gold Standard Diagnostic Test | Thick and thin blood smear |
| Risk Groups | Those in rural populations in malaria-endemic areas without mosquito protection (bed nets, window screens, etc.), travelers from non-endemic areas that do not use mosquito protection, agricultural workers, farmers |
| Geographic Significance | South America, Caribbean, much of Sub-Saharan Africa, and parts of Asia |

What is malaria?

Malaria is caused by a parasite of the genus *Plasmodium* that commonly infects the *Anopheles* species of mosquito, which feeds on humans. Four kinds of malaria parasites infect humans: *P. falciparum*, *P. vivax*, *P. ovale*, and *P. malariae*. In addition, *P. knowlesi*, a type of malaria that naturally infects macaques in Southeast Asia, also infects humans and causes malaria that is transmitted from animal-to-human ("zoonotic" malaria). *P. falciparum* is most likely to result in severe infections and may be fatal if not promptly treated.

What is the occurrence of malaria?

About 2,000 cases of malaria are diagnosed in the United States annually, mostly in returned travelers. Malaria is typically found in tropical and subtropical countries where the parasites in the *Anopheles* mosquito thrive. Malaria occurs in more than 100 countries and territories. About half of the world's population is at risk. Large areas of Africa and South Asia and parts of Central and South America, the Caribbean, Southeast Asia, the Middle East, and Oceania are considered malaria-prone areas. Yet, malaria does not occur in all warm climates. For example, malaria has been eliminated in some countries with warm climates, while a few other countries have no malaria because *Anopheles* mosquitoes are not found there.

How is malaria transmitted?

People most commonly contract malaria by being bitten by an infected female *Anopheles* mosquito. Because the malaria parasite is found in red blood cells of an infected person, malaria can also be transmitted through blood transfusion, organ transplant, or contaminated shared needles or syringes. Malaria may also be transmitted from a mother to her unborn infant before or during delivery ("congenital" malaria). Malaria is not spread from person-to-person like a cold or the flu, and it cannot be sexually transmitted. Malaria does not transmit through casual contact with malaria-infected people. However, humans infected with malaria can transmit malaria to a feeding female *Anopheles* mosquito. Only *Anopheles* mosquitoes can transmit malaria after a previous blood meal is taken from an infected person. When a mosquito bites an infected person, a small amount of blood is taken that contains microscopic malaria parasites.

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About a week later, when the mosquito takes its next blood meal, these parasites mix with the mosquito's saliva and enter the bitten person.

Who is at risk for malaria?

Anyone can get malaria, but most cases occur in people who live in countries with malaria transmission. People from countries without malaria can become infected with the disease during travel to countries with malaria, especially if they do not take appropriate malaria chemoprophylaxis, or rarely through a blood transfusion. Individuals from malaria-endemic areas may have acquired immunity or partial immunity, which can wane after leaving that area. Also, an infected mother can transmit malaria to her infant before or during delivery.

Plasmodium falciparum is the type of malaria that most often causes severe and life-threatening malaria; this parasite is very common in many countries in Sub-Saharan Africa. People who are most exposed to the bites of mosquitoes infected with *P. falciparum* are most at risk of dying from malaria. People who have little or no immunity to malaria (e.g., young children, pregnant women, or prone travelers) maintain a greater chance of illness or death. People living in impoverished rural areas and lack access to health care are at an increased risk for malaria. As a result of all these factors, an estimated 90% of deaths due to malaria occur in Africa south of the Sahara; most of these deaths occur in children under 5 years of age.

“The risk for a traveler contracting malaria differs substantially from region to region and from traveler to traveler, even within a single country, based upon travelers’ behaviors and circumstances. There is no accepted method of quantifying the risk and no numerical value for a risk threshold beyond which chemoprophylaxis is or is not recommended.” Refer to the CDC malaria risk assessment for travelers:

https://www.cdc.gov/malaria/travelers/risk_assessment.html

What are the signs and symptoms of malaria?

Malaria symptoms range from mild illness to severe disease and may be fatal. Early symptoms include fever, chills, sweats, headache, muscle aches, fatigue, nausea, vomiting, and diarrhea. Patients typically have all symptoms, but the absence of one does not rule-out malaria or lessen clinical suspicion. Malaria may cause anemia and jaundice because of red blood cell loss. If not promptly treated, the infection can become severe and may cause kidney failure, seizures, mental confusion, respiratory distress, coma, or death.

Following the infective bite by the *Anopheles* mosquito, the incubation period in most cases varies from 7 to 30 days. *P. falciparum* has a shorter incubation period, and *P. malariae* has a longer incubation period.

Antimalarial drugs taken for prophylaxis by travelers can delay the appearance of malaria symptoms by weeks or months, long after the traveler has left the malaria-endemic area. This can happen particularly with *P. vivax* and *P. ovale*, both of which can produce dormant liver stage parasites; the liver stages may reactivate and cause disease months after the infective mosquito bite.

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What are potential complications of malaria?

Severe malaria is a medical emergency and should be treated urgently and aggressively.

Severe malaria occurs when infections are complicated by organ failure or abnormalities in the blood or metabolism. Persons with severe malaria may experience confusion, coma, neurologic focal signs, severe anemia, and respiratory difficulties. Just one of these symptoms in a patient with malaria would indicate severe malaria, possibly life-threatening, and co-existing clinical signs/symptoms could indicate a higher degree of severity.

The manifestations of severe malaria include:

- Cerebral malaria with abnormal behavior, impairment of consciousness, seizures, coma, or other neurologic abnormalities
- Severe anemia due to hemolysis
- Hemoglobinuria due to hemolysis
- Acute respiratory distress syndrome (ARDS), which may occur even after the parasite counts have decreased in response to treatment
- Abnormalities in blood coagulation
- Low blood pressure caused by cardiovascular collapse
- Acute kidney failure
- Hyperparasitemia (more than 5% of the red blood cells are infected by malaria parasites)
- Metabolic acidosis often in association with hypoglycemia
- Hypoglycemia may also occur in pregnant women with uncomplicated malaria, or after treatment with quinine.

Other manifestations of malaria include:

- Neurologic defects may occasionally persist following cerebral malaria, especially in children. Such defects include trouble with movements (ataxia), palsies, speech difficulties, deafness, and/or blindness.
- Recurrent infections with *P. falciparum* may result in severe anemia. This occurs especially in young children in tropical Africa with frequent infections that are inadequately treated.
- Malaria during pregnancy (especially *P. falciparum*) may cause severe disease in the mother and may lead to premature delivery or delivery of a low-birth-weight baby.
- On rare occasions, *P. vivax* malaria can cause rupture of the spleen.
- Nephrotic syndrome (a chronic, severe kidney disease) can result from chronic or repeated infections with *P. malariae*.
- Hyperreactive malarial splenomegaly (also called “tropical splenomegaly syndrome”) occurs infrequently and is attributed to an abnormal immune response to repeated malarial infections. The disease is marked by a very enlarged spleen and liver, abnormal immunologic findings, anemia, and a susceptibility to other infections (such as skin or respiratory infections).

How is malaria diagnosed?

Laboratory diagnosis of malaria is confirmed through microscopic examination of thick and thin blood smears for the presence of malaria parasites. If there is any suspicion of malaria (for example, if the patient has recently traveled in a country where malaria transmission occurs), the test should be performed without delay; this may require three sets of serial blood smear examinations, as initial blood smears may be negative. Antigen detection tests called rapid diagnostic tests (RDT) can determine that the patient has malaria; however, these are less sensitive than microscopy and cannot confirm each specific species of the malaria parasite or

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the parasite density. Parasite nucleic acid detection using polymerase chain reaction (PCR) is more sensitive and specific than microscopy, but results are often not available quickly enough for routine diagnosis. PCR is a very useful tool for confirmation of species and detection of mutations associated with drug resistance.

How is malaria treated?

Malaria can rapidly become a severe and life-threatening disease; once the diagnosis is made, treatment must be initiated immediately. Malaria treatment tables are available through the CDC website at https://www.cdc.gov/malaria/diagnosis_treatment/clinicians1.html#general and the CDC Malaria Hotline at 770-488-7188. The type of medication and length of treatment depends on the type of malaria, where (geographic location) the person was infected, and how sick they are when treatment starts. Other important factors are age and whether the person is pregnant.

In *P. vivax* and *P. ovale* infections, patients having recovered from the first episode of illness may suffer several relapses after months or even years without symptoms. Relapses occur because *P. vivax* and *P. ovale* have dormant liver stage parasites (“hypnozoites”) that may reactivate. Treatment is available to reduce the risk of relapses.

How can malaria be prevented?

Consult with a travel or tropical medicine specialist for guidance when assessing the factors to determine the best prevention strategy for the individual traveler. Depending on level of risk, it may be appropriate to recommend no specific interventions, mosquito avoidance measures only, or mosquito avoidance measures plus chemoprophylaxis. Refer to the CDC’s malaria risk assessment for travelers at https://www.cdc.gov/malaria/travelers/risk_assessment.html.

Individual prevention strategies include:

- Avoid areas with high mosquito activity, especially during late evening and at night.
- Use an Environmental Protection Agency (EPA) registered bug spray.
- Wear loose-fitting, long-sleeved shirts and pants.
- Keep windows and doors closed or covered with screens.
- Empty standing water to prevent mosquitoes from laying eggs.

What are some public health considerations?

- Specify the species if known.
- Document relevant travel and deployment history occurring within the incubation period (incubation time range varies depending on species).
- Document chemoprophylaxis regimen.
- Report dual infections of different *Plasmodium* species separately.

References

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Heymann, David L. ed. 2022. *Control of Communicable Diseases Manual*. 21st Edition. Washington, DC: APHA Press.

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