Malaria Causes And Effects

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Introduction

Malaria is a preventable and treatable disease caused by *Plasmodium* parasites and transmitted mainly through the bites of infected female *Anopheles* mosquitoes. It is not caused by polluted air, poor hygiene, or weak immunity alone. Five parasite species commonly infect humans, with *Plasmodium falciparum* responsible for most severe disease and deaths, particularly in Africa. *Plasmodium vivax* has a wider geographic range and can relapse because dormant liver forms may reactivate.

Malaria remains a major global health challenge despite substantial progress. The World Health Organization estimated 282 million cases and 610,000 deaths in 2024, with the African Region carrying approximately 94 percent of cases and 95 percent of deaths. Young children, pregnant women, people with HIV, non-immune travelers, displaced populations, and people without reliable access to prevention and treatment face especially high risk. (World Health Organization, n.d.)

Historical Understanding of Malaria

Descriptions of periodic fever appear in ancient medical texts, but retrospective diagnosis is uncertain because many infections cause fever. The word malaria came from the Italian expression for “bad air,” reflecting the former belief that marsh vapors caused illness. The association with wetlands was observable, but the explanation was wrong: wetlands often support mosquito breeding.

In 1880, French military physician Alphonse Laveran observed parasites in the blood of patients in Algeria. He identified moving bodies associated with infected red blood cells, providing evidence that a protozoan organism caused malaria. Ronald Ross later demonstrated mosquito transmission in avian malaria, and research by Italian scientists clarified transmission of human malaria by *Anopheles* mosquitoes. These discoveries transformed prevention from avoidance of “miasma” toward vector control.

The Parasite Life Cycle

Transmission begins when an infected female mosquito injects sporozoites during a blood meal. The parasites travel to the liver, enter liver cells, and multiply. After this clinically silent stage, merozoites enter the bloodstream and invade red blood cells. Cycles of invasion, replication, and rupture produce fever and other symptoms.

Some parasites develop into male and female gametocytes in human blood. Another mosquito ingests these sexual forms during feeding. Fertilization and further development occur inside the mosquito, eventually producing sporozoites that move to its salivary glands. Laveran did not observe a male gametocyte “growing in the mosquito”; he observed parasite forms in human blood before the full transmission cycle was understood.

P. vivax and *P. ovale* can form dormant hypnozoites in the liver, causing relapse months after the original infection. Treatment must therefore consider species and patient factors rather than only clearing blood-stage parasites.

Why Fever Occurs

When infected red blood cells rupture, parasites and inflammatory material enter circulation. The immune response contributes to fever, chills, sweating, headache, and fatigue. Classical periodic fever patterns may occur but are not reliable enough for diagnosis. People can have irregular fever, especially early in infection or with *P. falciparum*.

Destruction and removal of red blood cells can cause anemia. The spleen enlarges as it filters abnormal cells. Severe disease may involve the brain, lungs, kidneys, liver, circulation, and coagulation system. In falciparum malaria, infected red cells can adhere to small blood vessels and reduce microvascular flow, contributing to cerebral malaria and organ dysfunction.

Symptoms and Severe Malaria

Common symptoms include fever, chills, headache, muscle aches, weakness, nausea, vomiting, and abdominal discomfort. Malaria cannot be reliably distinguished from other febrile diseases by symptoms alone. Suspected cases require prompt testing where possible.

Danger signs include impaired consciousness, repeated seizures, severe anemia, breathing difficulty, shock, jaundice with organ dysfunction, kidney injury, abnormal bleeding, and very high parasite levels. Severe malaria is a medical emergency. Delay in effective treatment can lead rapidly to death, especially in young children and non-immune patients.

Diagnosis

WHO recommends parasite-based diagnosis before treatment when testing is available. Microscopy can identify parasites, estimate density, and sometimes determine species. Rapid diagnostic tests detect parasite antigens and are valuable where microscopy is unavailable or delayed. Test quality, storage, species distribution, and recent treatment can affect results.

A negative result does not always end evaluation when clinical suspicion is high. Repeat testing or microscopy may be necessary. Molecular methods are useful in surveillance and specialized settings but are not generally the first tool for an acutely ill patient.

Treatment Principles

Treatment depends on parasite species, disease severity, patient age and weight, pregnancy, drug resistance, prior medicines, and location of infection. Uncomplicated *P. falciparum* malaria is generally treated with an effective artemisinin-based combination therapy according to national guidelines. Combining drugs helps clear parasites and slow resistance. (Institute of Medicine, 2004)

Severe malaria requires urgent parenteral treatment, commonly intravenous or intramuscular artesunate, followed by a complete oral combination regimen when the patient can take medicine. Supportive care may address hypoglycemia, seizures, anemia, kidney injury, shock, or respiratory distress. Inappropriate monotherapy, counterfeit medicines, incomplete courses, and delayed care increase harm and resistance.

For *P. vivax* or *P. ovale*, radical cure may require a medicine active against dormant liver stages. Because some of these medicines can cause dangerous hemolysis in people with glucose-6-phosphate dehydrogenase deficiency, testing and national guidance are important.

Vector Ecology and Environmental Conditions

Malaria transmission depends on competent mosquito species, temperature, rainfall, humidity, human behavior, housing, and access to interventions. Warm conditions accelerate parasite development within mosquitoes up to biological limits. Rain can create breeding sites, but excessive rain may wash them away. Irrigation, mining, construction, deforestation, and poorly managed water can alter local risk.

Africa’s burden is not explained by climate alone. Highly efficient vector species, widespread *P. falciparum*, poverty, weak health systems, conflict, displacement, insecticide resistance, drug resistance, and gaps in intervention coverage all contribute. Describing the disease as a consequence of unhygienic families is inaccurate and stigmatizing.

Insecticide-Treated Nets

Insecticide-treated nets create a physical barrier and kill or repel mosquitoes that feed at night. Long-lasting insecticidal nets have prevented large numbers of cases and deaths. Their impact depends on access, correct use, physical condition, insecticide susceptibility, and local mosquito behavior.

Programs now use different insecticide combinations in areas with resistance. Distribution must be accompanied by replacement, community engagement, and monitoring. A net cannot protect someone who does not receive it, cannot hang it, or works outdoors during peak biting times.

Indoor Residual Spraying and Other Vector Control

Indoor residual spraying applies insecticide to interior surfaces where mosquitoes rest. It can reduce transmission when the chosen insecticide is effective and coverage is high. Larval-source management may be useful where breeding sites are few, fixed, and findable, but it is not a universal substitute for nets or spraying.

Housing improvements such as screened windows, closed eaves, and well-fitted doors can reduce mosquito entry. Environmental management should be based on local entomological evidence rather than broad assumptions that draining every water body is feasible or ecologically safe.

Preventive Medicines

Chemoprevention protects people during periods of predictable risk. WHO-recommended strategies include intermittent preventive treatment in pregnancy, seasonal malaria chemoprevention for eligible children in highly seasonal areas, perennial malaria chemoprevention, post-discharge prevention for selected children, and preventive treatment for school-aged children in appropriate settings. Travelers may need chemoprophylaxis selected according to destination and medical history.

Preventive medicines complement rather than replace testing, treatment, vector control, and vaccination. Programs must monitor adherence, safety, coverage, and resistance.

Malaria Vaccines

WHO recommends the RTS,S/AS01 and R21/Matrix-M vaccines for prevention of *P. falciparum* malaria in children living in endemic areas, prioritizing moderate- and high-transmission settings. The vaccines are provided through multi-dose schedules and are now being introduced through routine immunization programs in African countries.

Vaccines reduce malaria and severe disease but do not provide complete protection. Their greatest impact occurs when combined with insecticide-treated nets, chemoprevention, prompt diagnosis, and effective treatment. Families should continue other preventive measures after vaccination.

Pregnancy and Malaria

Pregnancy changes immunity and makes malaria particularly dangerous. Infection can cause maternal anemia, placental infection, miscarriage, stillbirth, premature delivery, and low birth weight. In endemic areas, antenatal care should include recommended preventive treatment, nets, testing, and prompt management of illness.

Medication choices differ during pregnancy, so treatment should follow national and WHO guidance. Pregnant travelers should seek specialized advice because avoiding exposure may be safer than relying on any single preventive measure.

Effects on Children, Families, and Education

Young children may develop severe anemia or cerebral malaria quickly. Repeated illness contributes to missed school, caregiver absence from work, household expenditure, and pressure on health facilities. Severe disease can result in neurological impairment, although many children recover fully with timely treatment.

The economic burden extends beyond medicine. Families pay for travel, diagnostics, food during care, and lost labor. Governments fund surveillance, commodities, staff, laboratories, and vector control. Malaria can reduce productivity and deepen poverty, while poverty increases exposure and delays access to care.

Drug and Insecticide Resistance

Resistance threatens progress. Partial resistance to artemisinin derivatives has been documented in multiple regions, and partner-drug resistance can cause treatment failure. Surveillance must detect changes early, and countries need quality-assured medicines and updated policies. People should not use unapproved herbal or incomplete drug regimens as substitutes for effective treatment.

Mosquito resistance to insecticides also requires monitoring and diversified tools. Resistance management is not a reason to abandon nets; it is a reason to select appropriate products, rotate or combine interventions, and invest in new methods.

Climate Change, Conflict, and Health-System Disruption

Climate variability can change the geographic and seasonal suitability for transmission, but effects differ by location. Flooding can displace communities and damage services. Drought can change

water storage practices. Conflict interrupts prevention, diagnosis, treatment, and supply chains while increasing population movement.

Preparedness requires climate-informed surveillance, resilient supply systems, trained community health workers, and rapid response to outbreaks. Imported cases must also be recognized in countries where malaria is not normally transmitted.

Elimination and Surveillance

Elimination requires more than reducing national averages. Programs must identify where transmission persists, investigate cases, respond to outbreaks, and prevent re-establishment after interruption. Community trust, accurate data, cross-border coordination, and sustained funding are essential.

Conclusion

Malaria is caused by *Plasmodium* parasites transmitted mainly by infected *Anopheles* mosquitoes. Its effects range from short febrile illness to severe anemia, cerebral disease, organ failure, pregnancy complications, death, and major social costs. Accurate diagnosis and effective treatment save lives, while nets, spraying, housing improvement, chemoprevention, vaccines, and surveillance reduce transmission. The continuing burden is not a result of one climate or one behavior; it reflects biological, economic, political, and health-system conditions. Integrated, locally tailored interventions remain the most effective path toward control and elimination. (World Health Organization, n.d.)

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