

# Malaria Field Guide

The Prevention, Diagnosis and Treatment  
of Malaria in U.S. Africa Command  
(USAFRICOM)



 **USAPHC**  
U.S. ARMY PUBLIC HEALTH COMMAND



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## Purpose

This technical guide (TG) is for medical personnel operating in the USAFRICOM area of responsibility (AOR) for the prevention, diagnosis and treatment of malaria in tactical field-care situations. Check with approving physician before implementing care and treatments described in this TG. The TG is not a definitive source of current medical intelligence. Refer to the National Center for Medical Intelligence (NCMI), <https://www.intelink.gov/ncmi/index.php>, for the most current medical intelligence.

## Sources

The USAPHC (<http://phc.amedd.army.mil/>) has produced this TG by integrating instructional material contributed by military physicians and scientists. The TG is comprised of updated excerpts specific to USAFRICOM AOR from existing U.S. Army publications including USAPHC TG 273 Diagnosis and Treatment of Diseases of Tactical Importance to U.S. Central Command and the U.S. Navy Medical Department Pocket Guide to Malaria Prevention and Control, Environmental Health Center Technical Manual; NEHC-TM PM 6250.1; (2007). Refer to United States Africa Command Manual 4200.03 Health and Medical: Force Health Protection Procedures for Deployment and Travel for force health protection (FHP) requirements and standardized procedures for health surveillance in the USAFRICOM AOR.



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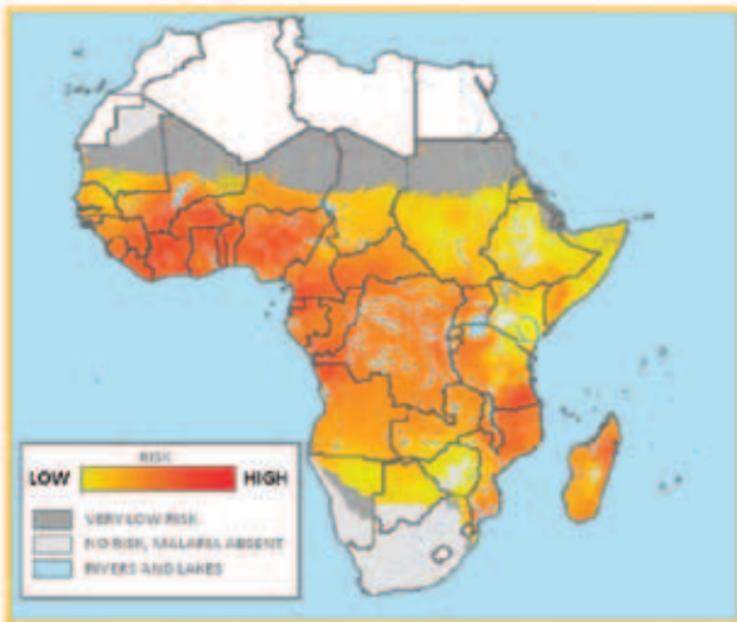
# background



Malaria is a serious mosquito-borne illness that is caused by a microscopic parasite which infects red blood cells. There are four primary species of malaria parasites that can infect humans: *Plasmodium (P.) falciparum*, *P. malariae*, *P. ovale*, and *P. vivax*. There are other species of *Plasmodium* that infect animals. In recent years, a fifth species, *P. knowlesi*, has been identified as a cause of human malaria in Southeast Asia. While infection with any of the malaria species can make a person very ill, *P. falciparum*, the predominant strain of malaria in Africa, causes severe disease and, without treatment, death.

U.S. military personnel are increasingly involved with missions in countries where malaria is present. Prompt diagnosis and treatment of *P. falciparum* is critical to prevent severe disease and death. Personnel need to strictly adhere to all countermeasures in malaria-infected areas, including chemoprophylaxis (malaria pills) and personal and unit protective measures.

## Risk of Contracting *Falciparum* Malaria in Africa (2009)



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# transmission

transmission



The malaria parasite is transmitted by bites of infected female *Anopheles* species (spp.) mosquitoes. *Anopheles* mosquitoes are primarily nighttime biters, including evening and early morning. Malaria cannot be transmitted from person-to-person like a cold or the flu. You cannot get malaria through casual contact with an infected person such as touching or kissing a person with the disease. The primary means of contracting malaria is via mosquito bite. Occasionally, transmission occurs by blood transfusion, organ transplantation, needle sharing, or congenitally from mother to fetus. Medical personnel should use standard precautions when in contact with malaria-infected patients. Utilize environmental controls to ensure patients are not exposed to mosquitoes.



*Anopheles* spp. Mosquitoes, Major Vectors of Malaria



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# prevention

## Overview

In 2008, there were 247 million cases of malaria and nearly one million deaths worldwide. Personnel from malaria-free areas are very vulnerable to the disease when they get infected (Key Malaria Facts, World Health Organization, <http://www.who.int/mediacentre/factsheets/fs094/en/>). Mosquito control, protection from mosquito bites, and chemoprophylaxis are key in reducing malaria transmission. Based on the deployment health risk assessment, specific malaria prevention interventions, including use of mosquito repellents and chemoprophylaxis are identified. Recommendations for chemoprophylaxis are based on information concerning parasite drug susceptibility for a specific location and season (see Centers for Disease Control and Prevention (CDC), [http://www.cdc.gov/malaria/diagnosis\\_treatment/treatment.html](http://www.cdc.gov/malaria/diagnosis_treatment/treatment.html) and the NCMI, <https://www.intelink.gov/ncmi/index.php>). Personnel need to strictly adhere to all countermeasures when in areas with malaria, including chemoprophylaxis (malaria pills) and personal and unit protective measures.

## Personal Protective Measures



### You need to know...

- » Dry cleaning removes permethrin from the uniform.
- » Flame-Resistant Army Combat Uniforms (FRACUs) and *NOMEX*<sup>®</sup> cannot be field treated with permethrin. (*Nomex*<sup>®</sup> is a registered trademark of E.I. du Pont de Nemours and Company. DuPont Canada Inc. is a licensee).
- » Beginning in June 2010, all deploying Soldiers issued FRACUs have uniforms that have been factory-treated with permethrin (FRACU-Ps).

## Skin

Use repellents that have been approved by the U.S. Environmental Protection Agency (USEPA). For your skin, use a product that contains 20-50% diethyl toluamide or DEET. DEET in higher concentrations is no more effective. Apply a thin, even coating to all exposed skin. Do not apply to skin that is underneath clothing. Do not apply to broken, irritated, or sunburned skin. To apply to your face, dispense a small amount of DEET onto your hands, then rub them carefully over your face, avoiding your eyes and mouth. Use Ultra 30<sup>®</sup> (NSN 6840-01-584-8393), ULTRATHON<sup>®</sup> (NSN 6840-01-284-3982) lotions or Cutter<sup>®</sup> pump spray (NSN 6840-01-584-8598). Follow label directions. Wash DEET off skin with soap and water when exposure to mosquitoes or other biting insects has ended. (Ultra 30<sup>®</sup> is a trademark of Sawyer Products, Inc., ULTRATHON<sup>®</sup> is a registered trademark of 3M; Cutter<sup>®</sup> is a registered trademark of Spectrum Brands).

## Clothing

Wear clothing that has been treated with permethrin at a concentration of 0.52% weight of permethrin/weight of fabric. Permethrin is available commercially as 0.5% spray formulations. Civilian clothing that is factory-impregnated with permethrin may also be purchased commercially. Permethrin will withstand numerous launderings. Permethrin should only be used on clothing, never on skin. Treat uniform with permethrin clothing repellent BEFORE putting it on. Use the Impregnation Kit (NSN 6840-01-345-0237, one kit treats one uniform, the treatment lasts for the life of the uniform) or Aerosol<sup>®</sup> Can (NSN 6840-01-278-1336, 3/4 of a can treats one uniform and the treatment lasts through 5-6 washes). Follow all label directions. (Aerosol<sup>®</sup> Can is a registered trademark of Coulston Products, Inc).

## Other personal and unit countermeasures:

- » When possible, stay inside well-screened areas at dawn, dusk, and nighttime. This is when *Anopheles spp.* mosquitoes are most active.
- » Eliminate mosquito breeding sites by improving surface water management.
- » Make sure door and window screens do not have holes.
- » Sleep under a permethrin-impregnated bed net (see Pop-Up Bed Net, NSN 3740-01-516-4415 below). If not available, treat a bed net before use

by lightly spraying the outside surface of the net with permethrin aerosol prior to setting it up (the Mosquito Net Used with Poles, NSN 7210-00-266-9736, below can be treated with permethrin, using Aerosol Can (NSN 6840-01-278-1336). Follow label directions. Spray the outside surface of the net prior to setting up the bed net. Permethrin will help prevent mosquitoes from being able to gain entry or bite through the net.

- » Once the permethrin-treated bed net has dried, erect net so that there are no openings. Tuck edges of the net under your mattress pad or sleeping bag. Do not allow the net to drape on the ground. Don't leave your net open during the day.
- » Don't let the net touch your skin while you sleep because insects may bite you through the netting.



*Permethrin-Treated Lightweight, Self-Supporting, Pop-Up Bed Net, NSN 3740-01-516-4415 OD Green.*



*Mosquito Net Used with Poles (not Permethrin-Treated), NSN 7210-00-266-9736.*

## Chemoprophylaxis

The use of chemoprophylaxis should be anticipated for operations in most regions. Malaria, particularly chloroquine-resistant *P. falciparum*, is endemic to most of Sub-Saharan Africa; additionally, there are a few foci of malaria in Egypt. Local threat maps regarding malaria drug resistance are available from the NCMI (<https://www.intelink.gov/ncmi/index.php>).

## Recommended Regimen

Malaria in various parts of Africa may be transmitted year round or seasonally, and an understanding of local epidemiology is important. Follow Theater Surgeon and NCMI guidance for the theater of operations. The Food and Drug Administration (FDA) approved regimens for force health protection in the AFRICOM AOR include:

- » Atovoquone-proguanil (Malarone®) 1 adult tablet by mouth (PO) per day (QD) starting 1-2 days before arrival in the at-risk region and continuing 7 days after departure from the region. (Malarone® is a registered trademark of GlaxoSmithKline.)
- » Doxycycline 100 mg PO QD, beginning 1-2 days before arrival in the at-risk region and continuing daily for 4 weeks after departure. Doxycycline hyclate is the least inexpensive but tends to cause more gastrointestinal (GI) upset than doxycycline monohydrate or enteric-coated doxycycline hyclate. If providers have the choice,

either doxycycline monohydrate or enteric-coated doxycycline hyclate would likely be better to prescribe as malaria chemoprophylaxis than doxycycline hyclate.

- » Mefloquine 250 milligrams (mg) PO weekly, beginning 1-2 weeks before arrival in the at-risk region and continuing for 4 weeks (4 doses) after departure. Initiating the use of mefloquine 4 weeks prior to travel will allow for most Soldiers who will have adverse effects requiring halting the medication to declare themselves prior to travel. **Ensure careful screening for contraindications.**

The choice of a particular regimen is based on a risk-benefit assessment of each regimen and the deployment-specific infection risk. Malaria chemoprophylaxis use is determined by multiple factors, including operational situation, length of exposure, prevalence of drug resistance, individual factors and any Service-specific policies. Mefloquine may be used in personnel with contraindications to doxycycline and atovaquone-proguanil who also lack a contraindication to mefloquine (active or recent history of depression, anxiety disorder, psychosis, or other major psychiatric disorder; history of seizures; history of recent traumatic brain injury; aircrew members, and divers).

## Presumptive Anti-Relapse Therapy (Terminal prophylaxis)

*P. vivax* and *P. ovale* have dormant liver stage parasites which can reactivate (“relapse”) and cause malaria symptoms several months or years after initial infection.

Primaquine is the only available drug that can eradicate persistent hepatic parasites (hypnozoites) of *P. vivax* and *P. ovale* malaria.

Primaquine must not be given to glucose-6-phosphate dehydrogenase (or G6PD) deficient individuals because of the risk of hemolytic anemia—nor to pregnant or breastfeeding G6PD-normal women, because fetal status is unknown. Pre-deployment testing of G6PD status is recommended prior to entering at-risk areas.

Use of primaquine, concurrently with another anti-malarial drug, in asymptomatic patients when they leave an endemic area, is referred to as presumptive anti-relapse therapy (PART) (also called terminal prophylaxis). Due to the low prevalence of non-falciparum malaria in Africa, terminal prophylaxis with primaquine for deployments shorter than 30 days should be based on individual risk and not mandated.

## **Primaquine Dosing for Presumptive Anti-Relapse Therapy (Terminal Prophylaxis) and Radical Cure**

The current FDA-approved dose regimen for primaquine for both anti-relapse therapy and radical cure (see Treatment tab: Treatment of Relapsing Malaria section) indications is 15 mg (base) PO QD X 14 days. The current CDC-recommended, first-line regimen is a higher dose of 30 mg (base) PO QD X 14 days for strains of *P. vivax* known to require higher dose for cure. Current Department of Defense (DOD) FHP policy does not allow mass prescription for FDA-approved drugs with unapproved dose regimens. Therefore, the post exposure [or 'post-travel'] use of primaquine should be limited to the approved regimen of 15 mg (base) PO QD X 14 days.

### **Directly Observed Therapy**

Directly Observed Therapy (DOT) is strongly recommended to ensure personnel are taking chemoprophylaxis as directed. DOT is the assignment of personnel to watch as Soldiers take their pills at the same time. Missing as little as one dose of doxycycline can put personnel at risk for infection. Chain-of-command support is critical for DOT to be executed effectively.



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# diagnosis

**Malaria MUST be considered in all febrile patients who have spent any time in an area where malaria is present.** If not diagnosed and treated promptly, *P. falciparum* is often fatal. While *P. falciparum* causes the most severe disease, other species of *Plasmodium* also have the potential to cause severe illness and even death. Symptoms can occur before parasites are detectable by blood smear, but patients that are critically ill due to malaria will have a detectable parasitemia at some time in their illness. Reported history of compliance with chemoprophylaxis and/or personal and unit protective measures does not exclude a patient from having malaria.

### Signs and Symptoms

Symptoms vary depending on malaria type involved but at the outset generally include —

- » fever
- » shaking chills
- » sweats
- » headache
- » muscle aches
- » exhaustion
- » nausea
- » vomiting
- » diarrhea

Patient ill with fever  $> 101^{\circ}\text{F}$  and is/has been in a malarious area.

YES

MUST rule out malaria. Start empiric treatment if malaria is suspected. Consider rapid medical evacuation.

YES

Perform blood smears or rapid diagnostic test (RDT). If initial smear or RDT is negative, repeat in 8-12 hours. If still negative, repeat a third time 8-12 hours later. *[Only after three properly spaced diagnostic tests should one exclude a diagnosis of malaria.]* **Negative tests that are clinically considered possible false-negative should be treated even as testing continues.** If accurate and reliable diagnostic testing is not available within 1-2 hours OR if clinical symptoms worsen during serial testing and no alternative diagnosis has been confirmed, empiric treatment for chloroquine-resistant falciparum malaria is recommended.

YES

If smear or RDT positive, treat (see Treatment section). Report confirmed and empirically treated cases to preventive medicine authorities.

Other signs and symptoms that may occur include —

- » nausea
- » vomiting
- » diarrhea
- » anemia
- » jaundice (yellow coloring of skin and eyes) can occur due to destruction of red blood cells

Infection with *P. falciparum*, if not promptly treated, may advance to complicated malaria and lead to —

- » kidney failure
- » seizures
- » coma
- » death

See Table 1 for additional information.

Symptoms of malaria may continue for weeks or months, with recurring episodes of fever and chills. *P. vivax* and *P. ovale* have dormant liver-stage parasites that can reactivate (“relapse”) and cause malaria symptoms several months or years after initial infection.

*P. malariae* may produce a long-lasting infection that can persist without symptoms (the infection is asymptomatic) for years, or even a lifetime.

Malaria in pregnant women can be more severe than in non-pregnant women and can cause adverse pregnancy outcomes, including —

- » prematurity
- » miscarriage
- » stillbirth
- » maternal death

Persons on chemoprophylaxis, or using antibiotics, especially macrolides, sulfa drugs, and quinolone antibiotics, may have delayed presentations, low parasitemia, and atypical presentations.

Table 1. Manifestations of Complicated Malaria

Major Signs	Description
Unarousable coma	Failure to localize or abnormal response to painful stimuli; coma persisting for >30 minutes after generalized convulsion
Seizures	More than two generalized convulsions in 24 hours
Severe anemia (normochromic, normocytic)	Hematocrit rapidly falling or <15%, or hemoglobin <5 grams per deciliter (g/dL), with parasitemia level >10,000 per milliliter (mL), or with >1 to 2% of red blood cells (RBCs) involved
Severe bleeding abnormalities	Significant bleeding from gums, nose, GI tract, and/ or evidence of disseminated intravascular coagulation
Pulmonary edema/ adult respiratory distress syndrome	Shortness of breath, fast labored respiration, rales

Table 1. Manifestations of Complicated Malaria  
(continued)

Major Signs	Description
Renal failure	Urine output < 400 mL/24 hrs (<12 milliliters per kilogram (mL/kg) per 24 hrs in children); no improvement with re-hydration; serum creatinine >3.0 mg/dL (>265 moles per liter (mol/L))
Hemoglobinuria	Black, brown, or red urine; not associated with effects of drugs or red blood cell enzyme defects (i.e., primaquine administration/G-6-PD deficiency)
Hypoglycemia	Glucose < 40 mg/dL (<2.2 milliliters per liter (mmol/L))
Hypotension/ shock	Systolic blood pressure (BP)<50 in children aged 1-5 or < 80 in adults; core to skin temperature > 10 °C difference
Acid base disturbances	Arterial pH <7.25 or plasma bicarbonate <15 mmol/L

Source: U.S. Navy Medical Department Pocket Guide to Malaria Prevention and Control, Environmental Health Center Technical Manual; NEHC-TM PM 6250.1, 2007.

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# diagnostic tests



Patients with suspected malaria should have a total of three blood smear exams or rapid diagnostic tests, one every 8-12 hours, to exclude malaria. Periodic sequestering of parasites in the deep-tissue space may result in transient drops in measurable parasite burden.

### Rapid Diagnostic Tests: BinaxNOW® Malaria Test

1. The BinaxNOW® Malaria Test is a rapid laboratory antigen test that can detect plasmodium parasites using a whole blood sample drawn from a vein or obtained by a finger stick. This is the first FDA-cleared product for detection and identification of the parasites that cause malaria. (BinaxNOW® is a registered trademark of Inverness Medical).
  - » First-line diagnostic tool **when a skilled microscopist is not available.**
  - » Differentiation between a *P. falciparum* only infection and a mixed infection containing *P. falciparum* and another malaria species is not possible with this test. Microscopy must be performed to make this determination, as well to differentiate among the *non-falciparum Plasmodium* species.
  - » Performs well for falciparum malaria down to 0.01% parasitemia and vivax malaria down to 0.12% parasitemia.

- » Not for malaria screening or in individuals that have no signs or symptoms of malaria or for monitoring anti-malaria therapy. Antigens may be detected for several days even after successful treatment.
- » A positive test result in an ill patient must lead to immediate treatment. If a negative test result is seen in an ill patient at some risk for malaria, empiric treatment should be considered, especially if skilled microscropy is not immediately available.

## 2. How does it work?

- » The patient's blood sample is applied to the sample pad. If malaria antigens are present they bind to anti-malaria antibodies.
- » A liquid reagent is then added to the pad allowing the antigen-antibody complexes to migrate along the test strip where they are captured by immobilized antibodies forming two test lines. A third line is formed (control line) if all of the reagents are working and migrating properly.
- » The test lines are positive if both or one of the test lines and control lines turn a pink to purple color. The test is negative if only the control line shows a pink-purplish color.

- » See manufacturer's test procedure card for additional information: [http://www.binaxnow.com/PDF/IN665001\\_rev2%20Malaria.pdf](http://www.binaxnow.com/PDF/IN665001_rev2%20Malaria.pdf). Consult the Product Insert for detailed instruction and performance characteristics.

## Blood Smear Exam

Blood smears identify intra-erythrocytic parasites on smears of peripheral blood.

Thick smears are more sensitive (about 20X) for finding parasites; thin smears are more accurate for determining parasite species.

- » Thick smear: place one drop of blood on a slide; with the corner of another glass slide, spread drop until it is about dime size, and newsprint below slide can barely be read; wait until thoroughly dry. DO NOT FIX WITH METHANOL; stain with Giemsa stain.
- » Thin smear: prepare film as for normal complete blood count (CBC), fix in methanol, use Giemsa stain. Wright's stain (called a CBC with manual differential), can be used if Giemsa stain is not available. However, species determination might be more difficult.

## **Additional laboratory findings (if available) —**

### **Hematologic:**

- » CBC :
  - » Anemia (normochromic, normocytic, hemolytic)
  - » Leukopenia
  - » Monocytosis (>10%)
  - » Eosinophilia not usually seen
  - » Thrombocytopenia (<150,000/mm<sup>3</sup>)

### **Chemistry:**

- » Hypoglycemia (not uniformly seen; may be severe, especially with guanidine therapy, and may be recurrent).
- » Electrolyte abnormalities, including hyperkalemia (from RBC lysis), and hyponatremia (from reduced free water clearance).
- » Elevated aspartate transaminase (AST)>alkaline phosphatase (ALT) normal.
- » Azotemia (pre-renal).
- » Hyperbilirubinemia.
- » Urinalysis: may be normal; however, increased protein, urobilinogen, and conjugated bilirubin may occur.
- » Microbiologic: standard techniques are not applicable.

- » Coagulation: normal in uncomplicated disease, but prolonged prothrombin time (PT) and partial thromboplastin time (PTT) with disseminated intravascular coagulation (DIC) may be seen in late stage disease.

**X-ray:** nonspecific, pulmonary infiltrates may be seen.

**Diagnostic confirmation:** Identification of parasite on blood smears or RDT.



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# treatment

treatment



**Note: All malaria medications should be obtained from approved sources. NEVER procure malaria medications from local pharmacies or other local vendors due to very high levels of counterfeit and tainted products in developing countries.**

Uncomplicated Malaria: *P. falciparum* resistance to chloroquine and sulfadoxine-pyrimethamine is widespread in Sub-Saharan Africa; these drugs should not be used. *P. vivax* is relatively rare in the continent, except in parts of the Horn of Africa, *P. ovale* may be seen in mixed infections with some frequency. Regardless of the species identified, for malaria acquired in Africa, **treat for chloroquine-resistant *P. falciparum***. Consider presumptive treatment with the addition of primaquine in those with no contraindication to cover the possibility of *P. vivax* or *P. ovale* infections. After diagnosis, blood smears should continue to be monitored for response to therapy. Decreasing parasite count signifies a favorable response to therapy. Frequency of testing depends on therapeutic response and severity of illness. Antigen-based RDT tests are not to be used to assess response to treatment as antigenemia persists for days after parasites clear.

» **Initial treatment for adult patients with uncomplicated malaria** who are able to tolerate oral medication —

» Artemether/lumefantrine (Coartem®) 20/120 mg per tab, 4 tablets as a single initial dose, 4 tablets again after 8 hours and then 4 tablets twice daily (morning and evening) for the following two days (total course of 24 tablets). (Coartem® is a registered trademark of Novartis AG).

or

» Atovaquone-proguanil (AP) [Malarone] 250/100 mg per tab, 4 tablets PO QD for 3 days (if not already on AP prophylaxis).

**Alternatives:**

» Quinine 650 mg (2 tabs) PO three times per day (TID) for 3 days PLUS doxycycline 100 mg PO twice per day (BID) X 7 days.

or

» Mefloquine 750 mg once followed by 500 mg 8-12 hours later.

## Complicated Malaria

Complicated or severe malaria treatment is with one of the quinidine regimens:

- » Quinidine gluconate (requires blood pressure monitoring and baseline electrocardiogram (EKG) with cardiac monitoring for QRS widening and/or lengthening of QT interval): 6.25 mg base/kg (=10 mg salt/kg) loading dose IV over 1-2 hours, then 0.0125 mg base/kg/min use (=0.02 mg salt/kg/min) continuous infusion for at least 24 hours.
- » An alternative regimen is Quinidine gluconate (requires blood pressure monitoring and baseline EKG with cardiac monitoring for QRS widening and/or lengthening of QTc interval): 15 mg base/kg (=24 mg salt/kg) loading dose IV infused over 4 hours, followed by 7.5 mg base/kg (=12 mg salt/kg) infused over 4 hours every 8 hours, starting 8 hours after the loading dose (see package insert).
- » Caution: do not give a quinidine-loading dose if the patient has received more than 40 mg/kg of quinine in the preceding 48 hours or if they have received mefloquine within the preceding 12 hours.

The treatment of confirmed or suspected severe malaria in a field environment in Sub-Saharan Africa is a significant challenge. The only US FDA approved drug with an approved indication to treat severe malaria is intravenous quinidine. Unfortunately this

drug is often not available and carries a risk of severe adverse events such as cardiac dysrhythmias leading to sudden cardiac death if used improperly in settings without the ability to conduct cardiac monitoring. IV quinidine is not used by any other country in the world to treat malaria other than the USA. Drugs that are usually available in Sub-Saharan Africa to treat severe malaria include intravenous quinine, and intravenous artesunate. Intravenous artesunate is considered the drug of choice to treat severe malaria.

- » IV quinine: 20 mg/kg loading dose over 4 hours, followed by 10 mg/kg every 8 hours given over 2 to 4 hours. Once parasite density <1% and patient can take oral medication, complete treatment with oral quinine, 650 mg salt PO TID. Quinidine/quinine course = 7 days in Southeast Asia; = 3 days in Africa or South America.
  
- » Caution: do not give loading dose if patient has received quinidine or mefloquine in the last 24 hours.

or

- » IV artesunate: 2.4 mg/kg initial dose, then 2.4 mg/kg dose 12 hrs later, then 2.4 mg/kg dose Q 24 hrs once daily for a total of 4 doses (per CDC protocol) or until patient can tolerate oral artemesin-based combination therapy (ie, Coartem) (WHO guidelines).

There is always a risk of obtaining fake or counterfeit drugs in Africa (see page 37) so this option is discouraged but realistically there may be no other option. The difficulty in managing or treating severe malaria in a deployed field setting in Africa should increase all efforts to prevent the disease in the first place.

Once parasite density <1% and patient can take oral medication, then transition to one of the above treatments for uncomplicated disease.

### **Complicated Malaria Management**

Patients presenting with any of the clinical manifestations listed in Table 1 should be treated for complicated malaria.

Treatment approach for complicated malaria —

- » Start treatment as soon as diagnosis is suspected.
- » Calculate dosage according to patient weight.
- » Give medication intravenously.
- » Give loading dose of medication if indicated.
- » If patient is comatose, place on his/her side and give a single parenteral dose of Phenobarbital (5-20 mg/kg) to prevent convulsions.
- » Measure parasite count and hematocrit every 6-12 hours.
- » Exchange transfusion should be strongly considered for patients with parasitemia (>10%) and for severely ill patients.

- » Switch to oral medication as soon as patient can tolerate tablets and response to treatment is confirmed.
- » Observe patients carefully for drug toxicity and complications.

Source: U.S. Navy Environmental Health Center Technical Manual; NEHC-TM PM 6250.1, 2007.

### Treatment of Relapsing Malaria

*P. vivax* and *P. ovale* have dormant liver stage parasites which can reactivate (“relapse”) and cause malaria symptoms several months or years after initial infection.

Primaquine is the only available drug that can eradicate persistent hepatic parasites called hypnozoites of *P. vivax* and *P. ovale* malaria.

Use of primaquine combined with another appropriate antimalarial to treat a known (or suspected) *P. vivax* or *P. ovale* infection is known as radical cure. Primaquine can cause severe hemolytic anemia in G6PD-deficient patients. Therefore, before treating with primaquine, the G6PD status of patients must be checked. Consult with physician regarding treatment of relapsing malaria in G6PD-deficient individuals.

**Note: All malaria medications should be obtained from approved sources. NEVER procure malaria medications from local pharmacies or other local vendors due to very high levels of counterfeit and tainted products in developing countries.**

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# disposition

disposition

## Duration

- » Treated: 3-5 days in uncomplicated cases. May recrudescence (relapse) within 4 weeks in cases of treatment failure.
- » Untreated: *P. falciparum* is rapidly fatal in untreated nonimmune patients.
- » Non-falciparum malaria is rarely fatal, but relapses can occur with *P. vivax* and *P. ovale* in up to 50% of cases without primaquine. Majority of cases occur within weeks to 1 year of initial infection, but there are case reports of latency up to 8 years if persistent liver forms are not eliminated (see treatment tab: Treatment of Relapsing Malaria section). *P. malariae* is rarely fatal but may persist and recrudescence for years if not treated.

## Complications

The following complications strongly indicate infection with *P. falciparum* (also see Table 1).

- » Hyperparasitemia: > 5% of RBCs on thin smear parasitized; correlates with other complications in a non-immune patient, though complications can be seen with lower degrees of parasitemia.
- » Cerebral malaria: Altered mental status, personality changes, lethargy, stupor, coma, or delirium.

- » Neurologic impairment: monoplegia, hemiplegia, cerebellar signs, seizures (assess for hypoglycemia).
- » Renal failure: may be prerenal or intrarenal (acute tubular necrosis (ATN)-like) in origin. Treatment: Prevent shock with careful attention to fluid status; supportive care to include dialysis if needed.
- » Adult respiratory distress syndrome (ARDS, noncardiogenic pulmonary edema): Pathogenesis: due to increased capillary permeability and fluid extravasation. Avoid excessive intravenous fluid administration to reduce incidence. May occur several days into therapy. Treatment is supportive, to include mechanical ventilation with positive pressure.
- » Splenic rupture/hemorrhage: Spontaneous or from palpation of the spleen, especially with *P. vivax* malaria. Treatment is emergent blood replacement and surgical control of hemorrhage.

Treatment is with appropriate antimalarials for “severe disease” and supportive care. Mortality is high (20-50%), and survivors may show neurologic sequelae.

### **Return to Duty**

- » For uncomplicated cases: local hospitalization for 48-72 hours with limited duty for several days (until drug therapy is completed).

- » For complicated cases: patients should be evaluated on a case-by-case basis.
- » In *P. vivax* cases, the patient should be gently examined to ensure that splenomegaly has resolved before allowing the patient to return to full duty.

### **Air Evacuation**

- » Ensure rapid air-evacuation plans are in place prior to USAFRICOM missions.



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# consult info

## Consult Information

### Malaria Prophylaxis, Diagnosis and Treatment

- » Questions about malaria prophylaxis, diagnosis and treatment guidelines should be addressed to [id.consult@us.army.mil](mailto:id.consult@us.army.mil) and [pmom.consult@us.army.mil](mailto:pmom.consult@us.army.mil).
- » Recommendations for malaria treatment and prevention are based on information on parasite drug susceptibility for a specific geographic setting. See CDC, [http://www.cdc.gov/malaria/diagnosis\\_treatment/treatment.html](http://www.cdc.gov/malaria/diagnosis_treatment/treatment.html) and NCMI, <https://www.intelink.gov/ncmi/index.php>.
- » Another resource is the CDC Malaria Hotline: (770) 488-7788 Monday-Friday 8:00 am to 4:30 pm EST or (770) 488-7100 after hours, weekends and holidays.

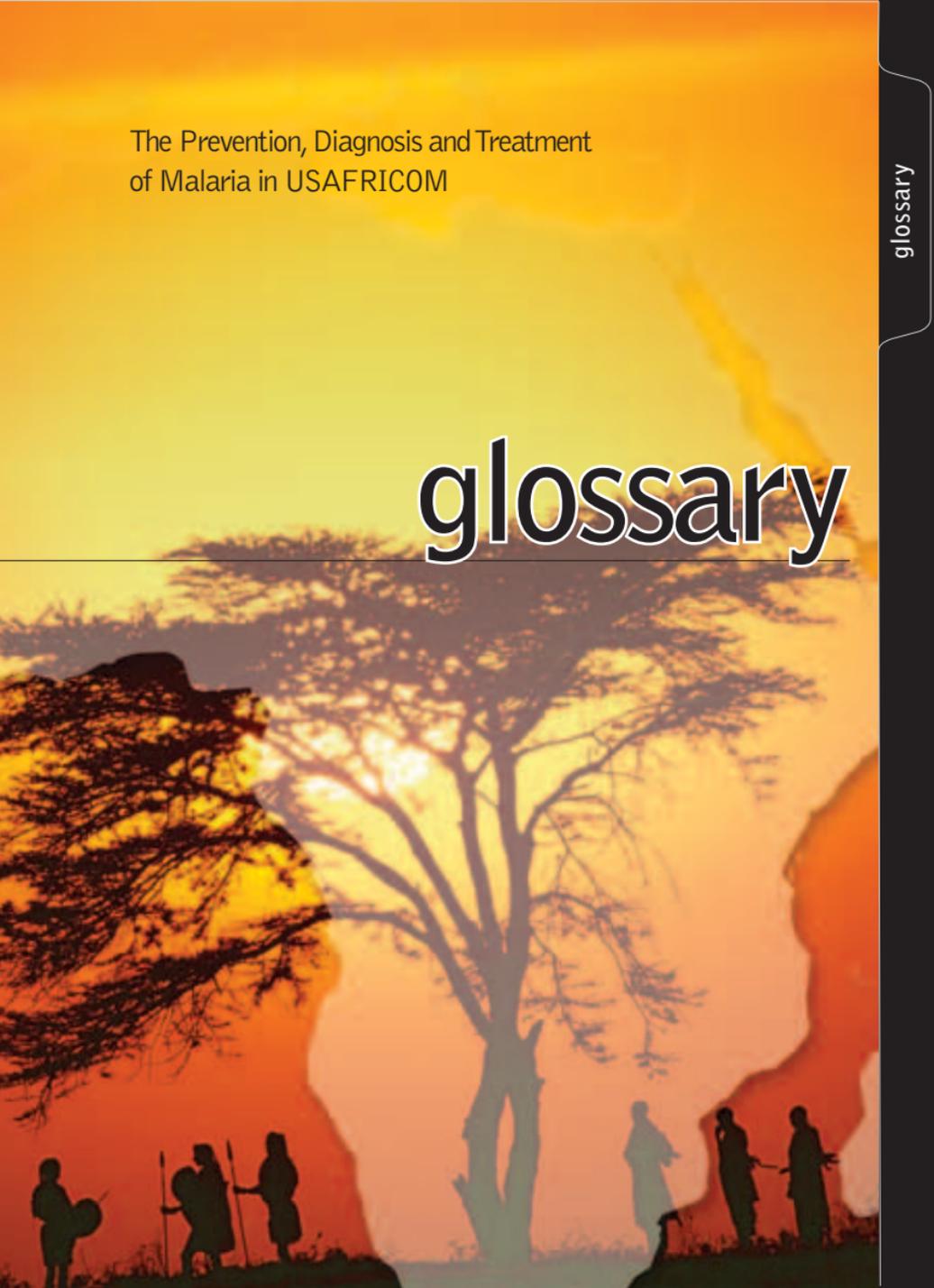
### Mosquito Control/Insect Repellent Questions

- » Questions about mosquito control/insect repellents and other unit protective measures contact: DoD Pesticide Hotline: (410) 436-3773/ DSN 584-3773 or email to [pesticide.hotline@amedd.army.mil](mailto:pesticide.hotline@amedd.army.mil).



The Prevention, Diagnosis and Treatment  
of Malaria in USAFRICOM

# glossary



## Glossary

**Anemia**- decrease in number of red blood cells and/or quantity of hemoglobin. Malaria causes anemia through rupture of red blood cells during merozoite release.

**Chemoprophalaxis**- method of disease prevention by taking specific medication. Malaria chemoprophylaxis requires drugs to be taken before, during, and after exposure. Very effective, but not absolute because of drug resistance and poor compliance.

**Dyspnea**- shallow, labored breathing

**Erythrocyte**- red blood cell

**Erythrocytic stage**- the malaria parasite's life cycle when infecting and developing within the red blood cells.

**Hematocrit**- the amount of blood consisting of red blood cells, measured as a percentage. Measured after a blood sample has been centrifuged or allowed to settle. Normal hematocrit values: Males 39-49%; females 33-43%.

**Hemolysis**- the destruction of red blood cells. Malaria causes hemolysis when malaria parasites mature and rupture red blood cells they infected.

**Hypnozoite**- a stage of malaria parasites found in liver cells. After sporozoites invade liver cells, some develop into latent forms called hypnozoites. They become active months or years later, producing a recurrent malaria attack. Only *P.vivax* and *P. ovale* species that infect humans develop latent stage hypnozoites. Primaquine is the only available drug active against hypnozoites.

**Hypoglycemia**- blood glucose less than the lower value of normal (70-110 mg/dl [3.9-6.1mmol/L in International System of Units (SI) reference units]). Glucose levels of 40 and below constitute severe hypoglycemia, a life-threatening emergency. Hypoglycemia is common in malaria as parasitized RBCs utilize glucose 75 times faster than uninfected cells. In addition, treatment with quinine and quinidine stimulate insulin secretion, reducing blood glucose.

**Hyponatremia**- serum sodium less than normal lower limit , which is 135-147 milliequivalent per liter (mEq/L) (135-147 mmol/L in SI reference units). Hyponatremia can be seen in malaria and is indicative of complicated malaria. Serum sodium levels approaching 120 and below constitutes a severe medical emergency.

**Hypotension**- see orthostatic hypotension

**Jaundice**- yellow discoloration of skin and eyes due to elevated blood levels of bilirubin.

**Orthostatic hypotension**- decrease in blood pressure occurring when an individual arises from a seated or lying position. A small decrease in blood pressure is normal, but large decreases are abnormal, especially if accompanied by clinical manifestations such as faintness, light-headedness, dizziness, or increased pulse. Orthostatic hypotension is a common finding in patients with malaria infections.

**Recrudescence**- a repeated attack of malaria (short-term relapse or delayed), due to the survival of malaria parasites in red blood cells. Characteristic of *P. malariae* infections.

**Recurrence**- a repeated attack weeks, months, or sometimes years after initial malaria infection, also called a long-term relapse. Due to re-infection of RBC's from malaria parasites (hypnozoites) that persisted in liver cells.

**Relapse**- a repeat attack of malaria.

**Tachycardia**- increased heart rate, defined as greater than 100 beats per minute.

**Tachypnea**- increased respiratory rate defined as greater than 20 breaths per minute.

**Thrombocytopenia**- low platelet count, defined as less than 150,000. Low platelet counts can lead to impaired blood clotting, and counts below 50,000 increase the risk of spontaneous bleeding. Thrombocytopenia is typical in malaria, though spontaneous bleeding is rare.





1-800-222-9698

<http://phc.amedd.army.mil>

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