**What is Malaria?** Malaria is a major international public health problem. It is caused by a bloodborne parasite and is transmitted by the bite of an infected mosquito. The parasite travels to the host’s liver, enters the liver, and cells grow and multiply. This may take six days or many months before the person becomes ill. (Even with chemoprophylaxis).

Four different species of parasites infect humans with malaria. *Plasmodium falciparum* accounts for approximately 50% of malaria cases worldwide and 95% of all malaria deaths. The other forms of malaria are usually non-lethal. The occurrence of each plasmodium species varies from region to region. It is important to know your **exact itinerary** so the correct medication will be prescribed. Malaria occurs in over 100 countries and territories. Central and South America, Hispaniola (Haiti and the Dominican Republic), Africa, the Indian Subcontinent, Southeast Asia, the Middle East and Oceania account for 300 to 500 million cases per year per the World Health Organization. One million people die from malaria every year. The Anopheles mosquito has nocturnal feeding habits, so transmission occurs primarily between dusk and dawn.

Early signs of malaria may include flu-like symptoms such as headache, fatigue, and loss of appetite. Abrupt chills and fever may then develop, along with muscle and joint pains. Symptoms may develop as early as 8 days after initial exposure and as late as several months after departure.

**Preventing Malaria:** Malaria is much easier to prevent than treat. If there is a risk of exposure, preventive medicine is necessary. The drug used will depend on your itinerary and health history. Chloroquine, Mefloquine, Doxycycline, Malarone, or Primaquine are the drugs used to treat malaria, depending on the country. (See **Important Information About Malaria Medications**). Occasionally, Malaria can occur despite taking anti-malarials. **If you become ill after returning home (and this could happen up to a year or more after), consult a doctor and be checked for malaria.**

Travelers are advised to use an appropriate preventive medicine **along with** personal protective measures as a means to adequately prevent malaria.

**Additional Protective Measures:**
- Use insect repellent containing DEET 30-35% (especially during the hours of dusk until dawn).
- Wear loose fitting, light-colored clothes that cover most of your body (i.e., arms, legs, ankles).
- Sleep inside screened areas or under mosquito netting.
- Avoid use of perfume, cologne, hair spray, or after-shave lotions.
- Use unscented soaps, shampoos, and deodorants.
- Remain in well-screened areas when possible.
- Use pyrethroid containing flying insect spray (i.e. Raid or Doom) in living and sleeping areas.
- Spray permethrin on clothing and bed nets. Permethrin is effective against gnats, ticks, chiggers, bedbugs, scorpions, centipedes, beetles, and flies.
- Children should use a different strength of DEET products because of the risk of DEET toxicity. (10% or less)
- Limit time outdoors between dusk and dawn.

Despite using protective measures, one can still contract malaria. Malaria can be treated effectively early in the course of the disease, but delaying treatment can have serious or even fatal consequences. Malaria may occur a few months or even a year or more after one returns home. Any illness causing fever, chills, sweats, and headache should be reported to a physician immediately.

**Follow-up Treatment:** If you have traveled in an area heavily infested with mosquitoes or have had **prolonged** exposure in malaria-endemic areas, you should consider being treated with Primaquine after leaving the area. Primaquine decreases the risk of potential relapses of *P. vivax* and *P. ovale* forms of malaria which could occur up to four years after a traveler has left a malaria area.

Information on specific risks by location and time of year can be obtained from the Centers for Disease Control (CDC), Malaria Hotline at (404) 332-4555, or visit their website at www.cdc.gov/travel. For questions or to report side effects, please contact Olin Health Center’s Travel Clinic at 353-3161, or visit our website at [www.msu.edu/~travel](http://www.msu.edu/~travel).
Important Information About Malaria Prophylaxis Medications

No chemoprophylactic regimen is 100% effective. May acquire malaria even if on chemoprophylaxis. Avoiding mosquito bites is very important. With prolonged (greater than one year) therapy of any antimalarial compound, a patient should have a baseline ophthalmologic exam and periodic exam (to include visual acuity, expert slitlamp, fundoscopic and visual field tests) performed. If there is any indication of abnormality in visual acuity, visual field, or retinal vascular areas or visual symptoms (light flashes and streaks), the drug should be discontinued and patient observed for progression. Long-term therapy patients should be monitored for neurologic abnormalities.

IF PREGNANT YOU SHOULD CONSIDER NOT TRAVELING INTO A MALARIA AREA UNTIL AFTER DELIVERY. FALCIPARUM MALARIA CARRIES A HIGHER RISK OF SERIOUS COMPLICATIONS AND RISK OF DEATH IN PREGNANT WOMEN.

CHLOROQUINE – 1 year prescription

- No baseline.
- If on drug for 1 year, should have an eye exam.
- Talk with patient about chance of fake drugs.
- Discontinue if marked darkening of urine, white blood count low.
- Establish with doctor in the country they are traveling to.

Precautions/contraindications
- Pregnancy (malaria infection in pregnant women may be more severe than in non-pregnant women)
- Nursing mothers
- Blood disorders (dyscrasias)--CBC (complete blood count) lab test should be done with prolonged therapy
- Hepatic, severe gastrointestinal disease, or neurologic disease
- Psoriasis
- *Retinal disease of the eyes or visual field changes
- *Porphyria (metabolic disorder)
- *G6-PD deficiency (enzyme deficiency) which causes hemolytic anemia following ingestion of antimalarial somaladixic acid, nitro Furadantin, phenacetin, uic, and some sulfonamides. Seen in Southeast Asians, African-Americans, Iraqis, Kurds, Sephartic, Jews, and Lebanese; less common in Greeks, Italians, Turks, North Africans, Spaniards, Portuguese, and Asentengzie Jews. All African American, Eastern European, Askhenzi Jewish patients should have G6-PD blood test before being given this medication. (Allow 2 weeks to get blood test back)
- Keep out of the reach of children—may be fatal if ingested.

Possible Side Effects: nausea, vomiting, dizziness, headache, tinnitus (ringing in ears), blurred vision, skin rash. Retinal damage may occur after long-term use or high dosage. Rarely: hypotension, hair loss, seizures, and psychosis.

Special Precautions: Chloroquine and related compounds have been reported to exacerbate psoriasis and porphyria. If patient has had an allergic reaction (hives, anaphylaxis) to Mefloquine (Larium) they should not use Chloroquine.

Notes
- Patient should have a recent eye exam before medication is prescribed. With long-term use, an eye exam and monitoring for neurologic symptoms should be done at 6 months and 1 year.
- After 5 years of Chloroquine use, retinopathy risk increases.
- If any visual problems occur while on this drug, patient should seek immediate medical attention.

DOXYCYCLINE – up to 1 year prescription

Contraindications
- Anticoagulants (blood thinners) (doxycycline increases the effect of anticoagulants)
- Hypersensitivity to past doses of tetracyclines
- Pregnancy and nursing mothers
Children younger than eight years of age

**Possible Side Effects** Nausea, vomiting, diarrhea, abdominal cramps, fever, skin rash, photosensitivity, yeast infections.

**Decreased effects of Doxycycline when used with:**
- antacids
- Dilantin (Phenytoin—decreases half-life of doxycycline)
- sodium bicarbonate
- Kaolin-Pectin (Kaopectate)
- barbiturates
- Tagamet
- carbamazepine (Tegretol)
- Pepto-Bismol
- iron products

**Special Precautions**
- Avoid use in those with hepatic (liver) disease or with lactating women.
- Avoid sun exposure since burns may occur; sunscreen should include UVA protection.
- Avoid use of Clinistix or Tes-Tape for urine if diabetic since this drug may cause a false negative test.
- Should not be used for longer than four months without being followed by a physician.
- Decreased effects of penicillin and oral contraceptives when used with Doxycycline. If you are using an oral contraceptive, an additional form of birth control should be used.
- Should be taken with large glass of water or food.
- Use of Methoxyflurane with Doxycycline may cause fatal renal toxicity.
- Be sure to take with 8 ounces of liquid to wash the drug down to reduce esophageal irritation.

**MEFLOQUINE (Larium) – 1 year prescription**

**Contraindications**
- Pregnancy and nursing mothers
- History of seizures or psychiatric disorders (depression, anxiety, psychosis)
- Cardiac disease (conduction abnormalities)
- Avoid use with certain drugs (i.e., quinine, quinidine, beta blockers anti-arrhythmia, anti-seizure medications—Depakene, Depakote, Chloroquine and Halofantrine should not be given with or subsequent to Larium)
- Hypersensitivity to previous dose
- Should not be taken longer than one year without being followed by a physician
- Compromised liver and renal function—not studies done with patients who have compromised liver or kidney function.
- If drug is administered for a prolonged period of time, periodic liver function tests should be performed
- Periodic ophthalmic examinations are recommended

**Possible Side Effects** Nausea, vomiting, diarrhea, loss of appetite, insomnia, dizziness, vertigo or fainting, nightmares, tinnitus (ringing in ears), visual difficulties, muscle pain, fever, rash. Rarely: confusion, seizures, psychosis, bradycardia, hair loss, emotional problems, and pruritus.

If you experience unexplained anxiety, depression, restlessness, or confusion, stop taking Mefloquine and consult your physician immediately.

If patient has had allergic reaction (hives, anaphylaxis) to Chloroquine, he/she should not take Larium.

Separate administration of mefloquine and oral typhoid by 24 hours. Take with at least 8 oz of water.

Patients with P. vivax malaria who are treated with mefloquine are at high risk to relapse. After initial treatment with Larium, patient should be treated with Primaquine.

**Precautions** Caution should be exercised in driving, piloting airplanes, operating machines as a disturbed sense of balance, neurological or psychiatric reactions have been reported. If signs of unexplained anxiety, depression, listlessness, or confusion are noted, could be a prodromal to a more serious side effect.

Should be taken with food or a milky drink.

**MALARONE (250 mg. Atouaquone and 100 mg. Proguanil) – up to 6 month prescription**

**Contraindications**
- Hypersensitivity to atovaquon or proguanil
- Pregnant and nursing mothers
- Not recommended for children weighing less than 11 kg.
- In severe renal impairment
**Possible side effects:** Abdominal pain, nausea, vomiting, headache, diarrhea, asthenia, anorexia, dizziness.

**Decreased effects of Malarone when used with:**
- Tetracyclines
- Reglan
- Rifampin
- Rifabutin

**Special precautions**
- Take with food or milky drink at the same time each day.
- No studies have been done in geriatric patients, so caution should be taken because this patient population may have reduced renal (kidney) function.
- Absorption may be reduced in patients with diarrhea & vomiting—repeat dose of Malarone if vomiting occurs within one hour after dosing.
- Consult physician if drug is discontinued.
- The concomitant administration of Malarone and any other medication containing Proguanil Hypochloride should be avoided.
- Malarone has not been studied in patients with hepatic (liver) impairment.
- No long term studies have been done on safety in long term use.

**PRIMAQUINE PHOSPHATE**

CDC recommended treatment schedule: Begin therapy during last 2 weeks of or following a course or suppression with chloroquine or a comparable drug. Adults, 26.3mg (15mg base) daily dose for 14 days.

**Contraindications**
- Concomitant administration of quinacrine and primaquine; the acutely ill suffering from systemic disease manifested by tendency to granulocytopenia (eg, rheumatoid arthritis and lupus erythematosus); concurrent administration of other potentially hemolytic drugs or bone marrow depressants.

**Warnings**
- Hemolytic reactions (moderate to severe): May occur in the following groups of people while receiving primaquine: Glucose-6-phosphate dehydrogenase (G-6-PD) deficient patients; individuals with idiosyncratic reactions (manifested by hemolytic anemia, methemoglobinemia or leukopenia) individuals with nictinamide adenine dinucleotide (NADH) methemoglobin reductase deficiency; or individuals with a family or personal history of favism. **Discontinue if marked darkening of the urine or sudden decrease in hemoglobin concentration or leukocyte count occurs.**

Safety in pregnancy has not been established.

**Precautions**
- Anemia, methemoglobinemia and leukopenia have occurred following large doses; do not exceed recommended dose. Perform routine blood examinations (particularly blood cell counts and hemoglobin determinations) during therapy. Patients who can have decreased white blood cell count or decreased hemoglobin.
- Pregnancy

**Drug Interactions**
- Do not administer primaquine to patients who have recently received quinacrine

**Adverse Reactions**
- GI: Nausea, vomiting, epigastric distress, abdominal cramps, loss of appetite, muscle weakness
- Hematologic: Leukopenia, hemolytic anemia in G-6-PD deficient individuals.

If GI upset occurs may be taken with food. If upset stomach (nausea and vomiting or stomach pain) continues, see a physician.

See a physician if a darkening of the urine occurs. See your doctor if you develop a rash, rapid heart rate, change in vision, hearing trouble, or ringing in your ears.

You may visit the Center for Disease Control (CDC) website at: [www.cdc.gov/travel](http://www.cdc.gov/travel), or the Olin Travel Clinic website at: [www.msu.edu/~travel](http://www.msu.edu/~travel).

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