Malaria in the United States: Treatment Tables

CDC Malaria Hotline: (770) 488-7788 or (855) 856-4713 (toll free) Mon–Fri, 9 am–5 pm EST;
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Accessible version available: www.cdc.gov/malaria/hcp/clinical-guidance/appendix-a-treatment-tables.html

Table 1. Uncomplicated malaria: *Plasmodium falciparum* or species unknown (If later diagnosed as *P. vivax* or *P. ovale*, see Table 2 for anti-relapse treatment; if pregnant woman, see Table 4)

Recommended Adult Regimens[1]	Recommended Pediatric Regimens[1,2]
Treatment options for infections acquired in any malaria-endemic area (including chloroquine-resistant areas)	
Listed in order of preference **A. Artemether-lumefantrine (Coartem®)**[3,4] (1 tab: 20 mg artemether and 120 mg lumefantrine) Adults: 4 tabs po per dose Five-day course[5]: Day 1: Initial dose and second dose 8 h later Days 2–5: BID dosing **or** **B. Atovaquone-proguanil (Malarone™)**[3,6] (Adult tab: 250 mg atovaquone and 100 mg proguanil) 4 adult tabs po QD x 3 days **or** **C. Quinine sulfate[7] plus doxycycline[8]** Quinine sulfate: 542 mg base (650 mg salt= 2 tabs in US) po TID x 7 days; Doxycycline: 100 mg po BID x 7 days **or** **D. Mefloquine**[10] (only when other options cannot be used) Dose 1: 684 mg base (750 mg salt= 3 tabs in US) po Dose 2 at 6 to 12 h: 456 mg base (500 mg salt= 2 tabs in US) po	**Listed in order of preference** **A. Artemether-lumefantrine (Coartem®)**[3,4] (1 tab: 20 mg artemether and 120 mg lumefantrine) 5–<15 kg: 1 tab po per dose 15–<25 kg: 2 tabs po per dose 25–<35 kg: 3 tabs po per dose ≥35 kg: 4 tabs po per dose Five-day course[5]: Day 1: Initial dose and second dose 8 h later Days 2–5: BID dosing **or** **B. Atovaquone-proguanil (Malarone™)**[3,6] (Adult tab: 250 mg atovaquone and 100 mg proguanil; Peds tab: 62.5 mg atovaquone and 25 mg proguanil) 5–<8 kg: 2 peds tabs po QD x 3 days 8–<10 kg: 3 peds tabs po QD x 3 days 10–<20 kg: 1 adult tab po QD x 3 days 20–<30 kg: 2 adult tabs po QD x 3 days 30–<40 kg: 3 adult tabs po QD x 3 days ≥40 kg: 4 adult tabs po QD x 3 days **or** **C. Quinine sulfate[7] plus doxycycline[8]** (or clindamycin[9]) Quinine sulfate: 8.3 mg base/kg (10 mg salt/kg) po TID x 7 days; Doxycycline: 2.2 mg/kg po BID x 7 days; or Clindamycin: 20 mg/kg/day po divided TID x 7 days **or** **D. Mefloquine**[10] (only when other options cannot be used) Dose 1: 13.7 mg base/kg (15 mg salt/kg) po Dose 2 at 6 to 12 h: 9.1 mg base/kg (10 mg salt/kg) po

Table 1. (Continued) Uncomplicated malaria: *Plasmodium falciparum* or species unknown (If later diagnosed as *P. vivax* or *P. ovale*, see Table 2 for anti-relapse treatment; If pregnant woman, see Table 4)

Recommended Adult Regimens[1]	Recommended Pediatric Regimens[1,2]
Treatment options only for infections acquired in chloroquine-sensitive areas (Central America west of Panama Canal, Haiti, and Dominican Republic) *Note: Regimens used to treat chloroquine-resistant infections may also be used.*	
Chloroquine phosphate (Aralen™ and generics) Dose 1: 600 mg base (1,000 mg salt) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 300 mg base (500 mg salt) po per dose **or** **Hydroxychloroquine (Plaquenil™ and generics)** Dose 1: 620 mg base (800 mg salt) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 310 mg base (400 mg salt) po per dose	**Chloroquine phosphate (Aralen™ and generics)** Dose 1: 10 mg base/kg (16.7 mg salt/kg) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 5 mg base/kg (8.3 mg salt/kg) po per dose **or** **Hydroxychloroquine (Plaquenil™ and generics)** Dose 1: 10 mg base/kg (12.9 mg salt/kg) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 5 mg base/kg (6.5 mg salt/kg) po per dose

Abbreviations: QD=once a day, BID=twice a day, TID=three times a day, QID=four times a day, h=hour(s), po=by mouth, tab(s)=tablet(s).

[1] If an antimalarial was taken for chemoprophylaxis, a different drug should be used for treatment.
[2] Not to exceed adult dose.
[3] To maximize absorption, artemether-lumefantrine and atovaquone-proguanil should be taken with a fatty food or drink.
[4] Artemether-lumefantrine can be used in pregnancy. Not recommended for infants <5 kg or women breastfeeding infants <5 kg. May be considered if other treatment options are not available or not tolerated, and benefits outweigh risks.
[5] Artemether-lumefantrine should be extended to a 5-day course due to multiple factors including its safety profile, immune status, and body size of U.S. travelers, and increasing spread of partial artemisinin resistance and decreasing susceptibility of lumefantrine.
[6] Atovaquone-proguanil is not recommended during pregnancy, in infants <5 kg, or in women breastfeeding infants <5 kg. May be considered if other treatment options are not available or not tolerated, and benefits outweigh risks.
[7] Quinine available in the U.S. has 324 mg (salt) per capsule; therefore, 2 capsules are needed for adult dosing. Pediatric dosing may be available at a compounding pharmacy. If a preferred treatment regimen (artemether-lumefantrine or atovaquone-proguanil) becomes available, switch due to potential side effects of quinine and complete a full course.
[8] Tetracycline (adult dose: 250 mg po QID x 7 days; pediatric dose: 25 mg/kg/day po divided QID x 7 days) with quinine is an alternative option for individuals ≥8 years old.
[9] Clindamycin with quinine is an alternative option for children <8 years old.
[10] Mefloquine increases risk of post-malaria neurological syndrome and is contraindicated in patients with epilepsy or neuropsychiatric disorders. In addition, mefloquine is not recommended for infections acquired in Southeast Asia due to drug resistance.

Table 2. Uncomplicated malaria: *Plasmodium vivax* or *Plasmodium ovale*

Recommended Adult Regimen[1] (BOTH acute and anti-relapse treatments recommended)	**Recommended Pediatric Regimen**[1,2] (BOTH acute and anti-relapse treatments recommended)
Acute treatment options for infections acquired in chloroquine-sensitive areas (malaria-endemic areas except Papua New Guinea or Indonesia) *Note: Regimens used to treat chloroquine-resistant P. vivax infections may be used if chloroquine or hydroxychloroquine is not readily available.*	
Chloroquine phosphate (Aralen™ and generics) Dose 1: 600 mg base (1,000 mg salt) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 300 mg base (500 mg salt) po per dose **or** **Hydroxychloroquine (Plaquenil™ and generics)** Dose 1: 620 mg base (800 mg salt) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 310 mg base (400 mg salt) po per dose	**Chloroquine phosphate (Aralen™ and generics)** Dose 1: 10 mg base/kg (16.7 mg salt/kg) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 5 mg base/kg (8.3 mg salt/kg) po per dose **or** **Hydroxychloroquine (Plaquenil™ and generics)** Dose 1: 10 mg base/kg (12.9 mg salt/kg) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 5 mg base/kg (6.5 mg salt/kg) po per dose
Acute treatment options for infections acquired in all malaria-endemic areas (including chloroquine-resistant areas in Papua New Guinea and Indonesia)	
Listed in order of preference **Note:** Artemether-lumefantrine and atovaquone-proguanil are equally preferred treatment options. **A.** **Artemether-lumefantrine (Coartem®)**[3,4] (1 tab: 20 mg artemether and 120 mg lumefantrine) Adults: 4 tabs po per dose Three-day course: Day 1: Initial dose and second dose 8 h later Days 2 and 3: BID dosing **or** **Atovaquone-proguanil (Malarone™)**[4,5] (Adult tab: 250 mg atovaquone and 100 mg proguanil) 4 adult tabs po QD x 3 days	**Listed in order of preference** **Note:** Artemether-lumefantrine and atovaquone-proguanil are equally preferred treatment options. **A.** **Artemether-lumefantrine (Coartem®)**[3,4] (1 tab: 20 mg artemether and 120 mg lumefantrine) 5–<15 kg: 1 tab po per dose 15–<25 kg: 2 tabs po per dose 25–<35 kg: 3 tabs po per dose ≥35 kg: 4 tabs po per dose Three-day course: Day 1: Initial dose and second dose 8 h later Days 2 and 3: BID dosing **or** **Atovaquone-proguanil (Malarone™)**[4,5] (Adult tab: 250 mg atovaquone and 100 mg proguanil; Peds tab: 62.5 mg atovaquone and 25 mg proguanil) 5–<8 kg: 2 peds tabs po QD x 3 days 8–<10 kg: 3 peds tabs po QD x 3 days 10–<20 kg: 1 adult tab po QD x 3 days 20–<30 kg: 2 adult tabs po QD x 3 days 30–<40 kg: 3 adult tabs po QD x 3 days ≥40 kg: 4 adult tabs po QD x 3 days

or **B. Quinine sulfate**[6] **plus doxycycline**[7] Quinine sulfate: 542 mg base (650 mg salt) po TID x 7 days; Doxycycline: 100 mg po BID x 7 days **or** **C. Mefloquine**[9] (only when other options cannot be used) Dose 1: 684 mg base (750 mg salt) po Dose 2 at 6 to 12 h: 456 mg base (500 mg salt) po	**or** **B. Quinine sulfate**[6] **plus doxycycline**[7] (or clindamycin[8]) Quinine sulfate: 8.3 mg base/kg (10 mg salt/kg) po TID x 7 days; Doxycycline: 2.2 mg/kg po BID x 7 days; or Clindamycin: 20 mg /kg/day po divided TID x 7 days **or** **C. Mefloquine**[9] (only when other options cannot be used) Dose 1: 13.7 mg base/kg (15 mg salt/kg) po Dose 2 at 6 to 12 h: 9.1 mg base/kg (10 mg salt/kg) po
Anti-relapse treatment[10]**:** Prior to use, quantitative G6PD testing needed to confirm normal activity	
Primaquine phosphate[11,12] 30 mg base (52.6 mg salt= 2 tabs in US) po qd x 14 days ≥70 kg dose should be adjusted to a total dose of 6 mg/kg, divided into doses of 30 mg base per day **or** **Tafenoquine (Krintafel™)**[12,13] 300 mg po x 1 dose	**Primaquine phosphate**[11,12] 0.5 mg/kg base (0.8 mg/kg salt) po qd x 14 days **or** **Tafenoquine (Krintafel™)**[12, 13] 300 mg po x 1 dose, only for patients ≥16 years old

Abbreviations: G6PD= Glucose 6 Phosphate Dehydrogenase, QD=once a day, BID=twice a day, TID=three times a day, QID=four times a day, h=hour(s), po=by mouth, tab(s)=tablet(s).

[1] If an antimalarial was taken for chemoprophylaxis, a different drug should be used for treatment.
[2] Not to exceed adult dose.
[3] To maximize absorption, artemether-lumefantrine and atovaquone-proguanil should be taken with a fatty food or drink.
[4] Artemether-lumefantrine can be used in pregnancy. Not recommended for infants <5 kg or women breastfeeding infants <5 kg. May be considered if other treatment options are not available or not tolerated, and benefits outweigh risks.
[5] Atovaquone-proguanil not recommended during pregnancy, in infants <5 kg, or in women breastfeeding infants <5 kg. May be considered if other treatment options not available or not tolerated, and benefits outweigh risks.
[6] Quinine available in the U.S. has 324 mg (salt) per capsule; therefore, 2 capsules are needed for adult dosing. Pediatric dosing may need compounding pharmacy. If a preferred treatment regimen (artemether-lumefantrine or atovaquone-proguanil) becomes available, switch due to potential side effects of quinine and complete a full course.
[7] Tetracycline (adult dose: 250 mg po QID x 7 days; pediatric dose: 25 mg/kg/day po divided QID x 7 days) with quinine is an alternative option for individuals ≥8 years old.
[8] Clindamycin with quinine is an alternative option for children <8 years old.
[9] Mefloquine increases risk of post-malaria neurological syndrome and is contraindicated in patients with epilepsy or neuropsychiatric disorders. In addition, mefloquine is not recommended for infections acquired in Southeast Asia due to drug resistance.
[10] Either option for anti-relapse treatment is recommended if chloroquine or hydroxychloroquine was used for acute treatment. If regimens other than either chloroquine or hydroxychloroquine were used for acute treatment, primaquine is the only option for anti-relapse treatment. Primaquine and tafenoquine are associated with hemolytic anemia in those with G6PD deficiency.
[11] Primaquine available in the U.S. has 15 mg (base) per capsule; therefore, 2 capsules are needed for adult dosing. For those with intermediate G6PD deficiency, weekly primaquine may be used (45 mg per week) for 8 weeks with close monitoring for hemolysis. For those with G6PD deficiency, consultation with an expert in infectious disease or malaria is advised to discuss alternative regimens to primaquine; however, they may be given chloroquine 300 mg base (500 mg salt) po weekly for 1 year from acute infection to prevent relapses.
[12] Primaquine and tafenoquine must not be used during pregnancy; pregnant patients with *P. vivax* and *P. ovale* infections should receive chloroquine 300 mg base (500 mg salt) po weekly after acute treatment for the remainder of pregnancy. If the patient acquired *P. vivax* infection in an area with chloroquine-resistant *P. vivax* infections, consultation with an expert in infectious disease or malaria is advised to discuss alternative regimens. After delivery, patients with normal G6PD activity can be given primaquine or tafenoquine depending on breastfeeding status or continue with chloroquine prophylaxis for a total of 1 year from acute infection. Primaquine or tafenoquine can be used during breastfeeding if the infant has normal G6PD activity.
[13] Tafenoquine should only be used if the G6PD quantitative test is normal and chloroquine or hydroxychloroquine is administered concurrently for acute treatment due to limited data on efficacy when used in combination with other regimens.

Table 3. Uncomplicated malaria: *Plasmodium malariae* or *Plasmodium knowlesi*

Recommended Adult Regimens[1,2]	Recommended Pediatric Regimens[1,2,3]
Treatment options for infections acquired in all malaria-endemic areas (no widespread chloroquine-resistance). Chloroquine and hydroxychloroquine should only be used if a mono-infection with *P. malariae* or *knowlesi* has been confirmed, ideally by PCR, as these species can be confused with *P. falciparum* on smear.	
A. Chloroquine phosphate (Aralen™ and generics) Dose 1: 600 mg base (1,000 mg salt) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 300 mg base (500 mg salt) po per dose **OR** **Hydroxychloroquine (Plaquenil™ and generics)** Dose 1: 620 mg base (800 mg salt) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 310 mg base (400 mg salt) po per dose **OR** **B. Artemether-lumefantrine (Coartem®)**[4,5] (1 tab: 20 mg artemether and 120 mg lumefantrine) Adults: 4 tabs po per dose Three-day course: Day 1: Initial dose and second dose 8 h later Days 2 and 3: BID dosing **OR** **C. Atovaquone-proguanil (Malarone™)**[4,6] (Adult tab: 250 mg atovaquone and 100 mg proguanil) 4 adult tabs po QD x 3 days	**A. Chloroquine phosphate (Aralen™ and generics)** Dose 1: 10 mg base/kg (16.7 mg salt/kg) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 5 mg base/kg (8.3 mg salt/kg) po per dose **OR** **Hydroxychloroquine (Plaquenil™ and generics)** Dose 1: 10 mg base/kg (12.9 mg salt/kg) po Doses 2 to 4 (3 additional doses) at 6, 24 and 48 h: 5 mg base/kg (6.5 mg salt/kg) po per dose **OR** **B. Artemether-lumefantrine (Coartem®)**[4,5] (1 tab: 20 mg artemether and 120 mg lumefantrine) 5–<15 kg: 1 tab po per dose 15–<25 kg: 2 tabs po per dose 25–<35 kg: 3 tabs po per dose ≥35 kg: 4 tabs po per dose Three-day course: Day 1: Initial dose and second dose 8 h later Days 2 and 3: BID dosing **OR** **C. Atovaquone-proguanil (Malarone™)**[4,6] (Adult tab: 250 mg atovaquone and 100 mg proguanil; peds tab: 62.5 mg atovaquone and 25 mg proguanil) 5–<8 kg: 2 peds tabs po QD x 3 days 8–<10 kg: 3 peds tabs po QD x 3 days 10–<20 kg: 1 adult tab po QD x 3 days 20–<30 kg: 2 adult tabs po QD x 3 days 30–<40 kg: 3 adult tabs po QD x 3 days ≥40 kg: 4 adult tabs po QD x 3 days

Abbreviations: QD=once a day, BID=twice a day, TID=three times a day, QID=four times a day, h=hour(s), po=by mouth, tab(s)=tablet(s).

[1] If an antimalarial was taken for chemoprophylaxis, a different drug should be used for treatment.
[2] Additional options include quinine combined with doxycycline or tetracycline (or clindamycin) or, if no alternatives are available, mefloquine. See Table 1 for dosing.
[3] Not to exceed adult dose.
[4] To maximize absorption, artemether-lumefantrine and atovaquone-proguanil should be taken with fatty food or drink.
[5] Artemether-lumefantrine can be used in pregnancy. Not recommended for infants <5 kg or women breastfeeding infants <5 kg. May be considered if other treatment options are not available or not tolerated, and benefits outweigh risks.
[6] Atovaquone-proguanil not recommended during pregnancy, in infants <5 kg, or in women breastfeeding infants <5 kg. May be considered if other treatment options are not available or not tolerated, and benefits outweigh risks.

Table 4. Uncomplicated malaria: Pregnant women

Recommended Adult Regimens[1,2]
***Plasmodium falciparum* or species unknown**
All trimesters (refer to Table 1 for dosing) Treatment options for infections acquired in any malaria-endemic area (including chloroquine-resistant areas) • **Artemether-lumefantrine (Coartem®)**[3] (preferred); or • **Quinine sulfate** plus **clindamycin**; or • **Mefloquine**[4] (only if no other options available) Additional treatment options available only if infection acquired in chloroquine-sensitive areas (Central America west of Panama Canal, Haiti, and Dominican Republic): • **Chloroquine phosphate (Aralen™ and generics)**; or • **Hydroxychloroquine (Plaquenil™ and generics)**
Plasmodium vivax or ***Plasmodium ovale*** (both acute and anti-relapse prevention are needed)
All Trimesters (refer to Table 2 for dosing) **Acute treatment** for infections acquired in all malaria-endemic regions except Papua New Guinea or Indonesia: • **Chloroquine phosphate (Aralen™ and generics)**; or • **Hydroxychloroquine (Plaquenil™ and generics)** **Acute treatment** for infections acquired in Papua New Guinea or Indonesia (may be used if chloroquine and hydroxychloroquine not readily available for infections acquired in other areas): • **Artemether-lumefantrine (Coartem®)**[3] (preferred); or • **Quinine sulfate** plus **clindamycin**; or • **Mefloquine**[4] (only if no other options available)
Anti-relapse prevention (treatment with either primaquine or tafenoquine contraindicated during pregnancy) • **Chloroquine** 300 mg base (500 mg salt) weekly until delivery, then consider anti-relapse treatment (refer to Table 2 for options and dosing)
Plasmodium malariae or ***Plasmodium knowlesi***
All Trimesters (refer to Table 3 for dosing) Treatment options for infections acquired in all malaria-endemic areas[5] • **Chloroquine phosphate (Aralen™ and generics)**; or • **Hydroxychloroquine (Plaquenil™ and generics)**; or • **Artemether-lumefantrine (Coartem®)**[3]

[1] If an antimalarial was taken for chemoprophylaxis, a different drug should be used for treatment.
[2] Atovaquone-proguanil is not listed due to insufficient data on its safety during pregnancy but may be considered if other treatment options are not available or not tolerated, and benefits outweigh risks.
[3] Artemether-lumefantrine can be used in all trimesters in pregnancy per WHO evidence review and policy.
[4] Mefloquine increases risk of post-malaria neurological syndrome and is contraindicated in patients with epilepsy or neuropsychiatric disorders. In addition, mefloquine is not recommended for infections acquired in Southeast Asia due to drug resistance.
[5] Additional options include quinine plus clindamycin or, if no alternatives are available, mefloquine. See Table 1 for dosing.

Table 5: Severe malaria[1]

Recommended initial regimen
Start IV artesunate promptly (recommended for all species and infections acquired in all areas). Commercially available from major distributors. 1 dose=2.4 mg/kg IV[2] Initial course: 3 doses in total at 0, 12 and 24 hours **If IV artesunate is not readily available, give oral antimalarials while obtaining IV artesunate**. When IV artesunate arrives, discontinue oral antimalarial and initiate IV treatment. Interim treatment options (Refer to Table 1 for dosing): **A. Artemether-lumefantrine (Coartem®)** (preferred); or **B. Atovaquone-proguanil (Malarone™)**; or **C. Quinine sulfate**; or **D. Mefloquine** (only if no other options available) If oral therapy is not tolerated, consider administration via nasogastric tube or after an antiemetic.
Reassess percentage of parasitemia at least 4 hours after the third dose of IV artesunate: **If parasitemia is >1%:** • Continue IV artesunate, same dose, QD up to 6 more days (for a total of 7 days of IV artesunate). Reassess parasitemia at least daily. When the parasitemia is ≤1%, see below. **If parasitemia is ≤1% and the patient is able to tolerate oral medications:** • See Follow-on Oral Treatment after IV Artesunate below. **If parasitemia is <1% but oral therapy is not tolerated:** • Can extend IV artesunate until oral therapy is tolerated or administer oral follow-on therapy via nasogastric tube or after an antiemetic based on clinical status. (See Follow-on Oral Treatment after IV Artesunate below.)
Follow-on Oral Treatment After IV Artesunate **Note**: Once the initial course of IV artesunate is completed, parasitemia is ≤1%, and the patient can tolerate oral medication, a full course of oral follow-on treatment should be administered beginning 8-24 hours after the last dose of IV artesunate. A full oral antimalarial treatment course is always necessary following IV artesunate, even if it is used for a total of 7 days, to ensure a longer acting partner medication is given along with the short acting artesunate. Give a complete follow-on oral regimen regardless of the interim drug used or the previous doses administered. Options include[3] (refer to Table 1 for dosing): • **Artemether-lumefantrine (Coartem®)**, or • **Atovaquone-proguanil (Malarone™)** If *P. vivax* or *P. ovale* infections, in addition to acute treatment listed here, anti-relapse treatment is needed. (Refer to Table 2 for dosing).

Abbreviations: QD=once a day, IV=intravenous

[1] Laboratory-confirmed or suspected malaria cases with ≥1 clinical criteria for severe disease (impaired consciousness/coma, prostration, seizures, severe anemia [hemoglobin <7mg/dl], acute kidney injury/ decreased urine output, pulmonary edema/ acute respiratory distress syndrome, circulatory collapse/ shock, acidosis, jaundice, abnormal bleeding/ disseminated intravascular coagulation, hypoglycemia); and/or parasite density ≥5%.

[2] Current dosing in small children <20kg at 2.4mg/kg is based on an FDA analysis modeling pharmacokinetics in a population created from the CDC growth charts. Note WHO recommends 3mg/kg dosing for children <20kg based on modeling the relationship between body weight and age of African children presenting with severe malaria.

[3] Additional options include quinine combined with doxycycline or tetracycline (or clindamycin) or, if no alternatives are available, mefloquine. See Table 1 for dosing.