

Malaria Prevention, Diagnosis, Treatment, and Surveillance in the US

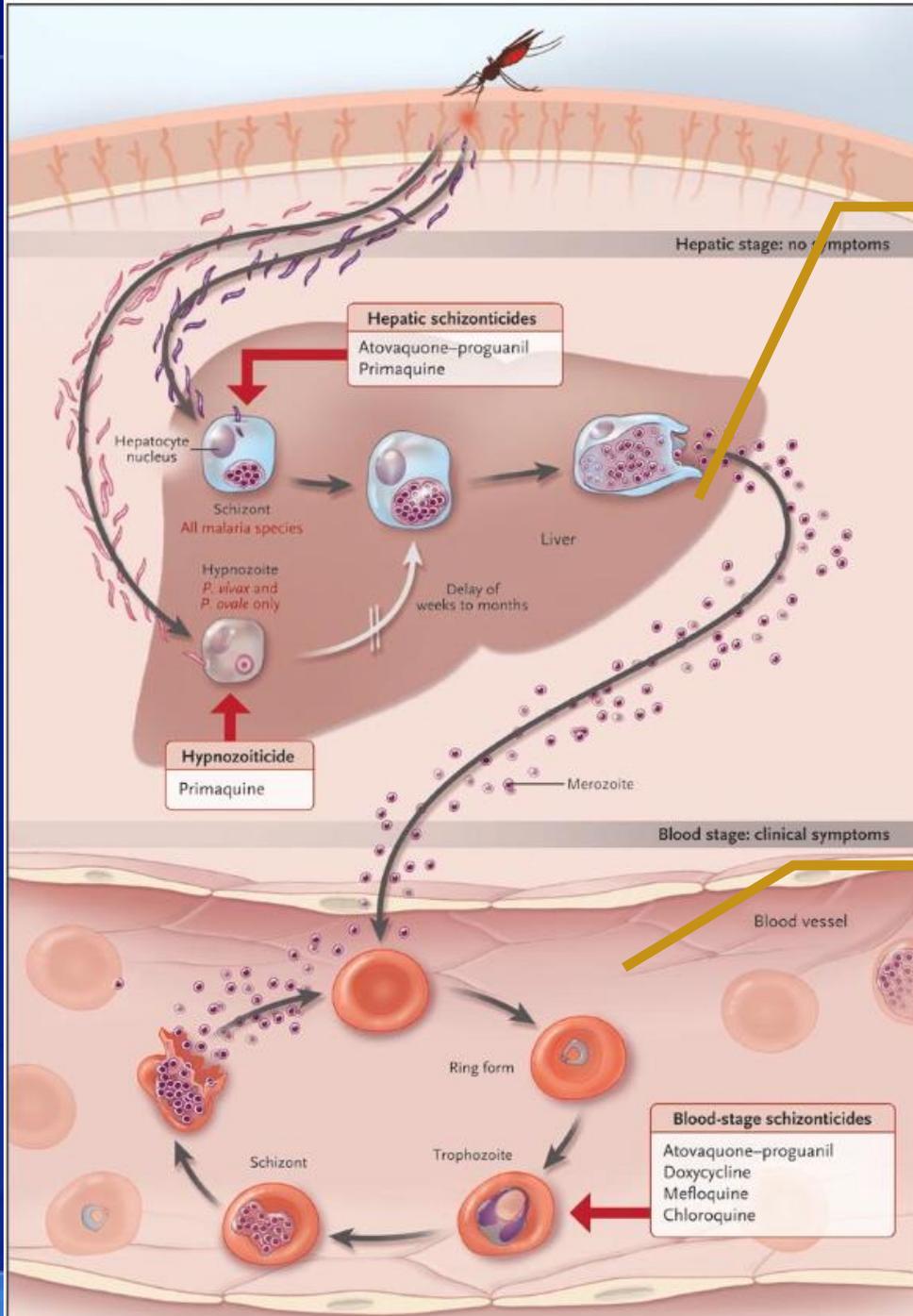


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Centers for Disease Control and Prevention

*Center for Global Health
Malaria Branch*



Malaria life cycle



- Lasts weeks to months.
- No symptoms.

- Sick with malaria

Uncomplicated Malaria

- **Symptoms: fever, chills, headache, body pains, diarrhea, vomiting, cough**
- **Signs: anemia, thrombocytopenia**
- **Symptoms may be very nonspecific**

Signs and Symptoms of Severe Malaria

- ❑ **Brain: Impaired consciousness, seizures, herniation**
- ❑ **Lungs: Acute respiratory distress syndrome**
- ❑ **Kidneys: Acute renal failure, hemoglobinuria**
- ❑ **Blood/Spleen: Parasitemia >5%, jaundice, severe anemia, abnormal bleeding**
- ❑ **Metabolic system: Acidosis, hypoglycemia**
- ❑ **Circulatory system: Shock (low blood pressure)**

Malaria is a nationally reportable disease

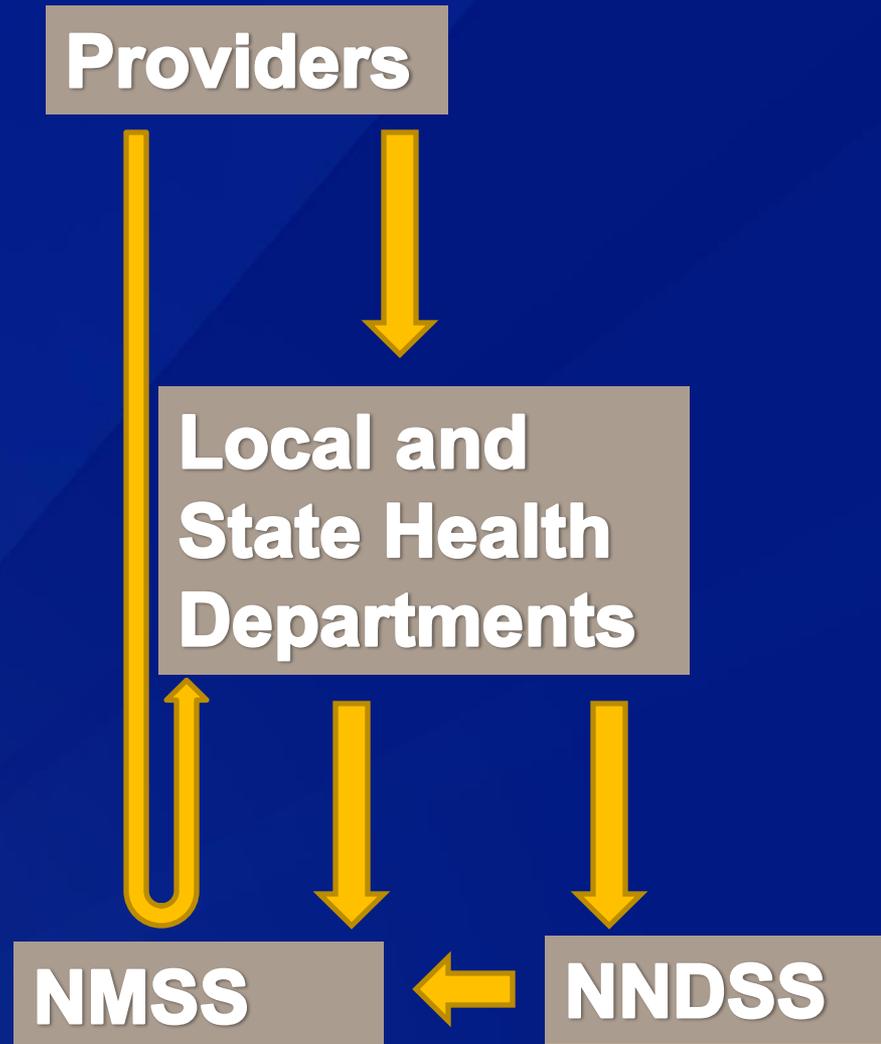
- ❑ **National Malaria Surveillance system is the oldest surveillance system at CDC**
 - *Grew out of the Malaria Control in War Areas Program which was the precursor to the modern CDC*
- ❑ **States and local governments have the authority to require reporting**
- ❑ **Data is then transmitted to CDC**
 - **Mail**
 - **Fax**
 - **Electronic**

Revised malaria case definition, 2012

CSTE position statement 13-ID-08

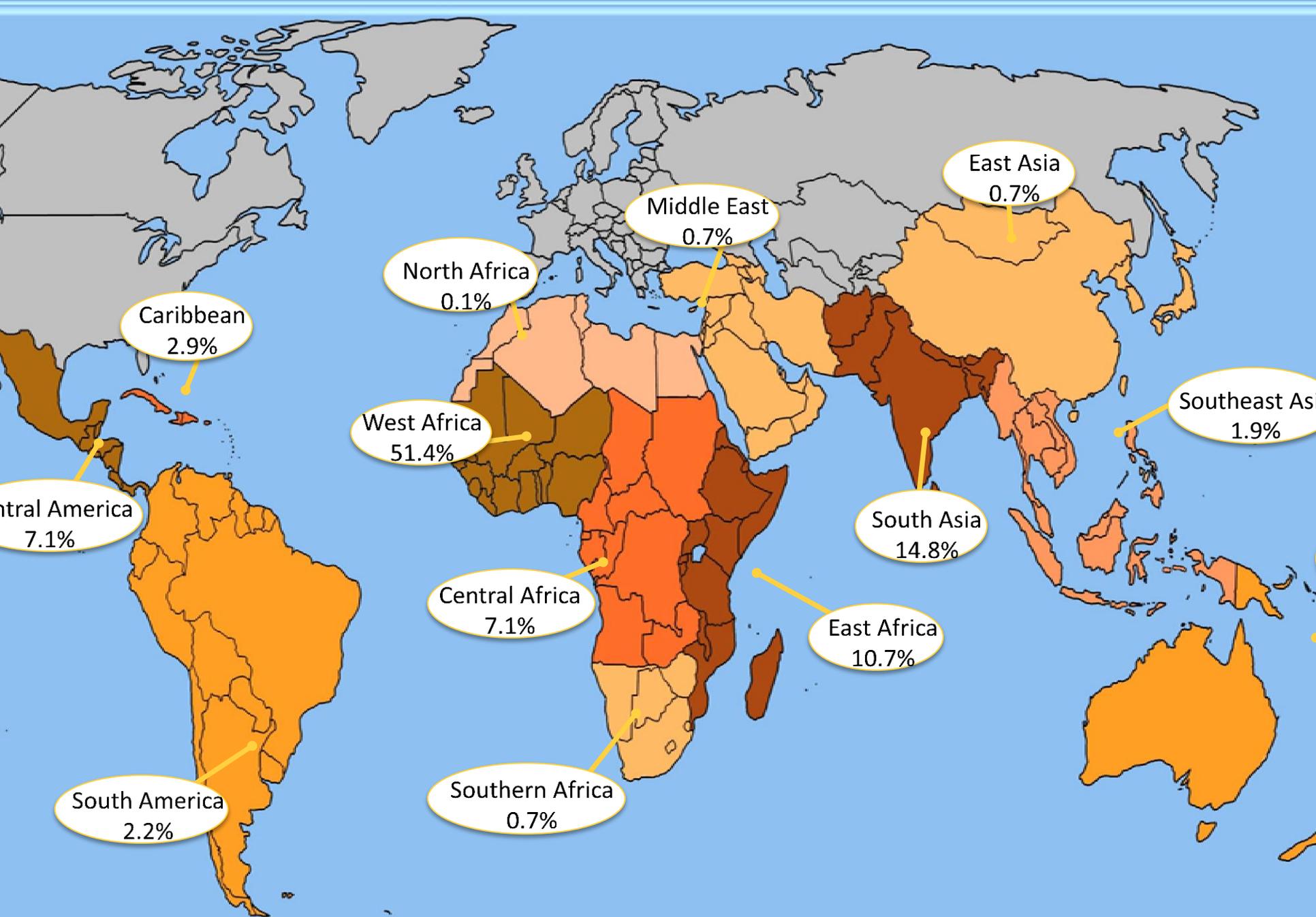
- **Diagnostic standard must include species determination and calculation of parasitemia**
- **PCR confirmation is encouraged**
 - Free species confirmation available at CDC
- **Would like to get 100% of malaria diagnosed in US species confirmed and evaluated for evidence of drug resistance**

Malaria reporting



Public health importance of malaria in the US

- **Cause of morbidity and mortality**
- **Resource utilization**
 - **~ 50% of malaria cases are hospitalized**
- **Cases are preventable**
 - **Chemoprophylaxis and personal protection measures**
- **Reintroduction is preventable**
 - **Re-emergence of malaria in the United States is possible**



Malaria Prevention

- **Ensure that all people who will be at risk of infection use the appropriate prevention measures**
- **Prevent adverse effects of those interventions among people using them unnecessarily**
- **Individual risk assessment**
 - Destination country
 - Detailed itinerary including specific cities
 - Types of accommodation
 - Season
 - Style of travel
 - Pregnancy or drug resistance at the destination may temper the risk assessment
- **Depending on level of risk**
 - no specific interventions
 - mosquito avoidance measures only
 - mosquito avoidance measures plus chemoprophylaxis

CDC recommendations

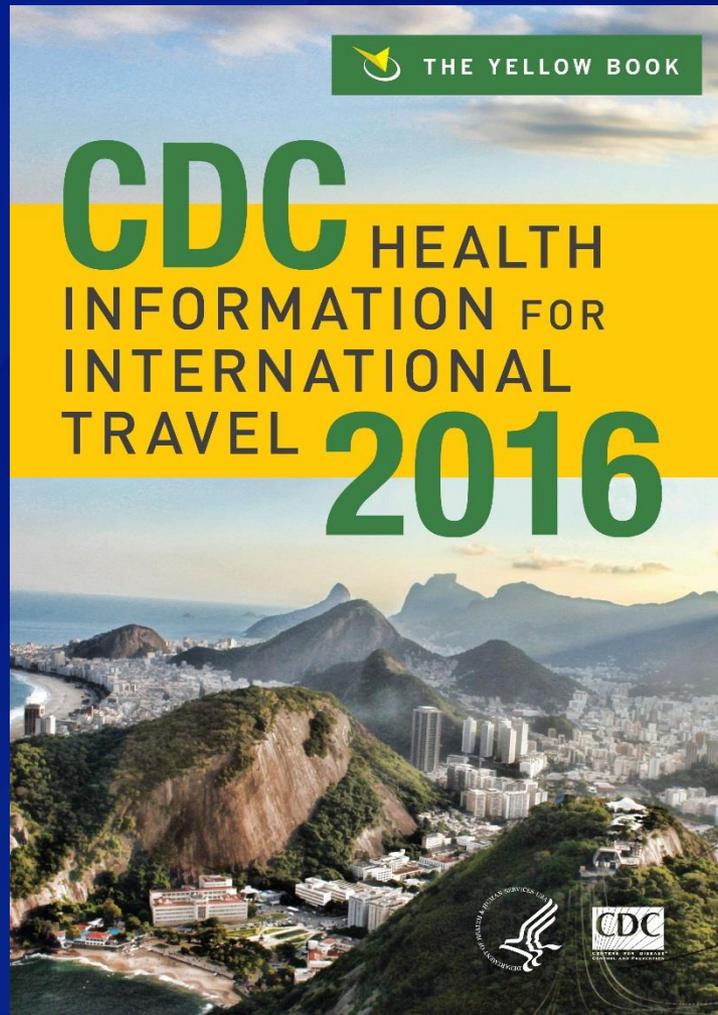
- **Maintain files on all countries in the world; actively collecting data**
 - World Health Organization (main and regional offices)
 - National malaria control programs
 - International organizations
 - CDC overseas staff
 - US Military
 - Academic, research, and aid organizations
 - Published records from the medical literature
- **Consider data in context**
 - Malaria control activities within that country
 - Natural disasters, wars, and other events (e.g., Ebola outbreak) that may be affecting the ability to control malaria or accurately count and report it
- **Consider volume of travel to countries**
- **Consider number of acquired cases reported in the US surveillance system**
- **Make judgments about reliability and accuracy**
- **Assess trends**

- **Describe areas of countries where transmission occurs, substantial occurrences of antimalarial drug resistance, the proportions of species present, and the recommended chemoprophylaxis options.**

Country specific recommendations

Country	Areas with Malaria	Estimated relative risk of malaria for US travelers ¹	Drug Resistance ⁶	Malaria Species ²	Recommended Chemoprophylaxis ³	Helpful links for Select Countries
Afghanistan	April-December in all areas at altitudes below 2,000m (<6,561ft)	High ⁵	Chloroquine	<i>P. vivax</i> 80-90% <i>P. falciparum</i> 10-20%	Atovaquone/ proguanil, doxycycline, or mefloquine,	Altitude information  for Afghanistan
Albania	None	None	Not Applicable	Not Applicable	Not Applicable	
Algeria	None	None	Not Applicable	Not Applicable	Not Applicable	
Andorra	None	None	Not Applicable	Not Applicable	Not Applicable	
Antarctica	None	None	Not Applicable	Not Applicable	Not Applicable	
Angola	All	Moderate	Chloroquine	<i>P. falciparum</i> 90% <i>P. ovale</i> 5% <i>P. vivax</i> 5%	Atovaquone/ proguanil, doxycycline, or mefloquine	
Anguilla (U.K.)	None	None	Not Applicable	Not Applicable	Not Applicable	
Antigua and Barbuda	None	None	Not Applicable	Not Applicable	Not Applicable	
Argentina	Rural areas of Salta and Jujuy province (along Bolivian border) and Misiones and Corrientes province (along border of Paraguay). Malaria present in Iguazu Falls.	Very Low	None	<i>P. vivax</i> 100%	Atovaquone/ proguanil, chloroquine, doxycycline, mefloquine, or primaquine ⁴	Map of provinces in Argentina  To look up if a city is within a certain province 
Armenia	Previously limited to the Ararat Valley in the Ararat and Artashat region and Masis district. No cases reported since 2006.	Very Low	None	Historically <i>P. vivax</i> 100%	Mosquito avoidance only	Regions in Armenia  To look up if a city is within a certain region 
Aruba	None	None	Not Applicable	Not Applicable	Not Applicable	
Australia; Including Cocos (Keeling) Islands.	None	None	Not Applicable	Not Applicable	Not Applicable	
Austria	None	None	Not Applicable	Not Applicable	Not Applicable	
Azerbaijan	Rural areas below 1,500 m (4,921 ft). None in Baku.	Very Low	None	<i>P. vivax</i> 100%	Atovaquone/ proguanil, chloroquine, doxycycline, mefloquine, or primaquine ⁴	Altitude information  for Azerbaijan
Azores (Portugal)	None	None	Not Applicable	Not Applicable	Not Applicable	

Yellow Book: Health Information for International Travel





CDC Malaria Map Application



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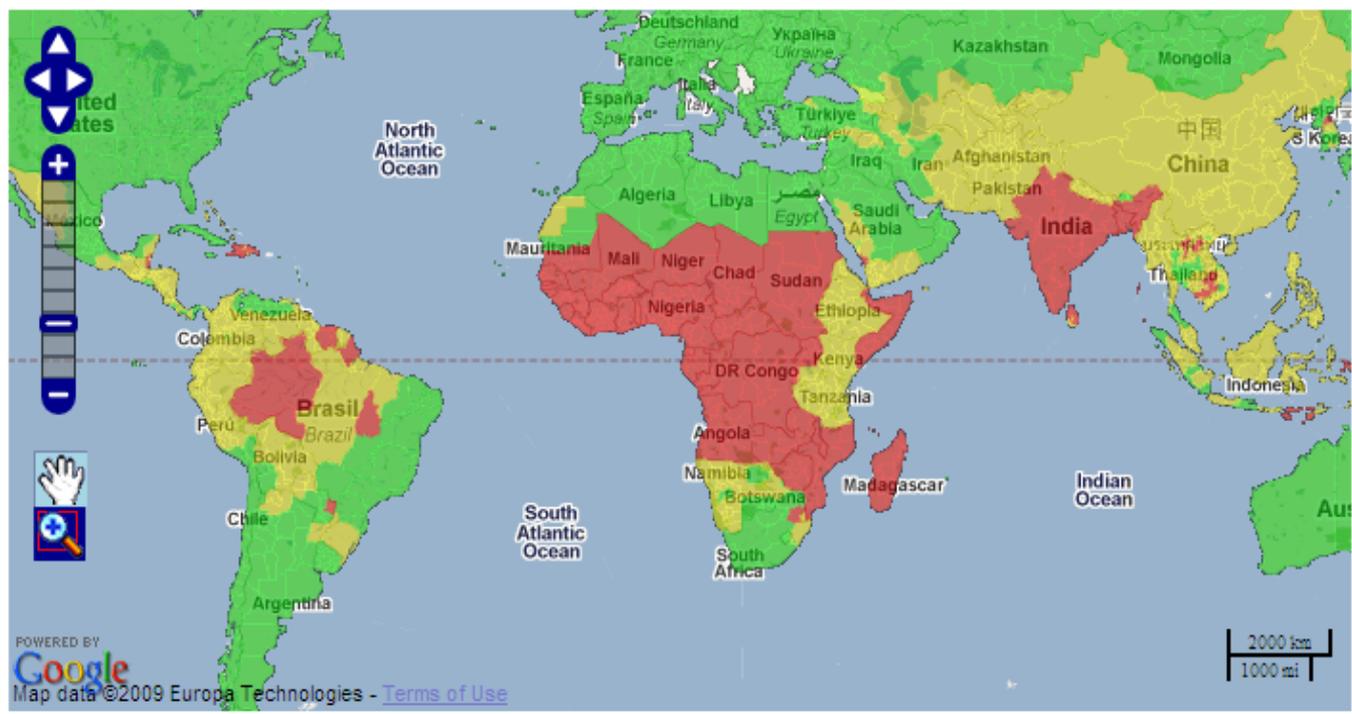
Search

Search all populated places (~ 6 secs)

Country

Province

City



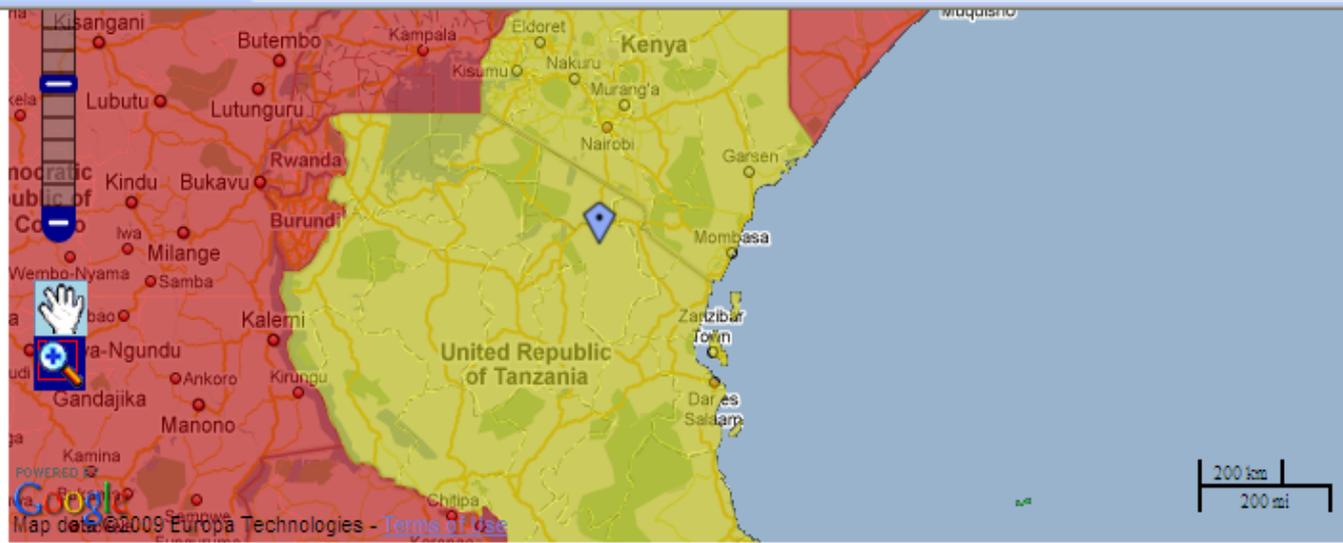
Alternative

Choose a color scheme:

Red, yellow, green

Map Legend

- Red: Malaria
- Yellow: Malaria
- Green: No known malaria



Choose a color scheme:

Map Legend

- Malaria
- Malaria
- No known malaria

- Country**
- Province**
[Arusha, Tanzania](#)
- City**
[Arusha, Tanzania](#)
[Arusha Chini, Kilimanjaro, Tanzania](#)

You searched for city named **Arusha**, in the country of **Tanzania**
NOTE: Malaria information generally available only for the province and country in which the city is located
 Elevation of this city: **1410 meter (4626 feet)**

Malaria in Country:

Country Name	Malaria in Country	Drug Resistance	Malaria Type	Prophylaxis for Areas with Malaria
Tanzania	All areas at altitudes <1,800m (<5,906ft).	Chloroquine	<i>P. falciparum</i> >85%, <i>P. malariae</i> and <i>P. ovale</i> >10%, and <i>P. vivax</i> rare	Atovaquone/proguanil, doxycycline, or mefloquine

Available as online resources

<http://wwwn.cdc.gov/travel/contentYellowBook.aspx>

<http://www.cdc.gov/malaria>



Chemoprophylaxis use

- ❑ **96% of the cases among US travelers did not take a recommended chemoprophylactic regimen**
 - **No drug**
 - **Wrong drug**
 - **Did not complete the regimen**
- ❑ **Chemoprophylaxis prevents malaria**

Malaria in missionaries and aid workers

- **After the earthquake in Haiti there was a surge in malaria cases in the US acquired in Haiti**
 - **16% of these cases occurred in missionaries and aid workers**
- **Military personnel, doctors, nurses, and other aid workers heading to West Africa to assist with the Ebola epidemic must use malaria chemoprophylaxis**
 - **Geosentinel Data from Ebola affected countries, 2009-2014: 40.3% of febrile travelers had malaria**
 - **Calls to CDC EOC during current Ebola outbreak: ~ 46% persons evaluated for Ebola were diagnosed with malaria**



Ebola Update

**CDC Response to 2014 Ebola
in United States and West Africa**

- **Both thick and thin smears must be done**
 - **Thick is more sensitive at detecting parasites**
 - **Thin determines species and parasitemia**
- **Standard methods using standard precautions can still be used**
- **Labs can choose to use the CDC recommended modifications to inactivate Ebola virus**



Ebola Update

**CDC Response to 2014 Ebola
in United States and West Africa**

For thick smears:

- **No pre-hemolysis in water and no fixation.**
- **Working Giemsa stain should be prepared with 2 ml of 5% Triton X-100 per 40 ml. Thick smear slides are placed into this solution for 45 minutes.**
- **Working Giemsa buffer should be prepared with 2 drops of 5% Triton X-100 per 40 ml. Stained slides should be washed as normal for 5 minutes in this buffer.**

For thin smears:

- **Fix thin smears for 15 to 30 minutes in 100% methanol.**
- **Working Giemsa stain should be prepared with 2 drops of 5% Triton X-100 per 40 ml. Dry thin smear slides should be placed into this solution for 45 minutes.**
- **Working Giemsa buffer should be prepared with 2 drops of 5% Triton X-100 per 40 ml. Stained slides should be washed as normal for 5 minutes in this buffer.**

Thick and thin smears cannot be on the same slide.

Diagnosis

- **History of travel to endemic area**
- **Clinical symptoms**
- **Thick and thin blood smears**
 - **If negative, repeat every 12-24 hrs for a total of 3 sets**
- **Thick smears**
 - **Best for detection of malaria parasites**
- **Thin smears**
 - **Identify species**
 - **Determine parasitemia (parasite density)**

Additional Diagnostic Options

- **PCR**
 - **Can be a bit more sensitive than microscopy**
 - **Results not available soon enough to establish diagnosis**
 - **More useful for species confirmation**
- **Rapid Diagnostic tests (RDTs)**
 - **Antigen detection**
 - **Can rapidly establish diagnosis**
 - **Less sensitive than microscopy**
 - **Does not confirm species**
 - **No quantification**
 - **Must be confirmed by microscopy**

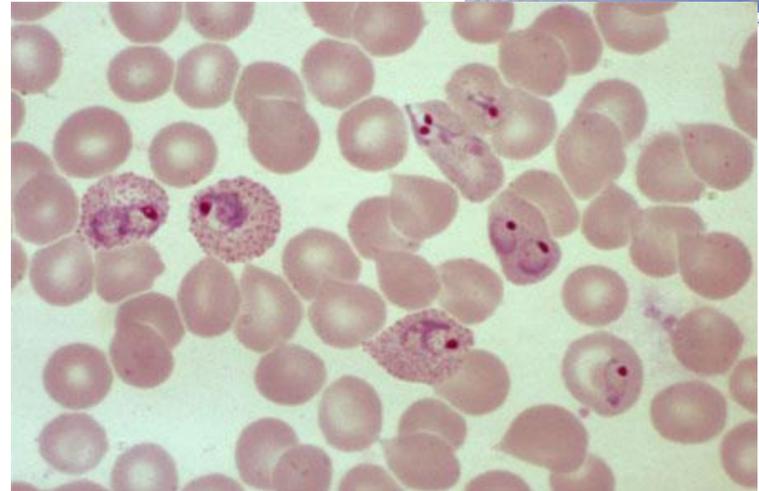
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DPD_x

Laboratory Identification of Parasites
of Public Health Concern



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Laboratory services at CDC

- **Telediagnosis (DPDX@CDC.GOV)**
- **Microscopy review**
- **PCR**
- **Drug levels**
- **Drug resistance testing**
- **Serology – not for acute diagnosis**

- **Specimen submission form and shipping instructions**

Treatment of uncomplicated malaria

- **Oral regimens**
 - **Malarone, Coartem, quinine combinations, mefloquine, chloroquine**
- **Can be managed outpatient**
 - **Some will progress to severe complications**
 - **Some species require additional medicine for relapse prevention**

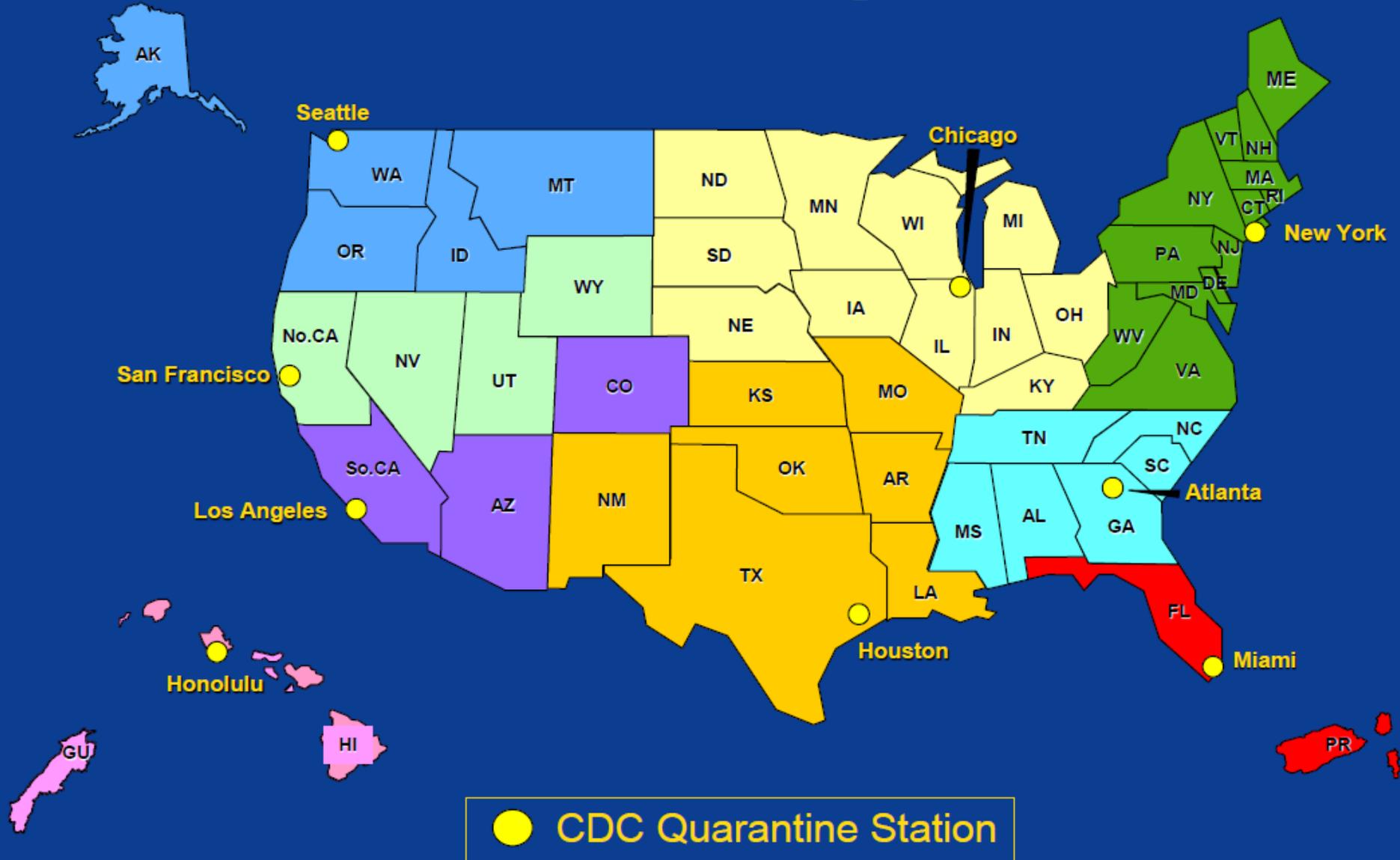
Medicines used for treatment of uncomplicated cases

<input type="checkbox"/> Atovaquone-proguanil	50%
<input type="checkbox"/> Quinine based	23%
<input type="checkbox"/> Chloroquine	10%
<input type="checkbox"/> Mefloquine	7%
<input type="checkbox"/> Artemether-lumefantrine	7%

Treatment of severe malaria

- **Parenteral regimens**
 - **IV quinidine is only FDA approved medicine available in the US**
 - **Ventricular arrhythmias, hypoglycemia, hypotension**
 - **IV artesunate available free through CDC under investigational new drug protocol**
- **Must be managed in the ICU**
 - **Continuous cardiac monitoring**
 - **Ventilator, dialysis as needed**

CDC Quarantine Stations and Jurisdictions for Drug Releases



Drug resistance surveillance

- **239 specimens submitted from 38 states**
- **Travel history reported for 193 cases**
 - **Africa: West Africa (n=106), East Africa (n=35), Central Africa (n=13), Southern Africa (n=3)**
 - **Asia (n=12)**
 - **Central / South America (n=9)**
 - **Caribbean (n=4)**
 - **Europe (n=1)**

Final slide

- ❑ Malaria is preventable through the use of mosquito avoidance and malaria chemoprophylaxis**
- ❑ When traveling in a malaria-endemic area, use your insect repellent and take your malaria pills**
- ❑ Fever in a traveler returning from a malaria endemic area must immediately be evaluated by smear microscopy to rule out malaria infection**
- ❑ Effective treatment administered ASAP can prevent progression to severe malaria**
- ❑ Severe malaria should be treated with the best available parenteral medicine**

Thank you

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, MS F22, Atlanta, GA 30333
Telephone, 770-488-7788 or 770-488-7100
E-mail: malaria@cdc.gov Web: www.cdc.gov/malaria

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Center for Global Health
Malaria Branch

