Malaria

Illness:	All species are transmitted by the bite of an infected female *Anopheles* mosquito. Occasionally, transmission occurs by blood transfusion or congenitally from mother to fetus. Although malaria can be a fatal disease, illness and death from malaria are largely preventable.
Infectious Agent:	Plasmodium spp.: *vivax, ovale, falciparum, malariae*
Incubation period:	Can vary depending on species, and also the person's immune status and whether they took prophylaxis; range 9–40 days.
Infectious period:	Persons are not infectious; however, persons who have had malaria are not allowed to donate blood for 3 years after treatment for malaria.
Symptoms:	Malaria is characterized by fever and influenza like symptoms, including chills, headache, myalgias, and malaise; these symptoms can occur at intervals. Malaria may be associated with anemia and jaundice, and *P. falciparum* infections can cause seizures, mental confusion, kidney failure, coma, and death. Malaria symptoms can develop as early as 6 days after initial exposure in a malaria-endemic area and as late as several months after departure from a malarious area, after chemoprophylaxis has been terminated.
Transmission routes:	Mosquito-borne; *Anopheles* spp. Malaria transmission occurs in large areas of Central and South America, Hispaniola, Africa, Asia (including the Indian Subcontinent, Southeast Asia, and the Middle East), Eastern Europe, and the South Pacific.
Treatment:	CDC has on-call physicians to advise on malaria treatment: **9–5 EST: 770-488-7788 or 855-856-4713** **After-hours: 770-488-7100, ask to page the malaria clinician.** Treatment guidelines available on-line: https://www.cdc.gov/malaria/

Information Needed for the Investigation

Verify the Diagnosis

- Thin and thick smears and EDTA whole blood from patients can be sent to ASPHL for parasite identification. ASPHL might also send slides or just digital images to CDC for further confirmation of species.

Environmental Investigation

- None; although ensure that cases are imported. Travel-specific data will be needed for the case report form.

Malaria

Reporting Requirements

- CDC has case investigation forms that can be used to track a case: https://www.cdc.gov/malaria/resources/pdf/report/Malaria_CSR_fillable.pdf.
    - Fax REDACTED form to CDC: 404-718-4815 or Submit form electronically via secure email to malaria@cdc.gov
    - Page 2 of the form is to be completed 4 weeks after treatment.

- Enter ALL lab-confirmed cases into NBS.
    - Please either scan/append the hard copy CDC investigation form to the case record in NBS.
    - **NOTE:** As of 2014 per case definition revisions, cases are attributed to location of diagnosis and NOT specifically location of residency; therefore, some cases may not have an AK address.

Other Information Available

- CDC's website: http://www.cdc.gov/malaria/index.html

Malaria (*Plasmodium* spp.)

2014 Case Definition

Background

Malaria is a mosquito-borne disease caused by a parasite; intraerythrocytic protozoa of the genus Plasmodium (e.g., *P. falciparum*, *P. vivax*, *P. ovale*, and *P. malariae* among other species). The first two species cause the most infections worldwide. *P. falciparum* is the agent that most commonly causes severe and potentially fatal malaria. *P. vivax* and *P. ovale* may have dormant liver stage parasites, which can reactivate and cause malaria several months or years after the infecting mosquito bite. *P. malariae* can result in long-lasting infections and if untreated can persist asymptomatically in the human host for years, even a lifetime. About 1600 cases of malaria are reported each year in the United States, most of which are imported, i.e., acquired in malaria-endemic countries.

Clinical Description

The first symptoms of malaria (most often fever, chills, sweats, headaches, muscle pains, nausea and vomiting) are often not specific and are also found in other diseases (such as influenza and other common viral infections). Likewise, the physical findings are often not specific (elevated temperature, perspiration, tiredness). In severe malaria (caused by *P. falciparum*), clinical findings (confusion, coma, neurologic focal signs, severe anemia, respiratory difficulties) are more striking and may increase the suspicion index for malaria.

Laboratory Criteria for Diagnosis

- Detection of circulating malaria-specific antigens using rapid diagnostic test (RDT)

OR

- Detection of species specific parasite DNA in a sample of peripheral blood using a Polymerase Chain Reaction (PCR) test. (Note: Laboratory-developed malaria PCR tests must fulfill Clinical Laboratory Improvement Amendments [CLIA] requirements, including validation studies)

OR

- Detection of malaria parasites in thick or thin peripheral blood films, determining the species by morphologic criteria, and calculating the percentage of red blood cells infected by asexual malaria parasites (parasitemia).

Criteria to Distinguish a New Case from an Existing Case

A subsequent attack experienced by the same person but caused by a different *Plasmodium* species is counted as an additional case.

A subsequent attack experienced by the same person and caused by the same species in the United States may indicate a relapsing infection or treatment failure caused by drug resistance or a separate attack.

Case Classification

Suspected

- Detection of *Plasmodium* species by rapid diagnostic antigen testing without confirmation by microscopy or nucleic acid testing in any person (symptomatic or asymptomatic) diagnosed in the United States, regardless of whether the person experienced previous episodes of malaria while outside the country.

Confirmed

- Detection and specific identification of malaria parasite species by microscopy on blood films in a laboratory with appropriate expertise in any person (symptomatic or asymptomatic) diagnosed in the United States, regardless of whether the person experienced previous episodes of malaria while outside the country.

OR

- Detection of *Plasmodium* species by nucleic acid test* in any person (symptomatic or asymptomatic) diagnosed in the United States, regardless of whether the person experienced previous episodes of malaria while outside the country.

OR

- Detection of unspeciated malaria parasite by microscopy on blood films in a laboratory with appropriate expertise in any person (symptomatic or asymptomatic) diagnosed in the United States, regardless of whether the person experienced previous episodes of malaria while outside the country.

*Laboratory-developed malaria PCR tests must fulfill CLIA requirements, including validation studies.

Case Classification Comment(s)

Clinical samples including Blood smears or EDTA whole blood from all cases can be referred to the CDC Division of Parasitic Diseases and Malaria Diagnostic Laboratory for confirmation of the diagnosis and antimalarial drug resistance testing. Any questionable cases should be referred to the CDC Division of Parasitic Diseases and Malaria Diagnostic Laboratory for confirmation of the diagnosis.

Comment(s)

Blood smears from questionable cases should be referred to the CDC Division of Parasitic Diseases Diagnostic Laboratory for confirmation of the diagnosis.
Cases also are classified according to the following World Health Organization categories:

- Autochthonous:
  - *Indigenous:* malaria acquired by mosquito transmission in an area where malaria is a regular occurrence
  - *Introduced:* malaria acquired by mosquito transmission from an imported case in an area where malaria is not a regular occurrence
- *Imported:* malaria acquired outside a specific area (e.g., the United States and its territories)

- *Induced:* malaria acquired through artificial means (e.g., blood transfusion, common syringes, or malariotherapy)
- *Relapsing:* Recurrence of disease after it has been apparently cured. In malaria, true relapses are caused by reactivation of dormant liver-stage parasites (hypnozoites) of *P. vivax* and *P. ovale*.
- *Cryptic:* an isolated case of malaria that cannot be epidemiologically linked to additional cases.