Malaria

Surveillance Protocol

January 2017

Malaria is a parasitic infection that results from being bitten by an infected female *Anopheles* mosquito. While there are approximately 430 species of *Anopheles,* only 30-40 transmit malaria [1]. Five species of parasites within the genus *Plasmodium* are the agents for malaria. Globally, malaria is a major public health problem in tropical regions and results in nearly one million deaths per year, primarily in Africa. One-hundred eight countries, inhabited by approximately 3 billion people, are endemic for malaria [3]. Malaria is one of the most common causes of fever with an unknown origin among those traveling from a malaria endemic country. In West Virginia, 1–2 travel-associated cases of malaria are reported each year from persons who have visited malaria-endemic areas. **Cases of malaria must be reported within one week to local health department in the patient's home county.**

Provider Responsibilities

1. Report suspect or confirmed cases to your local health department within one week. Supply requested clinical information to the local health department to assist with case ascertainment.
2. Health care providers needing assistance with diagnosis or management of suspected cases of malaria should call the CDC Malaria Hotline: 770-488-7788 or 855-856-4713 toll-free (M-F, 9am-5pm, eastern time).
    a. Coordinate with the West Virginia Office of Laboratory Services on shipping specimens to CDC for testing.
3. Submit any positive laboratory results pertaining to malaria to the local health department located in the patient's home county.

Laboratory Responsibilities

1. Perform appropriate testing for patients with suspected malaria. This involves thin or thick peripheral blood films, a Polymerase Chain Reaction test (PCR), or a Rapid Diagnostic Test (RDT) if a reliable microscope diagnosis is not available. PCR is most useful for confirming the species of parasite after the diagnosis has been established by either smear microscopy or RDT [4].
2. Forward copies of any positive malaria test results to the local health department in the patient's home county within one week of diagnosis.

Local Health Responsibilities

1. Conduct an appropriate case investigation.
    a. Contact the healthcare provider that ordered the laboratory test to obtain the clinical information on the WVEDSS form.
    b. If needed, contact the patient to obtain information regarding travel history.
    c. Educate the patient and the patient's family on mosquito bite prevention (to prevent local transmission of disease) and other appropriate prevention messages.
    d. Report all case data using WVEDSS.
2. Educate the public about malaria, especially regarding prevention measures when traveling.
3. Educate providers, laboratories, and infection control practitioners about diagnosis and reporting of malaria.
4. If a suspect or confirmed case has no travel history to an area where malaria is endemic, contact DIDE immediately.

   a. Conduct a home visit and perform an environmental assessment to identify potential risk factors for exposure to mosquitoes if there is an outbreak or cluster of malaria cases.
5. Consult with DIDE for guidance on appropriate case management and public health actions.

State Health Responsibilities

1. Review completed case reports from local health departments within one week.
2. Report all confirmed and suspected cases to CDC using West Virginia's Electronic Disease Surveillance System (WVEDSS).
3. Provide consultation to local health departments regarding case ascertainment.

Disease Control Objectives

1. Implement measures to prevent contact with female *Anopheles* mosquitoes while in a malaria-endemic.
2. Administer early treatment of infected patients to prevent severe stage malaria.

Disease Surveillance Objectives

1. To identify and monitor the epidemiologic characteristics of imported malaria infections in West Virginia.
2. To identify new or invasive *Anopheles* mosquito species not previously identified in West Virginia that could be capable of transmitting malaria.
3. To identify and characterize instances of local transmission if they occur. This information would direct vector surveillance (by species and geographic distribution) to evaluate their relative roles in potential transmission within West Virginia.

Disease Prevention Objectives

1. Reduce disease risk through:
   a. Public education regarding use of personal protective measures.
   b. Public education regarding travel to areas where malaria is endemic
2. Educate travelers regarding the importance of reporting onset of illness after travel to endemic countries.
3. Educate travelers to take malaria chemoprophylaxis prior to traveling to an area that is malaria-endemic.

Public Health Significance

When European explorers and colonists arrived in the Americas they brought *P. malariae* and *P. vivax* with them; *P. falciparum* was imported to the Western Hemisphere by Africans during slavery. The combination of a vulnerable population and an environment that facilitated the breeding of *Anopheles* mosquitoes allowed the disease to flourish. Malaria plagued the United States until the early 20th century. The modernization of the rural South and hydroelectric power in the 1930s resulted in a decrease of malaria cases. Malaria was practically eradicated in the United States until World War II when it reemerged with vigor due to soldiers returning home from the Pacific campaign. More soldiers died from malaria then from battle 8].

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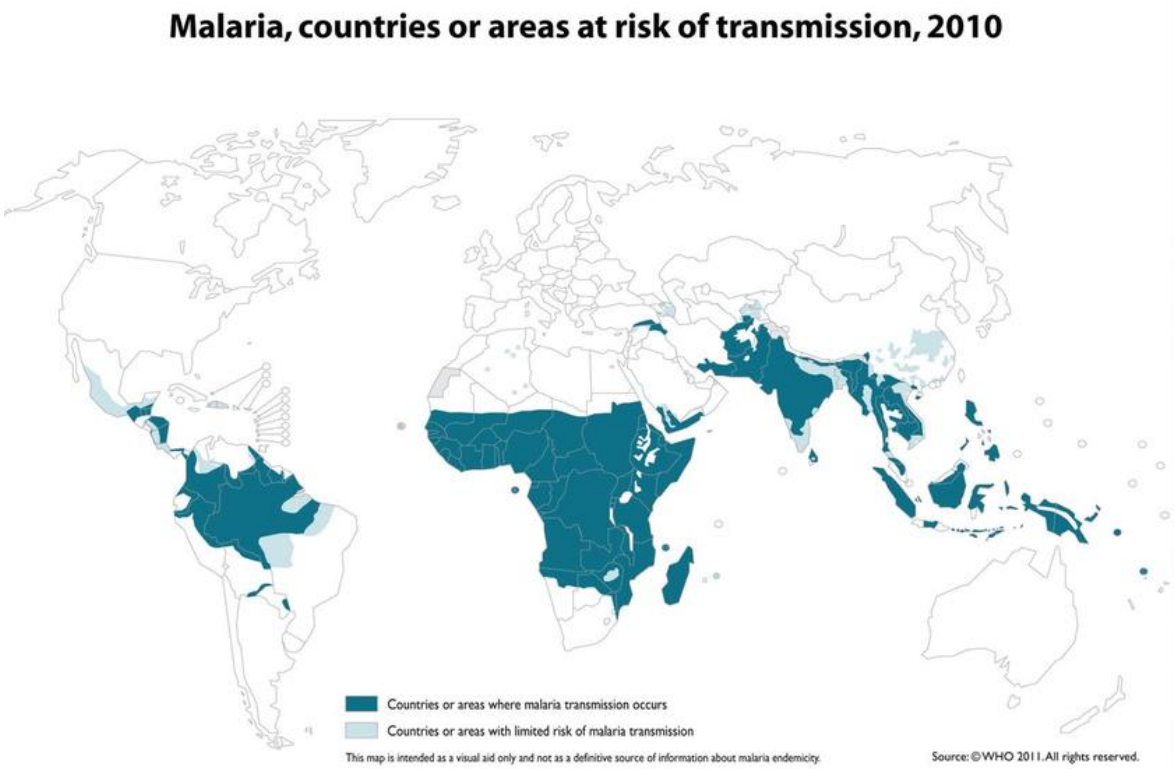
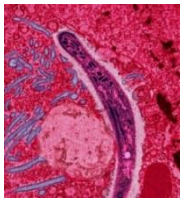


Malaria is infamous for its morbidity and mortality that it has caused and continues to cause around the globe, particularly in Africa, but the disease is also responsible for the creation of the Centers for Disease Control and Prevention [8].

Image accessed at: http://gamapserver.who.int/mapLibrary/Files/Maps/Global_Malaria_ITHRiskMap.JPG?ua=1

Clinical Description

Malaria can be divided into two categories, uncomplicated and severe. Most commonly a person experiencing uncomplicated malaria will present with flu like symptoms: fever, chills, sweats, headaches, nausea and vomiting, and body aches. In rare cases, uncomplicated malaria is accompanied with attacks that last 6-10 hours and occur every other day. These attacks consist of a cold stage (sensation of cold, shivering) followed by a hot stage (fever, headaches, vomiting; seizures in young children), and finally a sweating stage (sweats, return to normal temperature, tiredness) [5].
Severe malaria occurs when infections are complicated by organ failures or abnormalities in patient's blood or metabolism. The major complications of severe malaria include cerebral malaria, pulmonary edema, acute renal failure, severe anemia, and/or bleeding. Acidosis and hypoglycemia are the most common metabolic complications. Any of these complications can develop rapidly and progress to death within hours or days [6].


Plasmodium spp.

Etiologic Agent

Malaria is caused by protozoan parasites in the *Plasmodium* genus. Five species of *Plasmodium* can infect humans: *P. vivax*, *P. ovale*, *P. malariae*, *P. falciparum,* and *P. knowlesi* [2]. The most common species that cause illness in humans are *P. vivax* or *P. falciparum*. *P. falciparum* causes the most severe form of malaria. In areas of Africa and

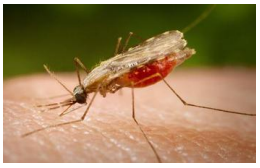
Asia with hyperendemic infection, reinfection in people with partial immunity results in a high prevalence of asymptomatic parasitemia [10].

Reservoir

Humans are the only important reservoir species [6].

Mode of Transmission

Malaria is transmitted by the bite of an infected female *Anopheles* mosquito. Malaria can also be transmitted from person to person through the use of an infected needle, receiving blood or tissue contaminated blood during a transfusion, and from mother to child (congenital) [7].



Female *Anopheles* mosquito

Incubation Period

The incubation period varies based on the species of parasite [7]:

- 9-14 days for *P. falciparum*
- 12-18 days for *P. vivax* and *P. ovale*
- 18-40 days for *P. malariae*
- 10-12 days for *P. knowlesi*

The use of prophylactic medication may prolong the incubation period or mask symptoms.

Period of Communicability

Humans can spread malaria as long as infectious gametocytes remain in the blood. Gametocytes usually appear within three days of parasitaemia with *P. vivax* and *P. ovale*, and after 10-14 days with *P. falciparum* [7]. Untreated or inadequately treated patients may be a source of infection for several years with *P. malariae*, up to 5 years with *P. vivax* and generally not more than 1 year with *P. falciparum* [7]. Transmission by transfusion (or needle stick injuries) may occur as long as asexual forms remain in the circulating blood. With *P. malariae*, this can continue for over 40 years. Stored blood can remain infectious for at least a month.

Case Definition

The 2014 case definition is the most current (CSTE Position Statement Number 13-ID-08)

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 1,600 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 Comments

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.

Preventive Interventions

Currently there is no commercially available malaria vaccine. Travelers can protect themselves from malaria by taking chemoprophylaxis before, during, and after their trip and by preventing mosquito bites. The type of chemoprophylaxis administered varies based on destination and by the risk of exposure [10]. There are three available in the United States for prevention of chloroquine-resistant malaria.

Table 1. Malaria Chemoprophylaxis Dosages and Schedules [10]

Drug Name	Dosage for Adults	Dosage for Children	Dosage for Pregnant Women	Duration of Treatment
Atovaquone-proguanil	Daily	A formula is available but not approved for children <11kg (24lbs)[1]	Should not be prescribed	Start the 1-2 days before exposure and continue until one week after leaving the malaria endemic area
Doxycycline	Daily	Should not be prescribed to children <8 years of age	Should not be prescribed; also not for women of childbearing age	Start 1-2 days before exposure and continue until 4 weeks after leaving the malaria endemic area
Mefloquine	Once weekly	Not approved for children <5 kg (11lbs) or <6 months of age[2]	Recommended during the 2nd and 3rd trimester	Start 2 weeks prior to exposure and continue until 4 weeks after leaving the malaria endemic area
Primaquine[3]	Daily	Calculated based on weight	Should not be prescribed	Start 1-2 days before exposure and continue until 7 days after leaving the malaria endemic area

[1] Can be used in children less than 5kg (11lbs) when exposure to chloroquine-resistant *P. falciparum* cannot be avoided

[2] CDC recommends that mefloquine be considered when exposure to chloroquine-resistant *P. falciparum* cannot be avoided

[3] Travelers must be tested for glucose-6-phosphate dehydrogenase (G6PD) deficiency and have a documented G6PD in the normal range before use

It is important to note that women who are pregnant or likely to become pregnant should avoid traveling to malaria endemic areas because chemoprophylaxis is not completely effective. Chloroquine or hydroxychloroquine are considered safe to use in all trimesters of pregnancy and is the drug of choice in chloroquine-sensitive areas [11]. Mefloquine is the agent of choice for chloroquine-resistant areas, and evidence suggests it is not associated with an increased risk to the fetus [11].

There are many ways to prevent mosquito bites during travel [10]:

- Repellants with DEET (30-35%), oil of lemon eucalyptus, IR3535, and picaridin (≥20%).
- Cover exposed skin by wearing long-sleeved shirts, long pants, and hats.
- Wear clothing that has been treated with permethrin (or another pyrethroid).
- Use a bed net when you are not sleeping in a sealed air-conditioned room.

Treatment

Malaria can be severe and is potentially fatal therefore, treatment should be initiated as soon as possible. The choice of the appropriate treatment depends on: the species of infecting parasite, possible drug resistance, and the severity of disease. Patients with severe malaria require intensive care and parenteral treatment until the parasite density decreases to less than 1% and they can tolerate oral therapy. If parasitemia exceeds 10% or if there is evidence of complications exchange transfusion may be necessary.

Surveillance Indicators

1. Proportion of cases with complete clinical, laboratory, and epidemiologic information including clinical symptoms, testing, and risk factor information (e.g. travel history, outdoor activities).

References

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