MALARIA

REPORTING INFORMATION

- Class A(2)
- Report by the end of the next business day
- Confidential Case Report Card (3812.11 rev. 12/81), lab report (3833.11), or telephone
- Requires completion of CDC Malaria Case Surveillance Report (form CDC 54.1 rev. 11-83). To be sent by the local health department to ODH, Vector-borne Disease Program, 900 Freeway Drive North, Columbus, OH 43229.

AGENTS

Malaria parasites. There are four species of genus *Plasmodium*: *P. falciparum*, *P. malariae*, *P. ovale*, and *P. vivax*. Mixed infections are not infrequent in endemic areas.

CASE DEFINITION

Clinical description

Signs and symptoms are variable; however, most patients experience fever. In addition to fever, common associated symptoms include headache, back pain, chills, sweats, myalgia, nausea, vomiting, diarrhea, and cough. Untreated *Plasmodium falciparum* infection can lead to coma, renal failure, pulmonary edema, and death. The diagnosis of malaria should be considered for any person who has these symptoms and who has traveled to an area in which malaria is endemic. Asymptomatic parasitemia can occur among persons who have been long-term residents of areas in which malaria is endemic.

Laboratory criteria for diagnosis

Demonstration of malaria parasites in blood films

Case classification

Confirmed - An episode of microscopically confirmed malaria parasitemia 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.

Comment

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.

Blood smears from questionable cases should be referred to the National Malaria Repository, CDC, for confirmation of the diagnosis.

Cases are also classified according to the following World Health Organization categories:

A. *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.

B. *Imported*

Malaria acquired outside a specific area (e.g., the United States and its territories).

C. *Induced*

Malaria acquired through artificial means (e.g., blood transfusion, common syringes, or malariotherapy).

D. *Relapsing*
Renewed manifestation (i.e., of clinical symptoms and/or parasitemia) of malarial infection that is separated from previous manifestations of the same infection by an interval greater than any interval resulting from the normal periodicity of the paroxysms.

E. *Cryptic*
An isolated case of malaria that cannot be epidemiologically linked to additional cases .

SIGNS AND SYMPTOMS
See case definition.

DIAGNOSIS
The four types of human malaria are confirmed and differentiated by demonstration of malaria parasites in thick blood films. Repeated microscopic examinations might be necessary and are most productive when the thick blood film was made during a febrile episode. Help with reading and interpretation of the smears may be obtained from CDC. Proper protocol is to send the sample(s) to CDC through the ODH lab. Call ODH, (614) 644-4659, to arrange for shipment of slides or other specimens to CDC.

EPIDEMIOLOGY

Source
Humans are the only important reservoir of human malaria.

Occurrence
Endemic malaria no longer occurs in the U.S. and many temperate zone countries. Malaria is known to exist in parts of Mexico, Haiti, Central and South America, Africa, the Middle East, Turkey, the Indian subcontinent, Southeast Asia, the Peoples Republic of China, the Malay Archipelago, and Oceania. Falciparum and vivax malaria are found in most endemic areas but ovale malaria is seen mainly in West Africa. *P. falciparum* strains resistant to chloroquine (CRPF) occur in both hemispheres. Confirmed cases have been found in most of the tropical South and Central Americas, Asia, and East Africa.

Each year many Americans travel to malarious areas of the world. Between 1990 and 1995, a range of 1087 - 1419 imported cases were reported in the US. There were 1800 reported in 1996 and 2001 reported in 1997. This apparent increase is probably due to increased travel by Americans, increased immigration, and a decline in funding of vector control in malarious areas.

Historically, malaria was indigenous to Ohio. Although indigenous malaria has been eliminated here, vector *Anopheles* mosquitoes remain prevalent. Thus Ohio is an area free of disease but with a continuing risk of transmission.

Mode of Transmission & Life Cycle
Malaria in humans is normally transmitted by the bite of a female *Anopheles* mosquito that is infected with one of four species of *Plasmodium*. As the mosquito feeds, it releases malaria sporozoites into the bloodstream, which enter liver cells (exoerythrocytic state). After the parasite matures, the liver cell ruptures and releases numerous merozoites. These invade red blood cells (RBCs), starting the erythrocytic stage of an infection. Within the RBCs the parasites mature, become schizonts, and divide again into merozoites. Finally, the infected RBCs rupture, and merozoites repeat the cycle by invading other RBCs. The release of merozoites from erythrocytes initiates the chills and fever of a typical malaria paroxysm. No human-to-human transmission occurs.

Relapses occur when *P. vivax* or *P. ovale* parasites that have remained dormant in the liver for months

or years mature, enter the blood, and initiate another series of erythrocytic cycles. Infections caused by *P. falciparum* and *P. malariae* do not relapse because these organisms have no persistent liver (exoerythrocytic) stage. Thus, *P. falciparum* and *P. malariae* infections can be cured by drugs that are active only against the parasite's erythrocytic stages. In *P. vivax* and *P. ovale* infections, therapy directed at the erythrocytic stages might eliminate parasites from the blood, but will not prevent relapses caused by parasites persisting in the liver.

Period of Communicability

Mosquitoes can be infected as long as infective gametocytes are present in the blood of patients. This varies with *Plasmodium* species and response to therapy, ranging from one to three years, especially in the untreated or insufficiently treated cases. Stored blood can remain infective for 16 days. *Anopheles* mosquitoes are infective about 2 weeks after ingesting the malaria parasite and then are infective for life, which can be up to 6 weeks.

Incubation Period (Average)

P. falciparum - 12 days
P. vivax, *P. ovale* - 14 days
P. malariae - 30 days
Via blood transfusions - generally short but varies with the number of parasites transfused.

PUBLIC HEALTH MANAGEMENT

Case

Investigation

Obtain a history to determine previous infection or exposure. This might aid in determining the possibility of chloroquine-resistance in cases of *P. falciparum.* If the patient has no recent history of overseas travel, contact VBDP **immediately** at (614) 752-1029.

Treatment/therapy

Selection and dosages of medication are dependent on:

1. The species of the malaria parasite present
2. The severity of the parasitemia
3. Presence of or possibility of Chloroquine-resistant *P. falciparum* malaria
4. Whether the case being treated is a relapse
5. The type of cure desired

Clinical Cure (also known as "treatment of the acute attack") - treatment to reduce or eliminate the asexual erythrocytic parasites that cause the clinical signs and symptoms of malaria.

Radical Cure (also known as "radical treatment") - therapy to completely eliminate malaria parasites so that a malaria attack cannot recur after treatment is completed. Radical treatment might require action against only erythrocytic parasites (*P. falciparum* and *P. malariae*) or against both erythrocytic and exoerythrocytic forms (*P. vivax* and *P. ovale*). In the latter instance, radical cure would consist of chloroquine or another drug to eliminate parasites from the blood and primaquine to kill parasites in the liver.

Due to the complexity of treatment decisions, specific treatment advice is not within the scope of this manual. Consultation is available. See "Consultation" under the Special Information Section that follows.

Isolation

No quarantine is indicated. However, hospitalized patients should be in mosquito-proof areas and blood/body fluid precautions should be observed.

Follow-up specimens
Not necessary unless there is a relapse of fever.

Public Health Significance
Malaria is a disease under surveillance by the World Health Organization, as it is considered an essential element of the world strategy of primary health care. The Centers for Disease Control is expected to notify WHO twice a year of those malaria cases imported into the USA, an area free of disease but with continuing risk of transmission. The vector *Anopheles* mosquitoes are present, so there is a risk of limited indigenous disease if the patient was exposed to mosquito bites prior to beginning treatment. There is a low public health significance related to a malaria patient in Ohio.

Contacts
Since no human-to-human transmission occurs, there are no advisories for contacts.

Prevention and Control
Travelers
Because of the nocturnal feeding habits of *Anopheles* mosquitoes, malaria transmission takes place primarily between dusk and dawn. Therefore, travelers can reduce their risk of acquiring malaria by remaining in well-screened areas during these hours or by sleeping under mosquito netting. Exposure to mosquitoes outdoors can be reduced by wearing clothing that adequately covers the arms and legs and by applying mosquito repellent to thin clothing and exposed skin. The most effective repellent is N, N diethyl-metatoluamide (deet), an ingredient of many commercially available insect repellents. Repellants which contain permethrin, applied to clothing and bed nets, gives additional protection. Follow label instructions.

Vaccination
No vaccine is available.

Prophylaxis
Malaria attacks can be minimized by the use of relatively safe, convenient, and inexpensive prophylactic medication. However, even when travelers are informed of their risk of acquiring malaria and obtain a prophylactic drug, they often fail to take it properly, or do not continue taking it for the necessary six weeks after returning home.

The choice of medication depends on several factors. These include whether the traveler has a history of drug allergy or intolerance, whether the area to be visited has chloroquine-resistant *P. falciparum* malaria, and whether the traveler is pregnant.

Chemoprophylaxis is not always successful. Although currently recommended antimalarial medications are generally effective, persons traveling to malarious areas should realize that the risk of acquiring the disease cannot be totally eliminated. Routine suppressive prophylaxis cannot prevent relapses of *P. vivax* and *P. ovale* infections. Travelers should be warned that if they experience malaria symptoms during, or even several years after, possible exposure to malaria, they should inform a physician of their travel history so that this diagnosis will be considered.

When malaria prophylaxis is discussed, the following terms are often used:

Suppression - prevention of the clinical symptoms of malaria by reducing or eliminating parasites in the blood. Suppression does not necessarily prevent either initial infection or relapses caused by parasites persisting in liver cells.

Suppressive Cure - elimination of malaria infection by continuing suppressive medication long enough to exceed the duration of the liver stage for the malaria species involved. In non-relapsing malaria (*P.*

falciparum and *P. malariae*), suppressive cure is usually achieved if the drug is continued for six weeks after the last exposure to malarious mosquitoes.

The best sources of information for prophylaxis recommendations are the MMWR supplements, "Prevention of Malaria in Travelers" and "Health Information for International Travel." Both are updated periodically and the most recent supplement should be consulted.

Consultation

Because of changing risk factors and recommendations, questions about malaria prophylaxis or treatment should be directed to the ODH, (614) 466-4643, or to the Centers for Disease Control (CDC), Atlanta, GA 30333. Malaria prevention information is available 24 hours a day by calling the MALARIA HOTLINE 1-888-232-3228.

Other Sources of Information:

Control of Communicable Diseases Manual, 1995. Published by the American Public Health Association, 1015 Fifteenth St., NW, Washington, D.C. 20005 [Updated every 5 years]

1997 Red Book: Report of the Committee on Infectious Diseases, 24th ed., Elk Grove, IL, American Academy of Pediatrics. [Updated approximately every three years]