# Malaria

## Revision Dates

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| Case Definition | July 2012 |
| Reporting Requirements | July 2012 |
| Remainder of the Guideline (i.e., Etiology to References sections inclusive) | June 2005 |



## Case Definition

### Confirmed Case

Laboratory confirmation of infection with or without clinical illness[1]:

- Demonstration of *Plasmodium* sp. in a blood smear/film (thick and thin).

### Probable Case

Laboratory confirmation of infection with or without clinical illness[1]:

- Detection of *Plasmodium* sp. antigen in an appropriate clinical specimen

**OR**

- Detection of *Plasmodium* sp. nucleic acid (e.g., PCR) in an appropriate clinical specimen.

[1] Clinical illness: Signs and symptoms vary however, most patients experience fever. In addition to fever, common associated symptoms include headache, back pain, chills, sweats, myalgia, nausea, vomiting, diarrhea and cough. Severe untreated malaria can lead to coma, seizures, renal failure, pulmonary edema and death.

Malaria cases are subdivided into the following categories:

- **Induced**: a confirmed case of malaria acquired through a blood transfusion from a donor in whom the parasite has been confirmed.
- **Autochthonous**: a confirmed case of malaria acquired by mosquito transmission within Canada.
- **Imported**: a confirmed case of malaria acquired outside Canada
- **Congenital, confirmed**: a confirmed case of malaria in an infant < 3 months old, who has not left Canada since birth, with confirmation of the presence of the parasite in the mother.
- **Congenital, probable**: a confirmed case of malaria in an infant < 3 months old, who has not left Canada since birth, but without demonstration of the presence of the parasite in the mother.

**NOTE:**

- A case is counted if it is the individual's first attack of malaria in Canada, regardless of whether or not she/he has experienced previous attacks of malaria outside the country.
- Co-infection or a subsequent attack in the same person caused by a different *Plasmodium* species is counted as an additional case.
- A repeat attack by the same species is not counted as a new case unless the person has traveled to a malaria-endemic area since the previous attack.

## Reporting Requirements

1. **Physicians, Health Practitioners and Others**
   Physicians, health practitioners and others listed in Sections 22(1) or 22(2) of the *Public Health Act* shall notify the Medical Officer of Health (MOH) (or designate) of all confirmed and probable cases in the prescribed form by mail, fax or electronic transfer within 48 hours (two days).

2. **Laboratories**
   Section 23(a)(ii) of the *Public Health Act* requires that all laboratories, including regional laboratories and the Provincial Laboratory of Public Health (ProvLab), shall report all positive laboratory results by mail, fax or electronic transfer within 48 hours (two days) to the:
   - Chief Medical Officer of Health (CMOH) (or designate),
   - MOH (or designate) and
   - Attending/ordering physician.

3. **Alberta Health Services and First Nations Inuit Health Branch**
   - The MOH (or designate) of the zone where the case currently resides shall forward the preliminary Notifiable Disease Report (NDR) of all confirmed and probable cases to the CMOH (or designate) within two weeks of notification and the final NDR (amendment) within four weeks of notification.
   - For out-of-zone reports, the MOH (or designate) first notified shall notify the MOH (or designate) of the zone where the client currently resides by mail, fax or electronic transfer and fax a copy of the positive laboratory report within 48 hours (two days).
   - For out-of-province and out-of-country reports, the following information should be forwarded to the CMOH (or designate) by phone, fax or electronic transfer within 48 hours (two days) including:
     - name,
     - date of birth,
     - out-of-province health care number,
     - out-of-province address and phone number,
     - attending physician (locally and out-of-province) and
     - positive laboratory report (faxed).



 

## Etiology

Malaria is caused by protozoan parasites of the genus *Plasmodium*. Four species of the disease are known to infect humans: *Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale,* and *Plasmodium malariae*. *Plasmodium* is a single celled organism.

## Clinical Presentation (1,2)

Signs and symptoms of malaria are variable, however, most patients experience fever. In addition to fever, common associated symptoms include flu like symptoms (headache, abdominal pain, myalgia, and malaise). Rigors and chills often occur. The diagnosis may be difficult as the fever pattern in the first few days resembles that seen in the early stages of many other illnesses. Most infections produce a primary attack of malaria within 2 – 4 weeks after the mosquito bite occurs.

*Plasmodium falciparum* is the most widespread and dangerous of the four species and has a high case fatality rate. When untreated, *Plasmodium falciparum* infection can lead to fatal cerebral malaria including coma, seizures, renal and respiratory failure and death. Prompt treatment is essential, even in mild cases, as irreversible complications may appear suddenly. The greatest risk period for clinical presentation of *P. falciparum* is in the 12 weeks following the last potentially infected mosquito exposure.

*Vivax*, *malariae*, and *ovale* malarias are generally not as life-threatening as *falciparum* infection except in the very young, very old, and those with immunodeficiency or concurrent disease. *Vivax* and *ovale* infection may appear many months after an individual has returned from an endemic area. Illness generally begins with malaise and a slowly rising fever. Over the next few days the temperature rises rapidly, often accompanied by headache and nausea,. Shaking chills are present often ending with profuse sweating. When left untreated the symptoms of *vivax*, *ovale* or *malariae* malaria subside in 10 to 30 days. Relapses may occur for up to five years but in the case of *malariae* infections, relapses may persist for as many as 40 – 50 years.

Blackwater Fever is a rare complication caused by the rupture of a large number of red blood cells. Haemoglobin is released into the blood stream and then excreted in the urine turning the urine dark. This event occurs almost exclusively in individuals with chronic *falciparum malariae*, especially in those who have had treatment with quinine.

Congenital malaria, caused predominantly by *P. vivax* and *P. falciparum*, occurs rarely. Manifestations may resemble neonatal sepsis including fever, poor appetite, lethargy and irritability.

Persons who are partially immune or have taken prophylactic medications may have an atypical clinical presentation and wide variations in the incubation period.

## Diagnosis (3)

Laboratory confirmation is made by the demonstration of malaria parasites on stained blood films. This is performed by regional laboratories. The ProvLab, and occasionally the National Microbiology Laboratory, may be consulted to assist with the confirmation of the diagnosis. (G Tyrell, personal communication, January 2005)

Both thin and thick blood films should be examined; thin film is most useful in species identification and thick film allows sufficient concentration of blood to find the parasite that may be present in small numbers. If the initial blood films are negative examinations should be repeated every 12 – 24 hours because the density of *P. falciparum* parasites in the peripheral blood varies. Parasites are often not demonstrable in blood films from patients currently or previously under treatment or prophylaxis.



 

## Epidemiology

### Reservoir

Humans are the only important reservoir for mosquitoes that transmit human malaria.

### Transmission (4)

Malaria parasites are transmitted from one person to another by an infected female *Anopheles* mosquito. Males do not transmit the diseases as they feed only on plant juices. Transmission occurs between dusk and dawn corresponding to the biting habits of the mosquito. There are about 380 species of *Anopheles* mosquito but only about 60 are able to transmit the parasite. They breed in water with each species having its preferred breeding ground, feeding pattern, and resting place. The risk of transmission is increased in rural areas and varies seasonally in many locations, being highest at the end of the rainy season.

The mosquito acquires the parasite by ingesting a meal of human blood containing the sexual stages of the parasite. *Plasmodium* develops in the gut of the mosquito in approximately 8 – 35 days. Parasites are then passed on in the saliva of the infected insect each time it takes a new blood meal. The parasites go through the first stage of growth and division in the human liver. The sporozoitses, which enter individual hepatocytes, produce 10,000 – 30,000 merozoites that emerge and enter red blood cells. The bloodstream phase is responsible for the signs, symptoms, and complications in all malarial infections. The gametocytes in the red blood cells and the liver infection do not cause disease. Malaria can be acquired (rarely) through blood transfusions, needlestick injuries or congenitally.

### Incubation Period

The incubation period (time between the infective bite and appearance of clinical symptoms) varies with the species; 7 – 14 days for *P. falciparum*, 8 – 14 days for *P. ovale* and *P. vivax*, and 7 – 30 days for *P. malariae.* Individuals with partial immunity or those taking chemoprophylaxis may have a prolonged incubation period. With infection by blood transfusion, the incubation period will depend on the number of parasites infused. The time is usually short but may range up to two months.

### Period of Communicability

Cases may infect mosquitoes as long as the gametocytes are present in the blood of the case. This may be less than one year for *P. falciparum* and up to three years for *P. malariae, P. vivax,* and *P. ovale*.

Although infection from blood transfusion is rare, transmission is able to occur as long as the asexual form of the parasite is present in the donor's blood (up to 40 – 50 years for *P. malariae*). Stored blood (post-donation) may remain infectious for up to two months.

### Host Susceptibility

Susceptibility is universal. In endemic areas where transmission is high, people are continuously infected so that they gradually develop tolerance or partial immunity to the disease. Until they have acquired this immunity, children remain highly vulnerable to infection, as do travellers to endemic areas. Immunocompromised individuals and pregnant women are highly susceptible as the natural defence mechanisms are reduced.



 

## Occurrence

### General (2)

It is estimated that worldwide, there are over 300 million new cases of malaria each year and that between 1.5 and three million people, mostly children, die of the disease annually. It is a major cause of illness in many tropical and subtropical areas. Frequent transmission occurs in large areas of South America, Southeast Asia and much of sub-Saharan Africa. International travellers from industrialized countries account for approximately 25,000 of these cases annually, but only about 10,000 are reported and 150 are fatal. Increased international travel, increased risk of transmission (in areas where malaria control had been reduced) and the spread of drug-resistant strains of malaria all contribute to the growing numbers.

Chloroquine–resistant *P. falciparum* occurs in most areas of the world where malaria is endemic. *P. vivax* is present in Papua New Guinea, is highly prevalent in Irian-Jaya, Indonesia, and has been reported from Sumatra, the Solomon Islands, and other areas of Indonesia. *Ovale* malaria occurs mainly in sub-Saharan Africa.

### Canada (1,4,5)

As international travel increased, the number of imported cases of malaria in Canada continued to rise. From 1994 to 1997 the numbers increased two-fold to a peak of 1036 cases reported in 1997. It is estimated that only 30 – 50% of cases are reported to public health. In 1997, CATMAT prepared recommendations to prevent and treat malaria. The number of cases decreased (368 in 1998 and 365 in 1999) however, the majority of cases of malaria continue to occur in immigrants and in travellers returning from malaria-risk areas. The number of imported cases in Canada is about 3 – 10 times the per capita rate of the United States.

The majority of imported *P. falciparum* cases have been acquired in sub-Saharan Africa and the majority of *P. vivax* cases are acquired in the Indian subcontinent. The increase in malaria cases has been associated with the increase in the number of severe cases and deaths. There were 11 reported deaths between 1997 and 2004 from *P. falciparum.* The case fatality rate of imported *P. falciparum* malaria varies from approximately 1 – 5% and increases to 30% in persons over 70 years of age.

From June 2001 to June 2004 there were 25 cases of malaria requiring parenteral quinine for treatment of severe or complicated disease. The factors contributing to all of these severe and fatal cases were noncompliance with or failure to use appropriate chemoprophylactic agents, delay in diagnosis and treatment, and incorrect therapy once a diagnosis was reached. The majority of infections and deaths due to malaria are preventable.

### Alberta (6)

In Alberta, from 1989 to 1995, fewer than 50 cases of malaria were reported annually. In 1996, 77 cases were reported. Ninety-four cases were reported in 1997. In 72 of the 94 cases reported in 1997 the site of exposure was identified as travel. From 1998 to 2002 the number of cases reported annually decreased (1998–40; 1999–35; 2000–26; 2001–36; 2002–25; 2003–45). The majority of these cases (65 – 81%) were reported in travellers. The source of infection in the remaining cases was unknown or ‘other’. No deaths from malaria were reported from 1989 to 2003.



 

## Key Investigation

### Single Case/Household Cluster

- Case information for public health assessment includes:
  - serology results,
  - symptom history and date of onset,
  - history of recent travel (within the last 10 months) including countries visited, urban or rural,
  - pre-travel advice including attendance at a travel clinic, recommendations for malaria prevention, prophylaxis taken (medication, dosage, adherence), insect precautions taken, treatment (self or medical),
  - history of recent blood transfusion (within previous 60 days),
  - history of needle sharing,
  - history of recent immigration from an endemic country and
  - history of previous malarial illness.

## Control

Refer to the current Canadian recommendations for the prevention and treatment of malaria among international travellers prepared by the Committee to Advise on Tropical Medicine and Travel (CATMAT) and published by the Public Health Agency of Canada. This publication describes current management, treatment, and prevention guidelines.(1)

**Management of a Case (1)** (G Taylor, personal communication, June 2003)

- Malaria should be considered a medical emergency and prompt treatment with appropriate antimalarials is essential.
- Consultation with an infectious disease or travel medicine specialist is strongly recommended.
- In transfusion-induced malaria, all donors must be located and their blood examined for parasites and for antimalaria antibodies. Positive donors should also be treated.
- In hospitals, routine practices should be used.

**Treatment of a Case (1)** (G Taylor, personal communication, June 2003)

- Prompt diagnosis, accurate identification of species, and appropriate initial management is essential to prevent malaria-associated morbidity and mortality.
- The choice of chemotherapy is based on the infecting species, possible drug resistance, the severity of disease and, to some extent, the place acquired. In addition, the patient's age, and the safety, availability and cost of antimalarial drugs are taken into consideration.
- *Falciparum* malaria is considered a medical emergency and starting appropriate therapy as soon as possible is very important.
  - Hospital centres across Canada have been identified as Centres of Excellence for Malaria and may be consulted. The location of these Centres of Excellence is available in the CATMAT publication. In Alberta, the Division of Infectious Diseases, University of Alberta Hospital (Edmonton) and the Division of Infectious Diseases, Alberta Children's Hospital (Calgary) have been identified as centres.

**Management of Contacts**

- No specific intervention is required.
- If there is a history of needle sharing, investigate, and treat all persons who shared the equipment.



 

**Preventive Measures (1,7,8)**

- Given the constantly changing situation with drug-resistant malaria, travellers should be referred to a tropical medicine or travel specialist for up-to-date malaria prevention recommendations.
- Pre-travel counseling
  - Information about the risk of acquiring malaria. This is especially important for young children, pregnant women, immunocompromised individuals, and the elderly.
  - Appropriate advice about the use of personal protection measures to reduce the risk of insect bites. This includes mosquito repellents, appropriate clothing (i.e., light colored long sleeved shirts, pants socks, etc) especially dusk to dawn, and insecticide impregnated mosquito nets. DEET (30 – 35%) is recognized as the most effective repellent. (30% is the highest concentration available in Canada)
  - Accurate advice about the use of malaria chemoprophylaxis, including continuing to take the antimalarial medication following return.
  - The need to seek early diagnosis and treatment for a febrile illness during or following travel in a malaria endemic area.



 

## References

(1) Public Health Agency of Canada. *Canadian recommendations for the prevention and treatment of malaria among international travellers*. Ottawa: CCDR 2004;30S1.http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/04vol30/30s1/index.html

(2) Public Health Agency of Canada. *Fatal falciparum malaria in Canadian travellers*. Ottawa: CCDR 1996;22-20.http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/96vol22/dr2220e.html

(3) Carsely J. *Malaria in Canada*. CMAJ 1997;156(1).

(4) Wellems T, Miller L. *Two worlds of Malaria*. N Eng J Med 2003;349:1496-98.

(5) Public Health Agency of Canada. *Fever in the international traveller initial assessment guidelines*. Ottawa: CCDR 1997:23(ACS-1).http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/97vol23/23sup/acs1.html

(6) *Malaria*. World Health Organization, Division of Control of Tropical Disease. January 2003. http://www-micro.msb.le.ac.uk/224/malaria.html

(7) Kain K et al. *Malaria deaths in visitors to Canada and in Canadian travellers: A case series*. CMAJ 2001;164(5):654-59.

(8) Alberta Health and Wellness, Disease Control and Prevention. *Communicable Disease Reporting System*. May 2003.



 