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Malaria Surveillance — United States, 2007

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Malaria Surveillance — United States, 2007

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Abstract

Problem/Condition: Malaria in humans is caused by intraerythrocytic protozoa of the genus *Plasmodium*. These parasites are transmitted by the bite of an infective female *Anopheles* mosquito. The majority of malaria infections in the United States occur among persons who have traveled to areas with ongoing malaria transmission. In the United States, cases can occur through exposure to infected blood products, congenital transmission, or local mosquitoborne transmission. Malaria surveillance is conducted to identify episodes of local transmission and to guide prevention recommendations for travelers.

Period Covered: This report summarizes cases in persons with onset of illness in 2007 and summarizes trends during previous years.

Description of System: Malaria cases confirmed by blood film, rapid diagnostic tests, or polymerase chain reaction are mandated to be reported to local and state health departments by health-care providers or laboratory staff members. Case investigations are conducted by local and state health departments, and reports are transmitted to CDC through the National Malaria Surveillance System, the National Notifiable Diseases Surveillance System, and direct CDC consultations. Data from these reporting systems are the basis for this report.

Results: CDC received reports of 1,505 cases of malaria among persons in the United States, including one transfusion-related case and one fatal case, with onset of symptoms in 2007; 1,564 cases were reported for 2006. *P. falciparum*, *P. vivax*, *P. malariae*, and *P. ovale* were identified in 43.4%, 20.3%, 2.0%, and 3.5% of cases, respectively. Nine patients (0.6%) were infected by two or more species. The infecting species was unreported or undetermined in 30.2% of cases. Based on estimated volume of travel, the highest estimated relative case rates of malaria among travelers occurred among those returning from countries in West Africa. Of 701 U.S. civilians who acquired malaria abroad and for whom chemoprophylaxis information was known, 441 (62.9%) reported that they had not followed a chemoprophylactic drug regimen recommended by CDC for the area to which they had traveled. Twenty-four cases were reported in pregnant women; none had adhered to a complete prevention drug regimen. One death was reported in a person infected with *P. vivax*.

Interpretation: No significant change in the number of malaria cases occurred from 2006 to 2007. No change was observed in the proportion of cases by species causing the infection. U.S. civilians traveling to countries in West Africa had the highest estimated relative case rates. In the majority of reported cases, U.S. civilians who acquired infection abroad had not adhered to a chemoprophylaxis regimen that was appropriate for the country where they acquired malaria.

Public Health Actions: Persons at risk for malaria infection should take one of the recommended chemoprophylaxis regimens appropriate for the region of travel and use personal protection measures to prevent mosquito bites. Any person who has been to a malarious area and who subsequently has a fever or influenza-like symptoms should seek medical care immediately and report their travel history to the clinician; investigation should always include blood-film tests for malaria with immediately available results. Malaria infections can be fatal if not diagnosed and treated promptly. Recommendations concerning malaria prevention are available from CDC at http://wwwn.cdc.gov/travel/content-diseases.aspx#malaria or by calling the CDC Malaria Hotline (telephone: 770-488-7788). Recommendations concerning malaria treatment are available at http://www.cdc.gov/malaria/diagnosis_treatment/treatment.htm or by calling the Malaria Hotline.

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Introduction

Malaria in humans is caused by infection with one or more of several species of *Plasmodium* (i.e., *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae,* and occasionally other *Plasmodium* species). The infection is transmitted by the bite of an infective female *Anopheles* species mosquito. *P. falciparum* and *P. vivax* species cause the most infections worldwide. *P. falciparum* is the species that most commonly causes severe, potentially fatal malaria. Worldwide, an estimated 350–500 million clinical cases and approximately 1 million deaths caused by malaria occur annually, primarily among children aged <5 years living in sub-Saharan Africa (*1*). *P. vivax* and *P. ovale* 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 that, if untreated, can persist asymptomatically in the human host for years, even a lifetime (*1*). *P. knowlesi*, a parasite of Old World monkeys, has been documented as a cause of human infections and some fatalities in Southeast Asia; investigations are ongoing to determine the extent of transmission to humans (*2,3*). A total of 49% of the world population lives in areas where malaria is transmitted (i.e., 109 countries in parts of Africa, Asia, the Middle East, Eastern Europe, Central and South America, Caribbean, and Oceania). Before the 1950s, malaria was endemic throughout the southeastern United States; an estimated 600,000 cases occurred in the United States in 1914 (*4*). During the late 1940s, a combination of improved housing and socioeconomic conditions, environmental management, vector-control efforts, and case management was successful at interrupting malaria transmission in the United States. Since then, malaria case surveillance has been maintained to detect locally acquired cases that could indicate the reintroduction of transmission and to monitor patterns of resistance to antimalarial drugs. Anopheline mosquitoes remain seasonally present in all states and territories except Hawaii.

The majority of reported malaria cases diagnosed each year in the United States are imported from regions where malaria transmission is known to occur, although congenital infections and infections resulting from exposure to blood or blood products are also reported in the United States. In addition, a limited number of cases are occasionally reported that might have been acquired through local mosquitoborne transmission (*5*).

State and local health departments and CDC investigate malaria cases acquired in the United States, and CDC analyzes data from reported cases to detect trends in acquisition. This information is used to guide malaria prevention recommendations for international travelers.

The signs and symptoms of malaria illness vary, but the majority of patients have fever. Other common symptoms include headache, back pain, chills, increased sweating, myalgia, nausea, vomiting, diarrhea, and cough. The diagnosis of malaria should always be considered for persons with these symptoms who have traveled to an area with known malaria transmission. Malaria also should be considered in the differential diagnosis of persons who have fever of unknown origin, regardless of their travel history. Untreated *P. falciparum* infections can rapidly progress to coma, renal failure, pulmonary edema, and death. This report summarizes malaria cases reported to CDC among persons with onset of symptoms in 2007.

Methods

Data Sources

Malaria case data are reported to the National Malaria Surveillance System (NMSS) and the National Notifiable Diseases Surveillance System (NNDSS) (*6*). Although both systems rely on passive reporting, the numbers of reported cases might differ because of differences in collection and transmission of data. A substantial difference between the data collected in these two systems is that NMSS receives more detailed clinical and epidemiologic data regarding each case (e.g., information concerning the area to which the infected person has traveled). Malaria cases can be reported to CDC through NMSS, NNDSS, or a direct consultation with CDC; cases identified through these various paths are compared and compiled, duplicates are eliminated, and cases are analyzed. This report presents data on the aggregate of cases reported to CDC through all reporting systems.

Cases of malaria confirmed by blood film, a rapid diagnostic test (RDT), or polymerase chain reaction (PCR) among civilians and military personnel are identified by health-care providers or laboratories.* Each confirmed malaria case is reported to local or state health departments and to CDC on a uniform case-report form that contains clinical, laboratory, and epidemiologic information. CDC reviews all report forms when received and requests additional information from the reporting provider or state if necessary (e.g., when no recent travel to a malarious country is reported). Other cases are reported by telephone to CDC directly by health-care providers, usually when they are seeking assistance with diagnosis or treatment. Information regarding cases reported directly to CDC is shared with relevant state health departments. All cases that have been reported as acquired in the United States are

* To confirm malaria diagnosed by blood films from questionable cases and to obtain appropriate treatment recommendations, contact either the state or local health department or CDC's Malaria Hotline (telephone: 770-488-7788).

investigated further, including all induced and congenital cases and possible introduced or cryptic cases. Information derived from uniform case report forms is entered into a database and analyzed annually.

An estimated case rate for each country was determined using estimates of travel volume for U.S. travelers to each country where cases of malaria were acquired and the number of cases among U.S. travelers attributable to each country. Data used to estimate country-specific relative case rates were extrapolated from World Tourism Organization estimates of annual numbers of U.S. travelers to specified countries (*7*). Estimated relative case rates were determined by dividing the individual country-specific case rates by the median individual country-specific case rate.

Definitions

The following definitions are used in this report:

- **U.S. residents:** Persons living in the United States; includes both civilians and U.S. military personnel, regardless of legal citizenship.
- **U.S. civilians:** U.S. residents, excluding U.S. military personnel.
- **Foreign residents:** Persons who have resident status in a country other than the United States.
- **Laboratory criteria for diagnosis:** Demonstration of malaria parasites on blood film, RDT, or PCR.
- **Confirmed case:** Symptomatic or asymptomatic infection that occurs in a person in the United States or one of its territories who has laboratory-confirmed (by microscopy, PCR, or RDT that is subsequently confirmed by microscopy or PCR) malaria parasitemia, regardless of whether the person has had previous episodes of malaria while in other countries. A subsequent episode of malaria is counted as an additional case if the indicated *Plasmodium* species differs from the initially identified species. A subsequent episode of malaria occurring in a person while in the United States could indicate a relapsing infection or treatment failure resulting from drug resistance if the indicated *Plasmodium* species is the same species identified previously.

This report also uses terminology derived from the recommendations of the World Health Organization (*8*). Definitions of the following terms are included for reference:

- **Autochthonous malaria:**
  - **Indigenous.** Mosquitoborne transmission of malaria in a geographic area where malaria occurs regularly.
  - **Introduced.** Mosquitoborne transmission of malaria from a person with an imported case in an area where malaria does not occur regularly.
- **Imported malaria:** Malaria acquired outside a specific area. In this report, imported malaria cases are those acquired outside the United States and its territories.
- **Induced malaria:** Malaria acquired through artificial means (e.g., by blood transfusion, organ transplantation, or using shared syringes).
- **Relapsing malaria:** Recurrence of malaria after the disease has been apparently cured. True malaria relapses are caused by reactivation of dormant liver-stage parasites (hypnozoites) found in *P. vivax* and *P. ovale*.
- **Cryptic malaria:** A case of malaria for which epidemiologic investigations fail to identify a plausible mode of acquisition (primarily cases identified in countries where malaria is not endemic).

Laboratory Diagnosis of Malaria

The early and prompt diagnosis of malaria requires that physicians obtain a travel history from every febrile patient. Malaria should be included in the differential diagnosis of every febrile patient who has traveled to a malarious area. If malaria is suspected, a Giemsa-stained film of the patient's peripheral blood should be examined for parasites as soon as possible. Thick and thin blood films must be prepared correctly because diagnostic accuracy depends on blood-film quality and examination by experienced laboratory personnel (*9*). Some reference laboratories and health departments have the capacity to perform PCR diagnosis of malaria, although PCR is generally reserved for cases for which blood-film diagnosis of malaria or species determination is inadequate. PCR results are also often not available quickly enough to be useful in the initial diagnosis of a patient with malaria.

An RDT, BinaxNOW Malaria, which detects circulating malaria-specific antigens, became available for use in the United States on June 13, 2007. The test is the first malaria RDT authorized for use in the United States and is only approved for use by hospital and commercial laboratories, not by individual clinicians or the general public. Use of RDTs in the United States can decrease the amount of time required to determine whether a patient is infected with malaria but does not eliminate the need for the standard tests (*10*). Positive and negative RDTs must be confirmed by microscopy or PCR. RDTs are generally less sensitive than blood films and do not quantify malaria parasites (*11*).

Results

General Surveillance

For 2007, CDC received 1,505 reports of cases of malaria occurring among persons in the United States and its territories. A total of 734 cases occurred among U.S. residents, 263 cases among foreign residents and 508 cases among persons with unknown resident status. Of the 734 cases reported among U.S. residents, 50.1% were among blacks, 27.2% among whites, 10.9% among Asians, and 4% among Hispanics; 67% of the U.S. resident cases were among males.

The 1,505 cases reported in 2007 is not significantly different from the 1,564 cases reported in 2006 (*9*) (Table 1) (chi-square test; p = 0.25). After a significant increase in cases from 2003 to 2004 (chi-square test; p = 0.002), the number of malaria cases appears to have plateaued beginning in 2004; during 2004–2007, no statistically significant change occurred in the number of reported cases (chi-square test; p = 0.21).

Plasmodium Species

Of the 1,505 cases reported in 2007, the infecting species of *Plasmodium* was identified and reported in 1,051 (69.8%) cases. *P. falciparum* and *P. vivax* accounted for the majority of infections and were identified in 62.2% and 29.0% of infected persons with species identified, respectively. The number of reported cases of *P. falciparum* and *P. vivax* remained stable during 2005–2007 (Table 2). Among 983 cases for which both the region of acquisition and the infecting species were known, *P. falciparum* accounted for 85.1% of infections acquired in Africa, 45.4% in the Americas, 18.2% in Oceania, and 10.7% in Asia (Table 3). Infections attributed to *P. vivax* accounted for 3.9% acquired in Africa, 52.7% in the Americas, 77.3% in Oceania, and 83.2% in Asia.

Region of Acquisition and Diagnosis

All cases were reported as imported cases, except for one transfusion-related case. Of 1,155 imported cases for which the region of acquisition was known, 744 (64.4%) were acquired in Africa, 253 (21.9%) in Asia, 131 (11.3%) in the Americas, and 27 (2.3%) in Oceania. Countries in West Africa accounted for 545 (73.3%) cases acquired in Africa, and India accounted for 151 (59.7%) cases acquired in Asia. In the Americas, 12 (9.2%) cases were acquired in North America, all of which were acquired in Mexico. A combined 99 (78.6%) cases were acquired in Central America and the Caribbean (Belize, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Nicaragua, and Panama), of which 66% of the cases were acquired in the Caribbean. Twenty (17.3%) cases were acquired in South America (Brazil, Guyana, French Guiana, Peru, and Suriname). Information regarding region of acquisition was missing for 349 (23.2%) imported cases (Table 3).

In the United States, six jurisdictions accounted for 50.7% of the reported cases: New York City (n = 233), California (n = 157), Texas (n = 136), New York (n = 93), New Jersey (n = 77), and Maryland (n = 67) (Figure 1). Compared with 2006, the states and regions with the most significant change in reported malaria burden in 2007 were New York City, Georgia, and Alaska. The number of cases reported in New York City increased from 174 cases in 2006 to 233 cases in 2007. Cases in Georgia decreased by almost half, from 90 in 2006 to 46 in 2007, and Alaska reported a significant decrease from 23 cases (all among military personnel) in 2006 to two cases in 2007. No cases from Alaska among military personnel were documented in 2007.

Imported Malaria by Resident Status

Of 997 imported malaria cases among persons with known resident status, 734 (73.6%) occurred among U.S. residents, and 263 (26.4%) occurred among residents of other countries. Of the 734 imported malaria cases among U.S. residents, 476 (64.9%) were acquired in Africa, 143 (19.5%) were acquired in Asia, and 75 (10.2%) were acquired in Central American and Caribbean regions (Table 4). Of the 263 imported cases among foreign residents, 167 (63.5%) were acquired in Africa. Among the 167 foreign residents who acquired malaria in Africa and for whom purpose of travel was known, 114 (68.3%) reported being recent immigrants or refugees, and 21 (12.6%) reported visiting friends and relatives in the United States. A total of 61 cases were in foreign residents who traveled from Tanzania and Burundi to the United States; reason for travel was known for 58 persons, among whom 57 were reported as being recent immigrants or refugees, and one was reported as visiting friends and relatives. In 2006, no foreign cases were reported from Tanzania or Burundi (*9*).

Estimated Relative Case Rates Among U.S. Residents

Using estimates of travel volume for U.S. travelers to each country from which cases of malaria were acquired and the number of cases among U.S. travelers attributable to each country, a case rate was estimated for each country. In 2007, the countries with the lowest estimated case rates of malaria among U.S. travelers were China and Thailand (Figure 2). Other countries with low estimated relative case rates included Mexico, Vietnam, and South Africa. In many of these countries, malaria risk areas are localized in small geographic areas of the country. Countries with estimated relative case rates

in the middle range included India, Honduras, Angola, and Pakistan, which have more homogenous malaria transmission throughout the country. Estimated relative case rates were highest in West African countries and Oceania, including Republic of the Congo, Benin, Papua New Guinea, and Solomon Islands. These high estimated case rates likely reflect not only widespread transmission areas but also higher transmission intensity (*1*).

Interval Between Arrival in the United States and Illness

Both the 1) interval between the date of arrival in the United States and onset of illness and 2) infecting *Plasmodium* species were known for 771 (51.2%) of the imported malaria cases (Table 5). Symptoms began before arrival in the United States in 78 (10.1%) persons and after arrival in 693 (89.9%) persons. Clinical malaria occurred <30 days after arrival in 398 (80.1%) of the 497 of persons with *P. falciparum* infections and in 74 (35.9%) of the 206 persons with *P. vivax* infections (Table 5). Six (0.8%) of the 771 persons became ill with a *P. vivax* infection ≥1 year after returning to the United States.

Imported Malaria Among U.S. Military Personnel

In 2007, a total of 33 cases of imported malaria were reported among U.S. military personnel. Nineteen persons reported travel to Afghanistan, and 10 reported travel to South Korea; the remaining four persons reported travel to Iraq and two unspecified countries in Africa. Information on infecting species was known for 25 cases; all cases were *P. vivax.* Of these 25 cases, 15 were among persons who reported having taken the appropriate primary chemoprophylactic drug; four reported taking the recommended primaquine for presumptive antirelapse therapy, and five patients reported adherence to the prescribed drug regimen. These cases were reported by state health departments and do not include all cases reported through malaria surveillance activities conducted by the U.S. Department of Defense.

Prophylaxis Use Among U.S. Civilians

Information concerning chemoprophylaxis use and travel area was known for 646 (92.2%) of the 701 U.S. civilians who had imported malaria. Of these 646 persons, 205 (31.7%) had taken chemoprophylaxis. Of the 205 persons who reported taking malaria chemoprophylaxis, 53 (25.9%) had not taken a CDC-recommended drug for the area visited, and 143 (69.8%) had taken a CDC-recommended medication. Data for the specific drug taken was missing for the remaining nine (4.4%) travelers. A total of 66 (46.2%) patients taking CDC-recommended chemoprophylaxis reported having taken mefloquine, 42 (29.4%) doxycycline, and 27 (18.9%) atovaquone/proguanil; four patients (2.8%) who had traveled only in areas where chloroquine-resistant malaria has not been documented reported having taken chloroquine. Four patients took a combination of two CDC-recommended malaria prophylactics for the specific travel region.

Malaria Infection After Recommended Prophylaxis Use

A total of 143 U.S. civilians contracted malaria after taking a recommended antimalarial drug for chemoprophylaxis. Of these, 43 (30.1%) reported complete adherence with the drug regimen, and 85 (59.4%) reported nonadherence; adherence was unknown for the remaining 15 (10.5%). Information regarding infecting species was available for 113 (79%) patients who had taken a recommended antimalarial drug and undetermined for the remaining 30 patients.

Cases Caused by *P. vivax* or *P. ovale*

Of the 143 patients who had malaria diagnosed after recommended chemoprophylaxis use, 39 (27.3%) had cases that were caused by *P. vivax*, and 12 (8.4%) had cases caused by *P. ovale*. Of the 51 total cases of *P. vivax* or *P. ovale*, 42 (82.3%) occurred >45 days after arrival in the United States. These cases were consistent with relapsing infections and do not indicate primary prophylaxis failures. Information on four cases was insufficient to assess a relapse infection because of missing data regarding symptom onset or return date. A total of five cases occurred ≤45 days after the patient returned to the United States; all were caused by *P. vivax.* Four of the five patients did not adhere to their malaria chemoprophylaxis regimen. The patient who contracted malaria but reported adherence to the chemoprophylaxis regimen had traveled to Papua New Guinea and had taken atovaquone/proguanil for malaria chemoprophylaxis. Possible explanations for this case include inappropriate dosing, unreported nonadherence, malabsorption of the drug, an early relapse from hypnozoites established at the start of this trip, or emerging parasite resistance.

Cases Caused by *P. falciparum* or *P. malariae*

Sixty of the 143 patients who had malaria diagnosed after recommended chemoprophylaxis use included 48 cases of *P. falciparum* and 12 of *P. malariae.* Of the 48 *P. falciparum* cases, all except two cases were acquired in Africa; one was acquired in Vietnam and one in India. Forty-two (87.5%) patients reported nonadherence to the antimalarial drug regimen, and three

persons had no adherence information available. Three (6.3%) patients who had all contracted malaria and had traveled to Africa reported adherence with antimalarial chemoprophylaxis; one patient took doxycycline, one patient took atovaquone/proguanil, and one took mefloquine. Of the 12 *P. malariae* cases, 10 were acquired in Africa, and one was acquired in Asia (Indonesia). Six of the patients reported nonadherence to the antimalarial drug regimen, and two had no adherence information available. The remaining four patients reported drug regimen adherence; two took mefloquine, and two took atovaquone-proguanil

Cases of Mixed Species Infection

Of the 143 patients who had taken a recommended malaria chemoprophylaxis, two reported a mixed *Plasmodium* species infection. One patient who traveled to Nigeria acquired a mixed infection of *P. falciparum* and *P. ovale,* and one patient who traveled to Indonesia acquired a mixed infection of *P. falciparum* and *P. vivax*. Both patients reported taking mefloquine for malaria chemoprophylaxis; however, neither patient adhered completely to the drug regimen.

Clinical Complications

Clinical complications associated with malaria were reported for 358 (23.8%) of the total 1,505 reported cases. One case was fatal. Although patients can have multiple clinical complications associated with malaria, the largest proportion (53.4%) of patients experienced anemia (hemoglobin <11 g/dL or hematocrit <33%). Of the 358 cases with clinical complications, 57 (15.9%) cases were classified as severe malaria, because one or more of the following manifestations were reported: cerebral malaria, renal failure, acute respiratory distress syndrome (ARDS), jaundice, or >5% parasitemia. Severe anemia (hemoglobin <7 g/dL) is also a characteristic of severe malaria (*12*); however, because data for severe anemia are not collected on the surveillance form, the percentage of severe malaria cases might have been higher.† Of the 57 patients with severe malaria, four (7%) reported taking chemoprophylaxis; however, none reported complete adherence to the drug regimen. Of the 57 patients with severe malaria cases, seven were treated using an investigational new drug protocol for intravenous artesunate; all seven patients recovered after treatment.

Purpose of Travel

Purpose of travel to areas where malaria is endemic was reported for 599 (85.4%) of the 701 U.S. civilians with imported malaria. Though travelers could report multiple reasons for travel, the largest proportion (62.8%) was persons who had visited friends or relatives in malarious areas; the second and third highest proportions (10.2% and 8.5%) were persons who had traveled as tourists or missionaries, respectively (Table 6). Proportions of various reasons for travel remained stable during 2005–2007.

Malaria by Age

Among the 1,464 cases among patients for whom age was known, 295 (20.2%) cases occurred in persons aged <18 years, 1,115 (76.2%) in persons aged 18–64 years, and 54 (4.6%) in persons aged ≥65 years. Although the majority of cases occur in persons aged 18–64 years, pediatric cases are of particular interest because the preventive care of most children is controlled by parents or guardians. Of the 295 (20.2%) cases among persons aged <18 years, 100 (33.9%) cases occurred among U.S. civilian children, 105 (35.6%) cases among children of foreign citizenship, and for 90 (30.5%) children, resident status was unknown.

Seventy-one (71.0%) of the cases among U.S. civilian children for whom country of exposure was known were attributable to travel to Africa. Of the 100 cases among U.S. civilian children, two (2.0%) children were aged <24 months, 22 (22.0%) were aged 24–59 months, 41 (41.0%) were aged 5–12 years, and 35 (35.0%) were aged 13–17 years. Of the 87 children for whom reason for travel was known, 73 (83.9%) were reported as visiting friends and relatives; the remaining 14 cases were attributed to tourist, missionary, and student travel. Thirty-one (33.3%) of the 93 children for whom chemoprophylaxis information was known were reported as having taken chemoprophylaxis, of whom 28 (90.3%) had taken an appropriate regimen; however, eight (28.6%) reported complete adherence.

Malaria During Pregnancy

A total of 24 cases of malaria were reported among pregnant women in 2007, representing 4.5% of cases among all women. Fourteen (58.3%) of the 24 cases occurred among U.S. civilian pregnant women; 21 of these patients reported travel to Africa, and three reported travel to Central and South American countries. Thirteen women reported visiting friends and relatives, and one reported missionary-related travel. Of the 14 cases of malaria reported among U.S. civilian pregnant women, three (21.4%) women reported taking malaria chemoprophylaxis. One woman reported taking an appropriate medication; however, she did not complete the drug regimen. No information was available on the birth outcomes of these women.

†Data on severe anemia (hemoglobin <7 mg/dL) will be reported in subsequent malaria surveillance summaries.

Selected Malaria Case Reports

Malaria Associated with Blood Transfusion

One case of induced malaria, caused by blood transfusion in the United States, was reported in 2007. A black woman aged 25 years with transfusion-dependent sickle cell disease and no previous travel history was admitted to a Houston, Texas, hospital on August 12, 2007, with complaints of abdominal pain. Treatment was provided for sickle cell crisis. On August 16, 2007, the woman became febrile and was evaluated for causes of fever. On August 20, 2007, *P. falciparum* malaria with 16% parasitemia was diagnosed, and quinidine and doxycycline were administered. A retrospective review of blood samples obtained on hospital admission revealed that the woman was parasitemic on the date of admission. The patient tolerated quinidine well and by August 24, 2007, her physician reported resolution of parasitemia. However, on August 28, 2007, the patient, who was still hospitalized, developed ARDS and acute renal failure, requiring mechanical ventilation and hemodialysis. After prolonged hospitalization, she recovered and was discharged.

During the year before admission, the woman had 66 units of red blood cells transfused; her most recent transfusions had occurred on June 12, 2007, and July 18, 2007. All of the units that she had received during June 12–July 18 had come from the same blood distribution facility. The hospital's transfusion services department was contacted to initiate an investigation of the donors of the units and identify the infected donor, thus preventing additional transfusion-related infections. Serologic testing using indirect immunofluoresence antibody identified one donor with elevated titers of antibodies to malaria consistent with previous malaria infection at an indeterminate time. All other donors' serologic tests were negative. The implicated donor was located and questioned regarding malaria history. The donor reported immigrating to the United States from Nigeria in 2001 and indicated that he had not traveled abroad since that time. The donor reported that in 1988, he was hospitalized for a severe febrile illness that was presumed to be a malaria infection. He did not recall the infecting species or the treatment provided. Investigators explained to the donor that his donated blood was likely to be the source of a malaria infection in another patient. He understood the findings but chose not to undergo any type of malaria therapy because he did not feel ill; however, he understood that he should be alert for any future episodes. The implicated donor was counseled not to donate blood until 3 years after undergoing an appropriate malaria therapy.

Imported Malaria Possibly Associated with Organ Transplantation

On January 18, 2007, a man aged 53 years returned to California after a 3-week trip to Pakistan for a kidney transplant; he did not take malaria chemoprophylaxis before his trip. During his stay in Pakistan, the man reported spending most of his time indoors. The transplant surgery was performed on January 7, 2007; the transplanted kidney came from India. During the transplant surgery, no transfusions were administered. On January 25, 2007, the man developed a fever and sought medical attention. Infection with *P. vivax* was diagnosed. Although the patient might have acquired the infection naturally in Pakistan, the kidney transplant procedure might have been the source.

Death Attributed to Malaria

One death attributable to malaria was reported in 2007. A man aged 67 years from India was visiting the United States to attend a wedding. He had a history of type 2 diabetes mellitus and hyperlipidemia. On October 17, 2007, the man was admitted to a U.S. hospital with fever, and *P. vivax* malaria infection was diagnosed. He was treated with quinine sulfate and doxycycline and subsequently had a negative blood smear. However, the man then developed respiratory failure and ARDS, which eventually resulted in severe hypoxia. The man developed oliguric renal failure and multisystem organ failure. He died on November 21, 2007.

Discussion

A total of 1,505 cases of malaria were reported to CDC for 2007, which is not significantly different from the number of cases reported in 2006. The number of cases reported with no information regarding residence status or clinical findings decreased from 634 in 2006 to 508 in 2007 (*9*). Excluding cases with no information on residence status, the percentage of U.S. resident cases during 2000–2007 remained stable.

During 2002–2007, the proportion of cases from Asia increased. The number of cases acquired in a specific region can be affected by many factors, including the amount of transmission occurring in the region, adherence to preventive measures (including mosquito avoidance and chemoprophylaxis) by travelers, the style of travel that occurs in that country (e.g., business or adventure travel), and the volume of travel to those countries.

Of the 1,504 imported cases, 508 (33.8%) cases did not have information on residential status. In addition, 350 (23.3%) cases did not have information describing travel history. High numbers of cases with no reported residential and clinical infor-

mation compromises the ability of the data to accurately reflect trends in malaria surveillance in the United States. Continued vigilance is needed by local and state health departments, health-care providers, and other health personnel in providing essential information regarding malaria cases when submitting cases through the various reporting systems to CDC.

Malaria cases acquired in Africa continue to account for the largest number of U.S. cases acquired from a specific region. The West African region accounts for almost 74% of the cases acquired in the continent; however, the number of cases acquired in Tanzania and Burundi increased. In 2006, only eight cases were acquired from Tanzania, and no persons with a malaria infection reported travel to or from Burundi (*9*). In 2007, a combined total of 61 cases were acquired in either Tanzania or Burundi. Among these, 57 persons were identified as resettling refugees or immigrants as their reason for travel to the United States.

CDC recommends presumptive treatment of *P. falciparum* malaria in refugees who are from areas where malaria is endemic before entering the United States to resettle. To ensure adequate presumptive treatment, the treatment regimen must be completed no sooner than 3 days before departure to the United States (*13*). This strategy decreases risk for symptoms, severe complications, or death associated with a malaria infection that could occur after arriving in the United States. Because refugees might settle in areas where access to health care is difficult to obtain or health-care providers are not familiar with malaria diagnosis or treatment, treating possible malaria infections in refugees before they immigrate to the United States is optimal to prevent ongoing infections from progressing to severe disease after arrival in the United States. Presumptive treatment also can reduce the risk for malaria reintroduction in the United States because the malaria vector, the female *Anopheles* mosquito, is found throughout the continental United States.

The International Organization for Migration (IOM) is an intergovernmental agency that evaluates most refugees bound for the United States and provides treatment for certain infectious diseases. To reduce the incidence of malaria among refugees after they arrive in the United States, IOM administered presumptive malaria treatment against *P. falciparum* to Burundi refugees resettling from Tanzania. In 2005, CDC recommended artemisinin-based combination therapy (ACT) as presumptive *P. falciparum* treatment for refugees resettling to the United States from sub-Saharan Africa (*14*). However, until July 2007, IOM continued to implement sulfadoxine-pyrimethamine (SP) treatment for malaria to refugees before arrival in the United States; *P. falciparum* infections in sub-Saharan Africa have considerable resistance to SP (*15*). Therefore, SP resistance is a possible explanation for the increase of cases in Burundi refugees who immigrated to the United States in 2007. In response to such cases, IOM is now implementing ACT treatment as presumptive *P. falciparum* treatment for refugees resettling in the United States (*14*). A total of 7,545 Burundian refugees from Tanzania resettled to the United States during 2007–2008 (*16*). Health-care providers in the United States caring for refugees resettling from malaria-endemic regions should remain aware of the possibility of malaria in this population, regardless of previous treatment.

One reason malaria surveillance is conducted is to monitor for prophylaxis failures that might indicate emergence of drug resistance. However, approximately 82% of imported malaria cases among U.S. residents for whom prophylaxis use was known occurred among persons who were not taking prophylaxis, were taking prophylaxis but not the regimen recommended for the region to which they were traveling, or were taking a recommended prophylactic regimen incorrectly. The majority of patients for whom appropriate prophylaxis was reported and who did not have a relapsing infection reported nonadherence with the recommended regimen or provided insufficient information to determine whether they adhered to an appropriate antimalarial chemoprophylaxis regimen. In the small subset of patients who reported choosing and adhering to the recommended prophylactic drug regimen, subsequent malaria might have been a result of malabsorption of the antimalarial drug or emerging drug resistance. Because CDC does not routinely evaluate blood drug levels among patients with malaria who report adherence with a recommended regimen, determining whether adherence reporting is inaccurate, the antimalarial drug was malabsorbed, or the patient was experiencing emerging drug resistance is not possible. No conclusive evidence exists to indicate a single national or regional source of infection among this group of patients or the failure of a particular chemoprophylactic regimen. Health-care providers who suspect chemoprophylaxis failure should contact CDC quickly, which will enable CDC to measure patient antimalarial blood drug levels and assess the parasite in vitro for genetic resistance characteristics to evaluate for possible drug resistance.

Severe malaria is characterized by one or more of the following clinical complications: prostration, impaired consciousness or coma, respiratory distress, seizures, shock, ARDS, jaundice, severe anemia, acute renal failure, disseminated intravascular coagulation, acidosis, hemoglobinuria, and >5% parasitemia (*17*). Intravenous quinidine gluconate, principally used as an antiarrhythmic medicine, also has antimalarial properties and is the only parenteral drug approved by the Food and Drug Administration for treatment of severe malaria that is available in the United States. However, quinidine has cardiotoxic effects and has become less available in U.S. hospitals with the advent of newer antiarrhythmic drugs (*18,19*). Since 2000,

the World Health Organization has recommended artemisinins such as artesunate rather than quinidine for treatment of severe malaria; artesunate has been used outside the United States for many years (*17*). On June 21, 2007, CDC's investigational new drug (IND) protocol for intravenous artesunate became effective, allowing the use of intravenous artesunate for the treatment of severe malaria. The medication is stocked at eight quarantine stations around the United States and can be shipped quickly when needed. Precise guidelines must be followed and eligibility requirements must be met to enroll a patient in the treatment protocol. Artesunate is provided free of charge to hospitals on request and on an emergency basis by the CDC Drug Service or by one of the CDC quarantine stations. Physicians who administer the drug to patients must notify CDC of any resulting adverse effects and comply with the IND protocol (*20*). To enroll a patient with severe malaria in this treatment protocol, health-care providers should call CDC's Malaria Hotline (Table 7).

As in previous years, the majority of malaria cases in 2007 were among persons who traveled to visit friends and relatives. Foreign-born U.S. civilians need to be aware that acquired immunity wanes quickly when exposure to malaria is interrupted and that they should take prophylaxis when returning to malarious areas. In addition, children of foreign-born U.S. civilians who are born in the United States have no immunity to malaria and are vulnerable to infection (*21*). In this report, approximately three fourths of the children who were visiting friends and relatives and contracted malaria had not been taking any chemoprophylaxis or had been taking an incorrect medication for chemoprophylaxis.

Twenty-four cases were reported in pregnant women, which is a 41% increase from 2006. Among the 14 U.S. civilian women who were pregnant and contracted malaria, three (21.4%) women reported taking chemoprophylaxis, and none of these three completely adhered to the drug regimen. The proportion of pregnant women taking chemoprophylaxis is lower than the percentage of total U.S. civilians with malaria who took chemoprophylaxis. Malaria during pregnancy poses a high risk for both maternal and perinatal morbidity and mortality (*22*). Pregnant women should be counseled to avoid travel to malarious areas. If deferral of travel is impossible, pregnant women should be informed that the risks for malaria greatly outweigh those associated with prophylaxis, and chemoprophylaxis should be used. Information for pregnant women is available at http://www.cdc.gov/malaria/travel/drugs_pregnant_public.htm.

Appropriate chemoprophylaxis, promptly seeking medical care if symptoms develop, and consideration of malaria in the differential diagnosis of fever in a traveler who has returned to the United States will help ensure malaria is properly managed and controlled in the United States. In addition, because induced malaria infections are possible, health professionals and blood donation and collection staff members must be attentive and thorough in their blood deferment protocols. FDA screening guidelines indicate that residents of countries where malaria is not endemic who then travel to areas where malaria is endemic should not be accepted as blood donors until 1 year after their departure from the malarious area. Former residents of areas where malaria is endemic should be deferred from blood donation until 3 years after their departure from the malarious area. Persons who receive a diagnosis of malaria should not donate blood until 3 years after treatment, during which time they must have remained asymptomatic (*23*).

Signs and symptoms of malaria are often nonspecific, but fever usually is present. Other symptoms include headache, chills, increased sweating, back pain, myalgia, diarrhea, nausea, vomiting, and cough. Prompt diagnosis requires that malaria be included in the differential diagnosis of illness in a febrile person with a history of travel to a malarious area. Clinicians should ask all febrile patients for a travel history, including international visitors, immigrants, refugees, migrant laborers, and other international travelers.

Prompt treatment of suspected malaria is essential because persons with *P. falciparum* infection are at risk for experiencing life-threatening complications soon after onset of illness. Ideally, therapy for malaria should be initiated immediately after the diagnosis has been made. Treatment should be determined on the basis of the infecting *Plasmodium* species, the probable geographic origin of the parasite, the parasite density, and the patient's clinical status (*22*). If a diagnosis of malaria is suspected and cannot be confirmed, or if a diagnosis of malaria is confirmed but species determination is not possible, antimalarial treatment should be initiated that is effective against *P. falciparum*. Resistance of *P. falciparum* to chloroquine is worldwide, with the exception of a limited number of geographic regions (e.g., Mexico and Central America); therefore, therapy for presumed *P. falciparum* malaria should include a drug effective against such resistant strains (*24*).

Health-care providers should be familiar with prevention, recognition, and treatment of malaria and are encouraged to consult appropriate sources for malaria prevention and treatment recommendations (Table 7). Physicians seeking assistance with the diagnosis or treatment of patients with suspected or confirmed malaria should call CDC's Malaria Hotline (Table 7) during regular business hours; during evenings, weekends, and holidays, physicians should call CDC's Emergency Operations Center (Table 7) and ask the staff member to page the person on call for the Malaria Branch. These resources are intended for use by health-care providers only.

Detailed recommendations for preventing malaria are available to the general public online at http://www.cdc.gov/travel/diseases.htm/malaria. In addition, CDC biannually publishes recommendations in *Health Information for International Travel* (commonly referred to as *The Yellow Book*) (*1*), which is available for purchase from Elsevier (http://www.elsevierhealth.com or telephone: 800-545-2522); the publication is also available and updated more frequently on the CDC Travelers' Health site at http://wwwn.cdc.gov/travel. Additional information on malaria prevention recommendations is available through the online CDC malaria map application (http://www.cdc.gov/malaria/risk_map). The application is an interactive map that provides information on malaria risk throughout the world. Users can search for or browse through countries, cities, and place names and obtain information about malaria and recommended malaria prevention medications in particular locations. The malaria map application complements resources currently available on the CDC Travelers' Health website.

CDC provides assistance for diagnostic parasitology through DPDx, CDC's Division of Parasitic Diseases diagnostic website. DPDx (available at http://www.dpd.cdc.gov/dpdx) provides free Internet-based laboratory diagnostic assistance (i.e., telediagnosis) to laboratorians and pathologists who are investigating suspected parasitic disease cases, such as malaria. Digital images captured from diagnostic specimens can be submitted by e-mail for consultation. Telediagnosis assistance from CDC is available during regular business hours (Monday–Friday, 8 a.m.–4:30 p.m. EST). Because laboratories can transmit images to CDC and obtain a rapid response (average time: minutes to several hours) to their inquiries, DPDx allows efficient diagnosis of challenging cases and rapid dissemination of information. As of January 2007, approximately 49 public health laboratories in 46 states and Puerto Rico had the ability to perform telediagnosis. Implementation of telediagnosis at public health laboratories is supported by CDC, including training of personnel in digital imaging techniques and diagnostic identification of parasites. The DPDx Internet site is CDC's reference for the telediagnosis of parasitic diseases and also serves as an online guide for diagnostic parasitology. The DPDx website contains reference material with images, text, and videos on approximately 100 different species of parasites, covering information on laboratory diagnosis, geographic distribution, clinical features, treatment, and life cycles.

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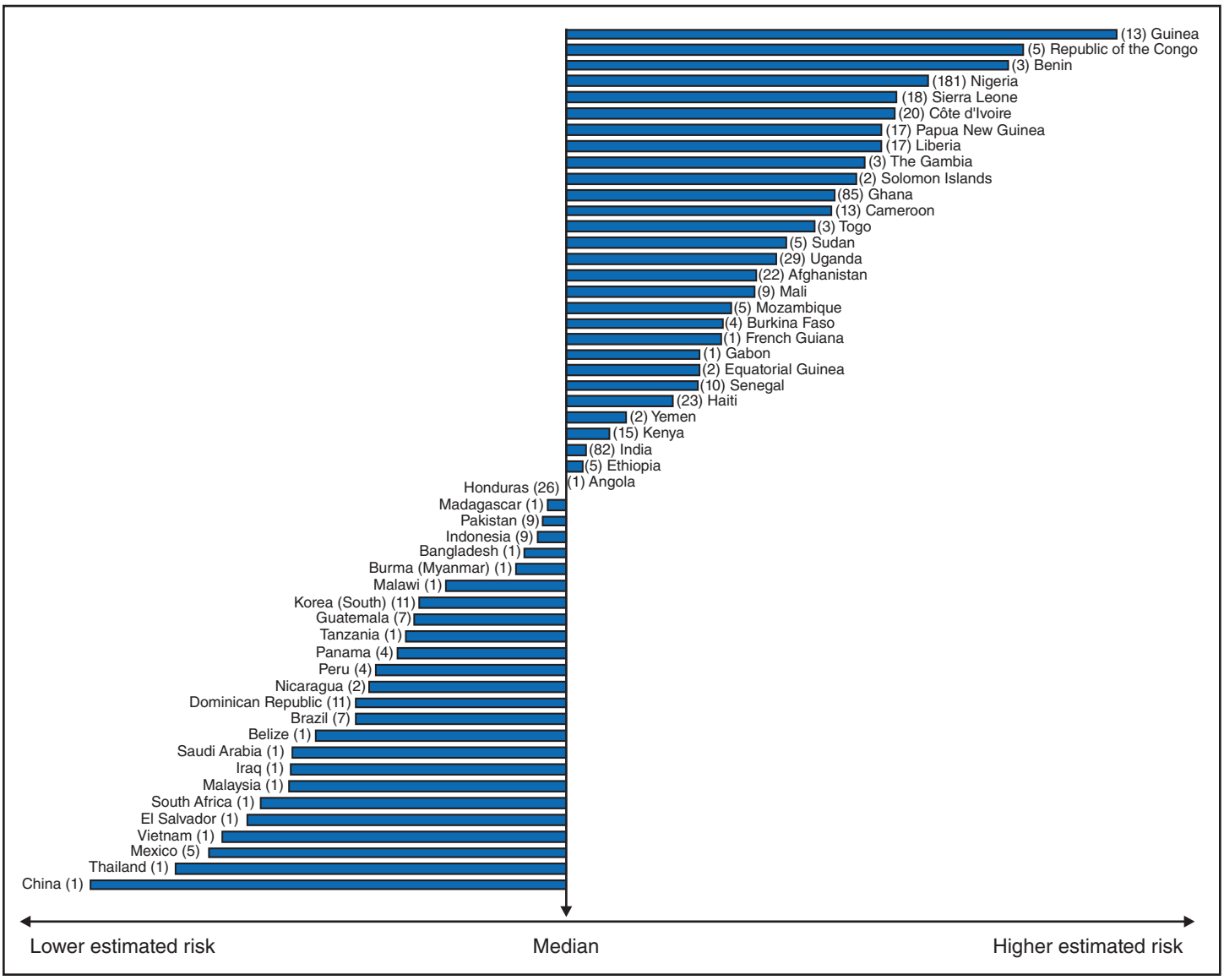
FIGURE 1. Number of malaria cases,* by state in which the disease was diagnosed — United States, 2007

* N = 1,505.

FIGURE 2. Imported malaria cases and estimated relative case rates among U.S. residents, by country of acquisition — 2007



* Using estimates of travel volume for U.S. travelers to each country from which cases of malaria were acquired and the number of cases among U.S. travelers attributable to each country, a case rate was estimated for each country. Data used to estimate country-specific relative case rates were extrapolated from World Tourism Organization estimates of annual numbers of U.S. travelers to specified countries (*7*). Relative case rates were determined by dividing the individual country-specific case rates by the median individual country-specific case rate. The number of cases of malaria among U.S. civilian travelers attributable to each country is displayed next to the country name in parentheses.

TABLE 1. Number of malaria cases* — United States, 1977–2007

Year	U.S. military personnel	U.S. civilians	Foreign residents	Status not recorded†	Total
1977	11	233	237	0	**481**
1978	31	270	315	0	**616**
1979	11	229	634	3	**877**
1980	26	303	1,534	1	**1,864**
1981	21	273	809	0	**1,103**
1982	8	348	574	0	**930**
1983	10	325	468	0	**803**
1984	24	360	632	0	**1,016**
1985	31	446	568	0	**1,045**
1986	35	410	646	0	**1,091**
1987	23	421	488	0	**932**
1988	33	550	440	0	**1,023**
1989	35	591	476	0	**1,102**
1990	36	558	504	0	**1,098**
1991	22	585	439	0	**1,046**
1992	29	394	481	6	**910**
1993	278	519	453	25	**1,275**
1994	38	524	370	82	**1,014**
1995	12	599	461	95	**1,167**
1996	32	618	636	106	**1,392**
1997	28	698	592	226	**1,544**
1998	22	636	361	208	**1,227**
1999	55	833	381	271	**1,540**
2000	46	827	354	175	**1,402**
2001	18	891	316	158	**1,383**
2002	33	849	272	183	**1,337**
2003	36	767	306	169	**1,278**
2004	32	775	282	235	**1,324**
2005	36	870	297	325	**1,528**
2006	50	736	217	561	**1,564**
2007	33	701	263	508	**1,505**

* A case was defined as symptomatic or asymptomatic illness that occurs in the United States or one of its territories in a person who has laboratory-confirmed malaria parasitemia (as confirmed by microscopy or polymerase chain reaction), regardless of whether the person had previous attacks of malaria while in other countries. A subsequent malaria infection occurring in a person is counted as an additional case if the demonstrated *Plasmodium* species differs from the initially identified species or if the infection is indicated as a relapsing infection caused by the same *Plasmodium* species identified previously. A subsequent malaria infection occurring as a result of a drug resistance failure is not counted as an additional case.

† The increase in persons with unknown civil status that began in the 1990s might be a result of a change in the surveillance form.

TABLE 2. Number of malaria cases, by *Plasmodium* species — United States, 2005, 2006, and 2007

Plasmodium species	2005		2006		2007	
	No.	(%)	No.	(%)	No.	(%)
P. falciparum	742	(48.6)	613	(39.2)	654	(43.4)
P. vivax	337	(22.1)	275	(17.6)	305	(20.3)
P. malariae	54	(3.5)	46	(2.9)	30	(2.0)
P. ovale	38	(2.5)	47	(3.0)	53	(3.5)
Mixed	12	(0.8)	10	(0.6)	9	(0.6)
Undetermined	345	(22.6)	573	(36.3)	454	(30.2)
Total	**1,528**	**(100)**	**1,564**	**(100)**	**1,505**	**(100)**

TABLE 3. Imported malaria cases, by country of acquisition and *Plasmodium* species — United States, 2007

Country of acquisition	*P. falciparum*	*P. vivax*	*P. malariae*	*P. ovale*	Unknown	Mixed	Total
Africa	**541**	**25**	**28**	**37**	**108**	**5**	**744**
Angola	1	0	0	0	0	0	1
Benin	5	0	0	0	0	0	5
Burkina Faso	4	0	0	0	0	0	4
Burundi	11	0	0	0	2	0	13
Cameroon	14	3	1	1	4	0	23
Central African Republic	1	0	0	0	0	0	1
Congo, Republic of the	3	0	1	1	0	0	5
Côte d'Ivoire	22	0	0	0	2	0	24
Egypt	1	0	0	0	0	0	1
Equatorial Guinea	1	0	0	0	1	0	2
Ethiopia	0	4	0	0	3	0	7
Gabon	2	0	0	0	0	0	2
Gambia	6	0	0	0	0	0	6
Ghana	97	2	2	5	14	0	120
Guinea	13	0	2	2	1	0	18
Kenya	11	2	1	1	5	0	20
Liberia	32	2	1	2	9	0	46
Madagascar	0	0	0	0	1	0	1
Malawi	3	0	0	0	0	0	3
Mali	10	0	0	0	3	0	13
Mozambique	4	1	0	0	3	0	8
Nigeria	171	4	8	17	30	4	234
Rwanda	2	0	0	0	0	0	2
Senegal	13	0	0	0	1	0	14
Sierra Leone	17	0	1	1	5	0	24
Somalia	0	1	0	0	0	0	1
South Africa	1	0	0	0	0	0	1
Sudan	4	1	1	0	3	0	9
Tanzania	37	1	1	2	6	1	48
Togo	4	0	0	0	0	0	4
Uganda	19	3	7	2	7	0	38
West Africa, unspecified	10	0	0	0	0	0	10
East Africa, unspecified	1	0	0	0	1	0	2
Central Africa, unspecified	0	0	0	0	1	0	1
Africa, unspecified	21	1	2	3	6	0	33
Asia	**23**	**179**	**2**	**7**	**38**	**4**	**253**
Afghanistan	0	22	0	0	4	0	26
Bangladesh	0	1	0	0	0	0	1
Burma (Myanmar)	2	4	0	0	1	0	7
Cambodia	1	1	0	0	0	0	2
China	0	2	0	0	0	0	2
India	13	106	1	3	25	3	151
Indonesia	3	3	1	0	4	1	12
Iraq	0	4	0	0	0	0	4
Korea (South)	0	12	0	0	3	0	15
Malaysia	0	1	0	0	0	0	1
Pakistan	1	9	0	4	1	0	15
Philippines	1	1	0	0	0	0	2
Saudi Arabia	0	1	0	0	0	0	1
Thailand	0	10	0	0	0	0	10
Vietnam	1	0	0	0	0	0	1
Yemen	1	1	0	0	0	0	2
Asia, unspecified	0	1	0	0	0	0	1

TABLE 3. (*Continued*) Imported malaria cases, by country of acquisition and *Plasmodium* species — United States, 2007

Country of acquisition	*P. falciparum*	*P. vivax*	*P. malariae*	*P. ovale*	Unknown	Mixed	Total
Central America and the Caribbean	**47**	**41**	**0**	**1**	**10**	**0**	**99**
Belize	0	0	0	0	1	0	1
Dominican Republic	10	0	0	0	1	0	11
El Salvador	0	1	0	0	0	0	1
Guatemala	0	11	0	0	1	0	12
Haiti	29	1	0	0	4	0	34
Honduras	5	25	0	1	1	0	32
Nicaragua	1	1	0	0	2	0	4
Panama	2	2	0	0	0	0	4
North America	**0**	**9**	**0**	**0**	**3**	**0**	**12**
Mexico	0	9	0	0	3	0	12
South America	**3**	**8**	**0**	**1**	**8**	**0**	**20**
Brazil	0	7	0	0	4	0	11
Guyana	0	0	0	0	1	0	1
French Guiana	0	0	0	1	0	0	1
Peru	2	0	0	0	2	0	4
Suriname	1	0	0	0	0	0	1
South America, unspecified	0	1	0	0	1	0	2
Oceania	**4**	**17**	**0**	**1**	**5**	**0**	**27**
Papua New Guinea	3	15	0	1	5	0	24
Solomon Islands	0	2	0	0	0	0	2
Oceania, unspecified	1	0	0	0	0	0	1
Unknown	**35**	**26**	**0**	**6**	**282**	**0**	**349**
Total	**653**	**305**	**30**	**53**	**454**	**9**	**1,504***

* One case that was transfusion related was not included as an imported case.

TABLE 4. Number of imported malaria cases among U.S. and foreign residents,* by region of acquisition — United States, 2007

Region of acquisition	U.S. residents		Foreign residents		Total	
	No.	(%)	No.	(%)	No.	(%)
Africa	476	(64.9)	167	(63.5)	**643**	**(64.5)**
Asia	143	(19.5)	77	(29.3)	**220**	**(22.1)**
Central America and the Caribbean	75	(10.2)	8	(3.0)	**83**	**(8.3)**
South America	13	(1.8)	0	(0)	**13**	**(1.3)**
North America	5	(0.6)	4	(1.5)	**9**	**(0.9)**
Oceania	20	(2.7)	3	(1.2)	**23**	**(2.3)**
Unknown†	2	(0.3)	4	(1.5)	**6**	**(0.6)**
Total	**734**	**(100)**	**263**	**(100)**	**997**	**(100)**

* Persons for whom U.S. or foreign status is not known are excluded.
† Region of acquisition is unknown.

TABLE 5. Number of imported malaria cases, by interval between date of arrival in the United States and onset of illness and by *Plasmodium* species* — United States, 2007

	P. falciparum		*P. vivax*		*P. malariae*		*P. ovale*		Mixed		Total	
Interval (days)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
<0†	62	(12.5)	13	(6.3)	1	(3.7)	2	(6.2)	0	(0)	**78**	**(10.1)**
0–29	398	(80.1)	74	(35.9)	14	(51.9)	10	(31.2)	8	(88.9)	**504**	**(65.4)**
30–89	22	(4.4)	44	(21.3)	8	(29.6)	2	(6.3)	0	(0)	**76**	**(9.8)**
90–179	6	(1.2)	33	(16.1)	1	(3.7)	11	(34.4)	1	(1.1)	**52**	**(6.7)**
180–364	6	(1.2)	36	(17.5)	2	(7.4)	5	(15.6)	0	(0)	**49**	**(6.4)**
≥365	3	(0.6)	6	(2.9)	1	(3.7)	2	(6.3)	0	(0)	**12**	**(1.6)**
Total	**497**	**(100)**	**206**	**(100)**	**27**	**(100)**	**32**	**(100)**	**9**	**(100)**	**771**	**(100.0)**

* Persons for whom *Plasmodium* species, date of arrival in the United States, or date of onset of illness is unknown are not included.
† Onset of illness before arrival in the United States.

TABLE 6. Number of imported malaria cases among U.S. civilians, by purpose of travel at time of acquisition — United States, 2007

	Imported cases	
Category for purpose of travel*	No.	(%)
Visiting friends and relatives	376	(62.8)
Tourism	61	(10.2)
Missionary or dependent	51	(8.5)
Business representative	47	(7.8)
Student or teacher	29	(4.8)
Peace Corps volunteer	6	(1.0)
Air crew or sailor	1	(0.2)
Other/mixed purpose	26	(4.3)
Unknown	102	(17.0)

* Percentages do not equal 100% because travelers can identify multiple reasons for purpose of travel.

TABLE 7. Sources for malaria prophylaxis, diagnosis, and treatment recommendations

Type of information	Source	Availability	Telephone number, website, or e-mail address
Prophylaxis	CDC's Traveler's Health website (includes online access to *Health Information for International Travel*)	24 hours/day	http://www.cdc.gov/travel
Prophylaxis	*Health Information for International Travel* (*The Yellow Book*)	Order from: Elsevier, Health Sciences Division Order Fulfillment 11830 Westline Industrial Dr. St. Louis, MO 63146	800-545-2522 or http://www.elsevier.com
Prophylaxis	CDC malaria map application	24 hours/day	http://www.cdc.gov/malaria/risk_map
Diagnosis	CDC Division of Parasitic Diseases diagnostic website (DPDx: Laboratory Identification of Parasites of Public Health Concern)	24 hours/day	http://www.dpd.cdc.gov/dpdx
Diagnosis	CDC Division of Parasitic Diseases diagnostic CD-ROM (DPDx)	Order by e-mail from CDC Division of Parasitic Diseases	dpdx@cdc.gov http://www.dpd.cdc.gov/dpdx/HTML/CDProducts.htm
Treatment*	CDC Malaria Branch	8:00 A.M.–4:30 P.M. EST, Monday–Friday	770-488-7788* (CDC Malaria Hotline)
Treatment*	CDC Malaria Branch	4:30 P.M.–8:00 A.M. EST, weekdays; all day weekends and holidays	770-488-7100* (This is the number for the CDC Emergency Operations Center. Ask staff member to page the person on call for the Malaria Branch.) http://www.cdc.gov/malaria/diagnosis_treatment/treatment.htm

* Telephone number is for health-care professionals only.

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