

The Current Status of Malaria in Louisiana

Amita Toprani, MD; Susanne Straif-Bourgeois, PhD, MPH;
Nathan Weed, MPH; and Raoult C. Ratard, MD, MPH&TM

Between 1992 and 2004, 118 cases of malaria were reported to the Louisiana Office of Public Health. Case surveillance data were collected in response to these case reports. These data are presented and analyzed here. All cases reported in Louisiana were imported from malaria-endemic regions. Despite the fact that malaria is a preventable and treatable disease, deaths due to malaria continue to occur. Counseling for travelers to malaria-endemic areas needs to be improved. In particular, region-specific prophylaxis guidelines published by the CDC are infrequently implemented. A travel history should be elicited from all patients who present with fever in the United States. If a history of travel to malaria-endemic areas is present, blood films should be obtained and examined for malaria parasites.

According to the World Health Organization, there are 300 to 500 million clinical cases of malaria each year resulting in up to 2.7 million deaths. Most of these cases occur in areas where malaria is endemic, particularly in Sub-Saharan Africa and parts of Asia and South and Central America.¹

Malaria was endemic in the southeastern United States (US) until the late 1940s. Early efforts to control malaria coincided with the US occupation of Cuba and the construction of the Panama Canal in the early 1900s. These efforts concentrated on military bases in the south. In the 1930s, control efforts expanded as a part of measures to promote the economic development of the Tennessee River valley region. Spraying insecticides, screening houses, and controlling water levels were effective in reducing the mosquito population. The National Malaria Eradication Program was established in July of 1947. It was a cooperative program among state and local health departments in the southeastern US and the newly established Centers for Disease Control. Over four million house insecticide applications were made between 1947 and 1949. The number of reported cases of malaria decreased from 15,000 in 1947 to 2000 in 1950. Malaria was considered officially eradicated from the US in 1951.¹

In recent years, almost every case of malaria reported in the US was imported by travelers from endemic countries. In the year 2002, there were 1,337 cases of malaria reported to the CDC and all but five of these were acquired outside of the United States.²

But the battle against malaria in the US is not over. The humidity, temperature, and rainfall patterns in the southern US make it an ideal habitat for *Anopheles* mosquitoes. Three effective vectors of malaria are found in Louisiana: *Anopheles crucians*, *An. Pseudopunctipennis*, and *An. quadrimaculatus*,³ and anopheline mosquitoes are present seasonally in every state except Hawaii.² In fact between 1957 and 2003, 56 outbreaks of locally transmitted mosquito-borne malaria have occurred in the US.⁴ Luckily these outbreaks have been small and relatively

isolated, but they underscore the real possibility of re-introduction of malaria into the United States and the need for continued public health surveillance.

POPULATION AND METHODS

Malaria is a notifiable disease throughout the US, and healthcare providers are required to report all cases of laboratory-confirmed malaria to their local or state health department. Reports in Louisiana are generally made using the web-based Reportable Disease Database.

Reported cases should fit the CDC case definition. Symptoms generally appear from 10 to 16 days after infection.⁵ Clinical presentation is variable, but most patients experience fever. In addition, common associated symptoms include headache, back pain, chills, sweats, myalgias, and nausea. Less frequently, vomiting, diarrhea, and cough may occur. The diagnosis of malaria should be considered for any person who has these symptoms and who has a history of travel to a malaria-endemic region. Laboratory confirmation is made by demonstration of malarial parasites in blood films.¹

A confirmed case of malaria is defined as 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."¹

Confirmed cases are further classified according to the World Health Organization categories described below.⁶

- *Autochthonous*:
 - *Indigenous*: malaria acquired by mosquito transmission in an area where malaria is a regular occurrence.
 - *Introduced*: malaria acquired by mosquito transmission from an imported case in an area where malaria is not a regular occurrence.

- *Imported*: malaria acquired outside a specific area (e.g., the United States and its territories).
- *Induced*: malaria acquired through artificial means (e.g., blood transfusion, common syringes, or malari-otherapy).
- *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 par-oxysms.
- *Cryptic*: an isolated case of malaria that cannot be epidemiologically linked to additional cases.

Data for case surveillance is collected by health department staff using the standard Malaria Case Surveillance Report Form provided by the CDC. Information regarding age, gender, race, and travel history of the patient is requested, as well as clinical information including malaria species, previous episodes of malaria, history of chemoprophylaxis, clinical complications, treatment regimen, and occurrence of hospitalization and death. Laboratory confirmation of malarial parasitemia is carried out at the facility where the diagnosis is made. Reports of confirmed cases are passed on to the National Malaria Surveillance System (NMSS), a passive surveillance system administered by the CDC's malaria branch.

RESULTS

In the 1940s, rates of malaria in Louisiana ranged from 100 to 600 cases per million per year with a peak in 1944 and 1945 coinciding with the return of soldiers from World War II. In the late 1940s, there was a dramatic decrease in the number of reported cases to less than 10 per million per year. Another peak in incidence occurred in 1952 after the Korean War. Since then case rates have remained low and stable to the present time (Figure 1).

Between 1992 and 2004, 118 cases of malaria were reported to the Louisiana Office of Public Health. The age distribution of cases was consistent across time. The majority of cases (84%) occurred in the group 15-64 years old. The group 0-14 years of age accounted for 13% of

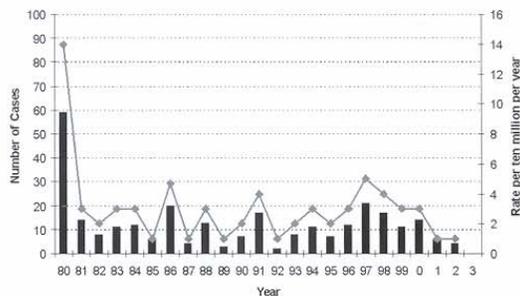


Figure 1. Cases of malaria in Louisiana from 1980-2003.

cases, and the remainder occurred in the 65 and over group. Of those with recorded gender, 79% were males. Case rates for males in all age groups ranged from 0.92 to 8.58 per million per year, whereas those for females were from zero to 3.13 per million per year. Seventy percent of cases occurred in whites, 20% in blacks, 6% in Asians, and 3% in Hispanic persons. Cases were seasonally distributed with the bulk of cases occurring from June through August.

All but two cases were classified as imported based on history of travel to malaria-endemic regions. Two cases were classified as cryptic due to lack of information. There was no evidence of local spread of malaria. Of the cases where travel history was available, 55% had traveled to Africa, 23% to Central America or the Caribbean, 11% to Asia, 10% to the Indian subcontinent, and 1% to South America. No change in the geographic origin of cases was observed over time. The most commonly cited reasons for travel were business (31%) and visiting relatives (29%).

Of the imported cases, 84% occurred in persons who had lived in the US for at least 12 months prior to traveling to a malaria-endemic region. Two percent of cases occurred in those who had lived in the US for less than 12 months, and 14% occurred in residents of other countries.

The majority of cases occurred in residents of Orleans Parish. East Baton Rouge, Jefferson, and Lafayette Parishes accounted for a significant number of cases as well. The remaining cases were spread among 23 other parishes.

Plasmodium falciparum was the most commonly diagnosed species, followed by *P. vivax* and *P. malariae*. No case of *Plasmodium ovale* was reported. Among the 96 cases where both the infecting species and the region of acquisition were known, 83% of the infections acquired in Africa were attributed to *P. falciparum* and 12% to *P. vivax*. Of cases acquired in Asia and the Americas, 24% and 26% of infections were caused by *P. falciparum* and 71% and 65% by *P. vivax*, respectively.

Of the cases where information on prophylaxis was available, 52 of 103 cases (50%) reported taking some kind of chemoprophylaxis. Of these, 22 (42%) took a regimen based on CDC recommendations for their region of travel. Twenty individuals (38%) took inappropriate regimens. In 18 of these 20 cases, chloroquine prophylaxis was used during travel to areas with known chloroquine-resistance. In ten cases, appropriateness of the prophylactic regimen could not be determined.

Of the 22 individuals who had taken CDC-recommended prophylaxis, only 5 patients (23%) reported full adherence to their regimen. Two of these had traveled to Africa (Angola and Nigeria); one was infected with *P. falciparum*, and the species was unknown for the other. Two individuals had traveled to Central America (Honduras and Nicaragua) and one to Asia (Korea). All three of these were infected with *P. vivax*.

MORTALITY

There were two fatal cases of malaria reported. The first occurred in January 1999 in a 27-year-old white man from Lafayette parish. He had a history of travel to Nigeria for business reasons. Before traveling, he had been a resident of the United States for over 12 months. He did not take any malarial chemoprophylaxis. He was diagnosed with *P. falciparum*, was hospitalized, and was treated with quinine. He developed anemia, cerebral malaria, renal failure, and the syndrome of acute respiratory distress before expiring.

The second case occurred in December 2003 in a 56-year-old white man with unknown parish of residence. He had traveled to Nigeria as a tourist and had lived in the US for over 12 months before travel. He was reported to have taken chloroquine prophylaxis. The patient was not hospitalized, and the species of malaria was undetermined. Neither patient had a prior history of malaria.

DISCUSSION

As recently as the 1940s, malaria was an endemic disease in Louisiana. After concerted public-health intervention, malaria was eradicated from the United States, and in recent years nearly all cases of malaria have been imported from other countries. Over the past 10 years, case rates in Louisiana have not exceeded five per million population.

Despite the presence of malarial vectors and weather conditions suitable for the spread of *Plasmodium* species, there has been no evidence of locally transmitted malaria in this state. The anopheline species indigenous to Louisiana are very poor vectors for most plasmodium species, except for *P. vivax*. Louisiana anophelines cannot transmit *P. falciparum* under natural, as opposed to experimental, conditions. Since 1992, instances of locally transmitted malaria have occurred in California, Florida, Michigan, Texas, and Virginia.⁷⁻¹⁰ There exists a large population of migrant farm workers in all of these states. Since they spend long periods of time outdoors, their presence provides substantial opportunity for local *Anopheles* mosquitoes to become infected with the parasite.

Nevertheless, because of the volume of international traffic in Louisiana, malaria will continue to occur in this state, as is evidenced by the 118 cases presented here. It is notable that in 71 of these cases, a chemoprophylaxis regimen was not used or was inappropriate for the region of travel. In nearly every case where prophylaxis was not appropriate, chloroquine was used during travel to an area with chloroquine-resistant organisms. Furthermore, in the two cases of fatal disease, both individuals had traveled to an area with endemic chloroquine-resistant malaria. In one case, prophylaxis was not taken, and in the other chloroquine was used. We can conclude that 60% of the malaria cases and both fatalities could have been prevented if appropriate pro-

phylaxis had been taken.

A recent article analyzed malaria-related deaths in US travelers. From 1963 to 2001, 123 malaria-related deaths in US civilians were reported to the National Malaria Surveillance System. Of these, only 34 (28%) took malaria chemoprophylaxis. Of those few who did take antimalarial drugs, only 20 used a regimen that was appropriate for their region of travel, and 6 of these did not adhere completely to the regimen. The authors also noted delays in seeking care, in diagnosis, and in initiating therapy, as well as the use of inappropriate therapeutic regimens in many of these fatal cases.¹¹

These data suggest that clinical services for the prevention of malaria are not properly implemented in Louisiana and throughout the US. Physicians who provide care for foreign travelers must be aware that chloroquine-resistance is now the rule rather than an exception in most of the world. Guidelines for region-specific chemoprophylaxis are available from the CDC website (<http://www.cdc.gov/travel>) and in *Health Information for International Travel*, also known as the "Yellow Book." These resources should be consulted before any prescription is written. Furthermore, patients must be made aware that strict adherence to the prescribed regimen is essential. Patients should also be warned to minimize contact with mosquitoes through the use of mosquito netting and insect repellants containing DEET (N,N-diethyltoluamide). DEET may be safely applied to exposed skin, with lower concentrations, such as 4%, recommended for children. Clinicians must also educate patients to watch for the symptoms of malaria and must emphasize the importance of seeking care as soon as symptoms develop.²

P. falciparum is the major species responsible for malarial deaths in the world and among travelers. Resistance to antimalarials has become a major difficulty in the treatment and prevention of *P. falciparum* infections. Any delay in the diagnosis of malaria in a returned traveler could result in a preventable death. The thick peripheral smear is much more effective at detecting lower parasitemia since it allows the microscopist to screen 20 to 50 layers while the thin smear spreads only a single layer of blood on the slide. If the parasite is allowed to infect several percent of the red blood cells, it may be too late to prevent a fatal outcome.

In the US, a travel history should be elicited from all patients who present with fever. Malaria should be considered if a history of travel to malaria-endemic areas is present. In these cases, Giemsa-stained thick and thin films of the peripheral blood should be obtained and examined for intracellular parasites. If malarial parasites are discovered, treatment should begin immediately because infections with *P. falciparum* can progress rapidly to organ failure and death. Because of its widespread resistance to chloroquine, presumed *P. falciparum* malaria should be treated with a drug effective against resistant strains.²

In summary, the majority of malaria cases imported into the US are preventable. It is essential for clinicians providing travel services to be aware of the current CDC guidelines for chemoprophylaxis and for all clinicians to consider the diagnosis of malaria in febrile patients with a history of travel to areas where malaria is endemic. Continued malarial surveillance is necessary due to the possibility of reintroduction of the disease into the United States.

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Dr. Toprani is a preventive medicine resident, **Dr. Straif-Bourgeois** is Assistant State Epidemiologist and Program Manager, **Mr. Weed** is an epidemiologist, and **Dr. Ratard** is State Epidemiologist in the Infectious Disease Epidemiology Section of the Louisiana Department of Health and Hospitals, Office of Public Health.

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