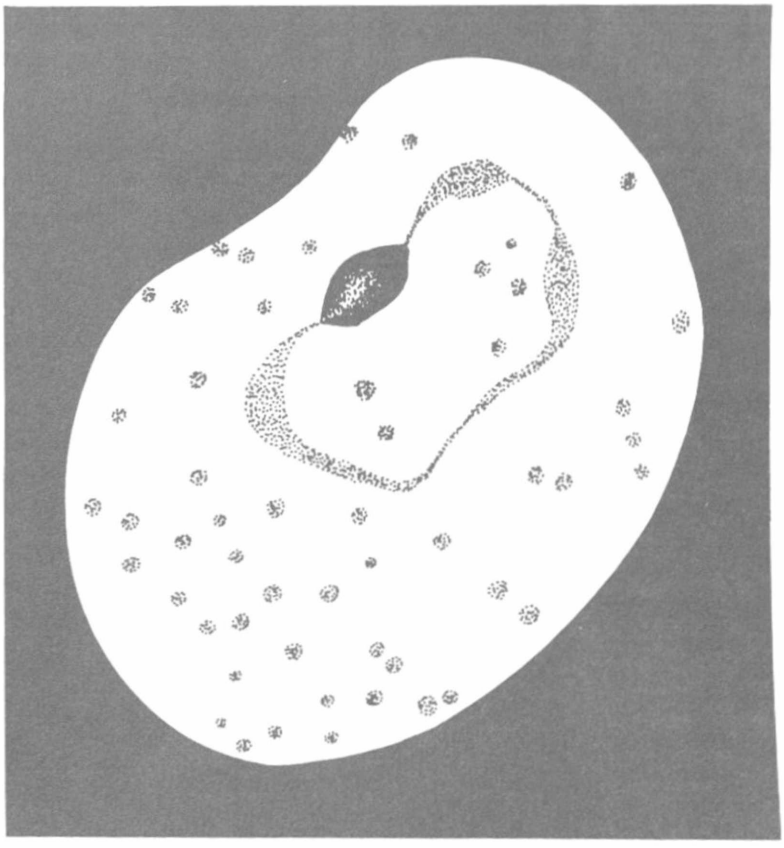
ANNUAL SUMMARY 1990
Issued August 1992

MALARIA

SURVEILLANCE



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service

CDC
CENTERS FOR DISEASE CONTROL

Preface

This report summarizes information received from state health departments, medical departments of the Armed Forces, and other sources. It is intended primarily for those responsible for disease control activities. Before quoting this report, contact the original investigator for confirmation and interpretation.

Contributions to the Surveillance Report are most welcome. Please address them to:

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Guidelines for the prevention of malaria in travelers are published in HHS Publication No. (CDC) 91-8280, *Health Information for International Travel 1991*. This booklet also provides information about countries and, where applicable, areas within each country where malaria risk exists. Also listed are areas of the world where chloroquine-resistant strains of *P. falciparum* are known to exist. The booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Suggested Citation

Centers for Disease Control: Malaria Surveillance Annual Summary 1990.
Issued November 1991

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Summary

A total of 1,098 cases of malaria with onset of illness in 1990 in the United States and its territories were reported to the Centers for Disease Control (CDC). This compares with 1,102 cases in 1989, a decrease of less than 1%.

The number of reported cases with onset in the United States occurred in the following groups:

U.S. military personnel	36
U.S. civilians	558
Foreign civilians	504

Plasmodium vivax was the parasite identified in 48% of the 1,098 cases, and *P. falciparum* was identified in 39%. *P. malariae* and *P. ovale* were reported in 5% and 2% of the cases, respectively. The species was not determined in the other 6%.

Seven of the 1,098 persons acquired the infection in the United States. Two deaths attributed to malaria were reported for 1990, compared with four for 1989.

Terminology

This report uses terminology derived from the recommendations of the World Health Organization (WHO).[1] Definitions of the following terms are included for reference.

Autochthonous

1. Indigenous—malaria acquired by mosquito transmission in an area where malaria occurs regularly.

2. Introduced—malaria acquired by mosquito transmission from an imported case in an area where malaria does not occur regularly.

Imported

Malaria acquired outside a specific area (the United States and its territories in this report).

Induced

Malaria acquired through artificial means; i.e., blood transfusion, common syringes, or malariotherapy.

Relapsing

Renewed manifestation (of clinical symptoms and/or parasitemia) of malarial infection that is separated from previous manifestations of the same infection by an interval greater than those due to the normal periodicity of the paroxysms.

Cryptic

An isolated case of malaria ascertained by appropriate epidemiologic investigation not to be associated with secondary cases.

General Surveillance

This section covers four topics: the incidence of malaria, the *Plasmodium* species involved, the area in which infection was acquired and in which the onset of illness occurred, and the interval between the patient's arrival in the United States and the onset of clinical symptoms.

Incidence

A total of 1,098 malaria cases with onset of illness in 1990 in the United States were reported to the Division of Parasitic Diseases, Center for Infectious Diseases, Centers for Disease Control (CDC), compared with 1,102 cases in 1989. In 1990, 7 of the 1,098 patients acquired the infection in the United States.

Only 36 cases occurred in U.S. military personnel. Civilians have accounted for most of the cases each year since 1973 (Table 1). The number of malaria cases in U.S. civilians decreased from 591 in 1989 to 558 in 1990, and malaria in foreign civilians increased from 476 reported cases in 1989 to 504 in 1990 (Fig. 1).

Plasmodium Species

The *Plasmodium* species was identified in 1,032 (94%) of the 1,098 cases. In 1990, *P. vivax* was identified in blood from 48% of the infected persons and *P. falciparum* from 39% (Table 2).

Table 1. All primary malaria cases* in civilians and U.S. military personnel with onset of illness in the United States, 1966-1990

Year	U.S. Military Personnel	U.S. Civilians	Foreign Civilians	Unknown	Total
1966	621	89	32	22	764
1967	2,699	92	51	15	2,857
1968	2,567	82	49	0	2,698
1969	3,914	90	47	11	4,062
1970	4,096	90	44	17	4,247
1971	2,975	79	69	57	3,180
1972	454	106	54	0	614
1973	41	103	78	0	222
1974	21	158	144	0	323
1975	17	199	232	0	448
1976	5	178	227	5	415
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

*A "case" is defined as: 1) a person's first attack of malaria in the United States, regardless of whether or not he/she had experienced previous attacks of malaria while outside the country and 2) a positive peripheral blood smear examined in the local or state health department laboratory. A subsequent attack in the same person caused by a different *Plasmodium* species is counted as an additional case. A repeated attack in the same person in this country caused by the same species is not considered an additional case.

Table 2. Malaria cases by *Plasmodium* species, United States, 1989-1990

Species	1989		1990	
	Total	Percent	Total	Percent
P. vivax	532	48.3	531	48.4
P. falciparum	448	40.7	428	39.0
P. malariae	36	3.3	50	4.6
P. ovale	17	1.5	20	1.8
Mixed	1	0.1	3	0.3
Undetermined	68	6.2	66	6.0
Total	**1,102**	**100.0**	**1,098**	**100.0**

Fig. 1 Cases of Malaria in U.S. Civilians and Foreign Civilians, United States, 1970-1990

*Includes Puerto Rico, the Virgin Islands, and Guam

Area of Acquisition and of Onset of Illness

The area in which each of the 1,098 patients acquired malaria infection is listed in Table 3. From 1989 to 1990, cases imported from India increased 34.3%. The number of cases imported from Africa did not increase in 1989 and 1990, halting the upward trend observed since 1978.

The geographic distribution of malaria cases within the United States is shown in Fig. 2 by the state in which the patient first developed clinical symptoms of malaria.

Interval Between Arrival and Illness

The interval between the date of arrival in the United States and the date of onset of illness was known for 602 of the patients for whom the infecting *Plasmodium* species was also identified. Clinical malaria developed within 1 month after the patient's arrival in 86.0% of the *P. falciparum* cases and in 31.4% of the *P. vivax* cases (Table 4). Only 24 (4.0%) of the 602 patients became ill 1 year or more after their arrival in the United States.

Imported Malaria in Military Personnel

Thirty-six cases of imported malaria in U.S. military personnel were reported for 1990. The Army accounted for 12 cases, the Navy for 4, the Air Force for 3, the Marine Corps for 15 cases, and the branch of service was not recorded for 2 cases.

Imported Malaria in Civilians

Of the 1,055 imported malaria cases in civilians, 551 (52%) were in U.S. citizens, whereas 504 (48%) were in citizens of other countries (Table 5).

Fig. 2 Malaria cases with onset in the United States, by state, 1990

Table 3. Malaria cases by distribution of *Plasmodium* species and area of acquisition, United States, 1990

Area of Acquisition	*Vivax*	*Falciparum*	*Malariae*	*Ovale*	Mixed	Unknown	Total
AFRICA	56	356	19	17	1	34	483
Africa, Unspecified*	8	17	2	2	0	4	33
Africa, East*	2	9	0	0	0	1	12
Africa, West*	0	18	1	2	0	1	22
Africa, South*	0	1	0	0	0	0	1
Angola	0	4	0	0	0	0	4
Benin	0	1	0	0	0	0	1
Botswana	1	0	0	0	0	0	1
Burkina Faso	0	3	0	0	0	0	3
Cameroon	0	3	0	0	0	1	4
Central African Rep.	0	3	0	0	0	0	3
Chad	1	1	0	0	0	0	2
Comoros	0	1	0	0	0	0	1
Ethiopia	3	5	0	0	0	0	8
Equatorial Guinea	1	0	0	0	0	0	1
Gabon	0	2	0	0	0	1	3
Gambia	0	1	0	0	0	0	1
Ghana	3	30	2	1	0	1	37
Guinea	0	1	0	0	0	0	1
Ivory Coast	2	10	0	3	0	1	16
Kenya	5	32	1	2	1	3	44
Liberia	3	28	3	1	0	2	37
Madagascar	1	1	0	0	0	0	2
Malawi	0	1	0	0	0	0	1
Mali	1	3	0	1	0	0	5
Morocco	1	0	0	0	0	0	1
Mozambique	0	1	0	0	0	0	1
Niger	1	0	1	0	0	0	2
Nigeria	8	134	3	5	0	16	166
Senegal	0	1	0	0	0	1	2
Sierra Leone	6	12	1	0	0	0	19
Somalia	1	2	1	0	0	0	4
Sudan	6	7	2	0	0	0	15
Tanzania	1	2	0	0	0	0	3
Togo	0	4	0	0	0	0	4
Uganda	0	6	1	0	0	0	7
Zaire	0	8	1	0	0	2	11
Zambia	1	2	0	0	0	0	3
Zimbabwe	0	2	0	0	0	0	2
ASIA	236	45	22	2	2	21	328
Asia, Unspec.*	0	1	0	0	0	1	2
Asia, Southeast*	8	5	1	0	0	1	15
Middle East, Unspec.*	1	0	0	0	0	0	1
Afghanistan	3	1	0	0	0	0	4
Burma	1	0	1	0	0	0	2
China	0	1	0	0	0	0	1
India	175	25	16	2	1	16	235
Indonesia	10	3	0	0	0	0	13
Pakistan	15	4	2	0	1	1	23
Philippines	14	3	0	0	0	1	18
Sri Lanka	0	0	1	0	0	0	1
Saudi Arabia	1	0	0	0	0	0	1
Thailand	2	2	1	0	0	0	5
Turkey	1	0	0	0	0	0	1
Vietnam	5	0	0	0	0	1	6
CENTRAL AMERICA AND CARIBBEAN	91	11	4	0	0	3	109
Central Am. Unspec.*	13	0	0	0	0	0	13
Belize	6	0	0	0	0	0	6
El Salvador	23	0	0	0	0	1	24
Guatemala	16	1	2	0	0	1	20
Haiti	1	6	0	0	0	0	7
Honduras	25	4	2	0	0	1	32
Nicaragua	7	0	0	0	0	0	7
NORTH AMERICA	98	2	3	0	0	3	106
Mexico	93	1	2	0	0	3	99
United States	5	1	1	0	0	0	7
SOUTH AMERICA	16	4	1	0	0	2	23
South Am. Unspec.*	1	0	0	0	0	0	1
Bolivia	1	0	0	0	0	0	1
Brazil	2	0	0	0	0	0	2
Colombia	2	0	1	0	0	0	3
Ecuador	5	2	0	0	0	2	9
Guyana	1	1	0	0	0	0	2
Peru	4	0	0	0	0	0	4
Venezuela	0	1	0	0	0	0	1
OCEANIA	21	7	1	0	0	0	29
Papua New Guinea	18	6	1	0	0	0	25
Solomon Islands	3	0	0	0	0	0	3
Vanuatu	0	1	0	0	0	0	1
UNKNOWN	13	3	0	1	0	3	20
Total	**531**	**428**	**50**	**20**	**3**	**66**	**1,098**

*Country unspecified.

U.S. Civilians

Of the 551 cases in U.S. civilians, 308 (56%) were acquired in Africa, and 133 (24%) were acquired in Asia (Table 5).

From 1981 through 1988, imported malaria caused by *P. falciparum* in U.S. civilians infected in Africa increased each year, but this trend was halted in 1989. The downward trend, which continued in 1990, is attributable to the significant decline in the number of cases acquired in East Africa (mainly Kenya) (Table 6).

The largest percentage of U.S. civilians had traveled to visit friends and relatives (Table 7).

Foreign Civilians

Of the 504 cases in foreign civilians, 179 (36%) were acquired in Asia and 162 (32%) in Africa.

Malaria Acquired in the United States

Congenital Malaria

Case 1—In November 1990, a 2-month-old girl born in Washington state had splenomegaly, anemia, and a positive Coombs' test. The laboratory identified *P. vivax* parasites in a blood smear. The infant was treated with chloroquine and had an uneventful recovery. The mother had moved to Washington from her native Mexico more than 6 months before the delivery. She had had undiagnosed febrile episodes during pregnancy. Blood smears in November 1990 were negative. She was treated with chloroquine and primaquine.

(Reported by: S. Pearson, M.D., Toppenish; John M. Kobayashi, M.D., Washington

Table 4. Imported malaria cases by interval between date of entry and onset of illness and by *Plasmodium* species, United States, 1990

Interval (in months)	*Vivax* (%)	*Falciparum* (%)	*Malariae* (%)	*Ovale* (%)	Total (%)
<1	89 (31.4)	240 (86.0)	12(48.0)	3 (20.0)	344 (57.1)
1-2	69 (24.4)	27 (9.7)	3 (12.0)	5 (33.3)	104 (17.2)
3-5	53 (18.7)	8 (2.9)	4 (16.0)	5 (33.3)	70 (11.6)
6-12	55 (19.4)	0 (0.0)	3 (12.0)	2 (13.3)	60 (10.0)
12	17 (6.0)	4 (1.4)	3 (12.0)	0 (0.0)	24 (4.0)
Total	**283 (100.0)**	**279 (100.0)**	**25 (100.0)**	**15 (100.0)**	**602 (100.0)**

Table 5. Imported malaria cases in civilians, by area of acquisition, United States, 1990

	United States		Foreign		Total	
Area of Acquisition	**Cases**	**Percent**	**Cases**	**Percent**	**Cases**	**Percent**
Africa	308	55.9	162	32.1	470	44.5
Asia	133	24.1	179	35.5	312	29.6
Central America	32	5.8	64	12.7	96	9.1
Caribbean	2	0.4	5	1.0	7	0.7
Mexico	24	4.2	75	15.9	99	9.4
South America	18	3.3	5	1.0	23	2.2
Oceania	28	5.1	1	0.2	29	2.7
Unknown	6	1.1	13	2.6	19	1.8
Total	**551**	**100.0**	**504**	**100.0**	**1,055**	**100.0**

State Department of Social and Health Services, Seattle, Washington.)

Case 2—A 2-month-old boy born in Virginia was brought to his doctor in November 1990 with a 1-week history of fever and anemia. *P. vivax* parasites were identified in a blood smear. The infant was treated with chloroquine and had an uneventful recovery. Four months before the delivery, the mother had returned from a visit to her native Pakistan, where she had had malaria. No *Plasmodium* parasites were found in her blood smears. She was treated with chloroquine and primaquine.

(Reported by: L.G. Butler, M.D., Alexandria; Grayson B. Miller, M.D., Virginia State Department of Health, Richmond, Virginia.)

Induced Malaria

Case 1—A 67-year-old male resident of San Francisco who underwent coronary bypass surgery on October 15, 1990, received packed red cells, platelets, and plasma from five donors. He developed fever episodes on December 2, and on January 4, 1991, *P. malariae* parasites were identified on a blood smear. He was treated with chloroquine and had an uneventful recovery from his malaria infection.

The patient was born in China and immigrated to the United States in 1940. He had not traveled abroad since that time except for a 6-month visit to Hong Kong in 1959-60. He had no history of IV drug use. He had received blood transfusions in 1965, 1980, and 1984.

One of the five blood donors had antibodies to malaria. The indirect fluorescent antibody assay titer was 1024 to *P. malariae*. Examination of blood smears of this donor, the 56-year-old wife of the patient, revealed scanty *P. malariae* parasites. She had immigrated from southern China in 1960 and had a history of having had malaria as a child in the 1940s. She had not traveled outside the United States since 1960 and had no history of blood transfusions or IV drug use.

(Reported by: F. Taylor, M.D., Director, Alba L. Barreto, Disease Control Investigator, Bureau of Communicable Disease Control, San Francisco; Ronald R. Roberto, M.D., Chief, Disease Control Section, California Department of Health Services, Berkeley, California.)

Case 2—A 59-year-old resident of Jacksonville, Florida, with metastatic lung cancer became febrile on December 28, 1990. On December 30, he was admitted to the hospital with a diagnosis of fever and neutropenia. On December 31, the laboratory noted malaria parasites in a peripheral blood smear. The infection was initially diagnosed as *Plasmodium vivax* malaria, and the patient was treated with oral chloroquine. His clinical condition worsened, and he developed mental status changes on January 3, 1991. Review of the blood smears identified *P. falciparum*, with a parasitemia of 30%. The patient was treated with intravenous

Table 6. Imported *P. falciparum* infections in U.S. civilians, by area of acquisition in Africa, 1981-1990

Year	East Africa	West Africa	Other	Total
1981	24	24	9	57
1982	43	23	8	74
1983	48	22	29	99
1984	36	55	17	108
1985	84	42	38	164
1986	73	44	24	141
1987	86	76	54	216
1988	92	143	58	293
1989	59	159	54	272
1990	40	163	78	281

quinidine and a 1-volume exchange blood transfusion. The next day the parasite count had dropped to 0.5%. He had an uneventful recovery from his malaria infection.

The patient did not have a history of malaria, foreign travel, or IV drug use but had received 11 units of packed red blood cells and 1 unit of platelets from August 8 through December 30 as part of the treatment for his malignancy. Serum and whole blood were collected from each donor. All donors had denied a history of foreign travel at the time of blood donation. Only one donor had antibodies to *P. falciparum*, with a titer of 1024.

The donor with a positive titer for *P. falciparum* malaria was a 38-year-old native-born American resident of Florida. When requestioned, he recalled a trip to Kenya in May 1990, more than 6 months before he donated blood. He had taken chloroquine weekly as malaria prophylaxis, beginning 2 weeks before his departure and continuing for 8 weeks after his return. He also took Fansidar, 1 tablet weekly, starting at the same time as the chloroquine and continuing for 6 weeks after his return. He reported no febrile illness during his trip or following his return. He denied having taken any antimalarials or antibiotics since his return. He had no pertinent medical problems nor a prior history of malaria.

(Reported by: Diana L. Wells, M.D., Richard Hopkins, M.D., John J. Witte, M.D., Florida State Department of Health and Rehabilitative Services, Tallahassee; John Montgomery, James Ripka, Duval County Public Health Unit, Jacksonville; Sanford A. Mullen, M.D., Florida-Georgia Blood Alliance, Jacksonville; M. Smedberg, M.D., Holmes Regional Medical Center, Melbourne, Florida.)

Case 3—In December 1990, the Texas Department of Health (TDH) was contacted by a man who had recently moved from the northeastern United States and who was considering malariotherapy for Lyme disease (LD). He described a 2-year history of unsuccessful treatment with multiple antibiotics for arthralgias and palpitations, which had been diagnosed as LD. TDH personnel discouraged the man from attempting malariotherapy, emphasizing previously published warnings.[1] Despite these warnings, he obtained blood infected with *Plasmodium vivax* from an unknown source in the northeastern United States and injected himself intravenously with the infected blood on December 20 and 23; he experienced his first febrile episode on December 25. The patient reported that he subsequently experienced approximately 10 paroxysms of fever, up to 104.9° F, lasting 12 hours. Thick and thin smears of the patient's blood, obtained by TDH on January 4,1991, revealed *P. vivax*. The patient refused all attempts at medical intervention and treated himself during January 13-16 with chloroquine. No malaria parasites were detected in the patient's blood when tested on January 22.

The patient reported that the infected blood had been tested at the source for human immunodeficiency virus, syphilis, and hepatitis B virus. TDH obtained the remainder of the infected blood for testing and detected numerous *P. vivax* parasites.

(Reported by: J. Rawlings, MPH, J.N. Perdue, D. Perrorta, Ph.D., D. Simpson, M.D., State Epidemiologist, Texas Department of Health. Bacterial Zoonoses Branch, Division

Table 7. Imported malaria cases in U.S. civilians, by category, United States, 1989

Category	Cases	Percent
Tourist	69	12.5
Business representative	70	12.7
Government employee	6	1.1
Missionary	61	11.1
Peace Corps	16	2.9
Seamen/aircrew	1	0.2
Teacher/student	23	4.2
Visiting friends/ relatives	179	32.5
Other	23	4.2
Unknown	103	18.7
Total	**551**	**100.0**

of Vector-Borne Infectious Diseases, National Center for Infectious Diseases; Division of Field Epidemiology, Epidemiology Program Office, CDC.)

Cryptic Malaria

Case 1—On July 30, 1990, *Plasmodium vivax* parasites were identified during a routine blood smear examination of a 13-year-old male resident of Oceanside in north San Diego County, California, who had an 11-day history of flu-like symptoms. The patient was admitted to a hospital with splenomegaly and a hemoglobin of 5.9 g/dL. He was treated with chloroquine and primaquine and had an uneventful recovery. The patient did not have a history of foreign travel, intravenous drug use, or blood transfusions. He lives in a suburban housing development less than ½ mile from the San Luis Rey River. The open area between his house and the river is flat, with heavy vegetation near the river. In the evenings he often visited a nearby park located within 150 yards of the river. Several encampments of migrant workers (MWs) employed in local farms were identified along the river. No history of malaria-like illness could be elicited from MWs in these encampments. No cases of malaria have been reported among these MWs or among other residents of Oceanside.

Entomologic investigations along the river during August 1-6, 1990, identified *Anopheles hermsi* larvae and adult mosquitoes. No anopheline mosquitoes were identified near the patient's residence. Control measures consisted of larviciding mosquito breeding sites with oil and fogging with pyrethrins along the riverbed.

(Reported by: M. Ginsberg, M.D., S. Hunt, M. Bartzen, A. Cordillo, M.D., D. Ramras, M.D., M. Mizrahi, San Diego Department of Health Services; R.R. Roberto, MD, G.W. Rutherford, M.D., State Epidemiologist, Infectious Disease Branch, California Department of Health Services, Berkeley, California.)

Case 2—On June 8, 1990, a 33-year-old female resident of Bay County in the Florida panhandle consulted a physician with a 5-day history of remittent fever, chills, myalgia, and headaches. *P. vivax* parasites were identified on a peripheral blood smear. She was treated with chloroquine and primaquine and had an uneventful recovery. The patient did not have a history of foreign travel, blood transfusion, or intravenous drug use. A survey of medical care providers in Bay County and neighboring Gulf County did not identify other cases of malaria or unexplained febrile episodes within the previous 3 months. The patient and her family had spent the nights of May 19 and 27 sleeping outdoors in a campground in Gulf County, 30 miles from her home. Mosquito biting at night was reportedly intense.

A door-to-door survey of residents of this campground and follow-up visits with the owner of the campground did not identify any suspected cases of malaria. A large fish farm contiguous to the campsite employed about 40 MWs in May, many of whom came from Mexico and Central America. None of these MWs were known to have had symptoms compatible with malaria. Health care providers in the area had not treated any patients with malaria-like symptoms. Efforts to trace and survey the MWs were unsuccessful.

On June 14, about 50 *An. quadrimaculatus* mosquitoes, which are competent vectors of malaria, were caught in light traps near the campsite. Control measures included ultra-low-volume spraying with malathion.

(Reported by: P. Sylvester, M.D., J. Cerosimo, M.D., B.W. Clements, R.A. Calder, M.D., Florida Department of Health and Rehabilitative Services, Tallahassee; S. McClellan, M.D., T. Smith, M.D., Gulf Coast Hospital, Panama City, Florida.)

Comment: Both malaria cases were classified as cryptic because no other patients with malaria could be associated with them. It is most likely, however, that both individuals acquired their infections in the United States through bites of mosquitoes that had become infected after biting MWs with malaria. Transmission of mosquito-borne *P. vivax* malaria in San Diego County has been a regular occurrence since 1986.[2,3] Common features of these episodes have been 1) frequent identification of the initial cases in residents; 2) limited access to medical care for migrant workers from malaria-endemic countries, resulting in delays in identifying

and treating parasitemic persons and in instituting control measures; 3) the presence of standing water and the lack of adequate sanitary facilities and shelter in the encampments; and 4) the proximity of competent *Anopheles* vectors and a susceptible population. In contrast, although *An. quadrimaculatus* is widespread in Florida, no cases of suspected or confirmed mosquito-borne malaria infections have been identified in this state since 1948, possibly because there may be fewer infected migrant workers in close proximity to anopheline vectors in Florida than in San Diego County.

Conditions similar to those in Florida and California may exist in other states with large populations of migrant workers, especially those states in the Southwest and along the Gulf of Mexico. Health-care providers should realize that introduced malaria can occur in migrant workers as well as in local residents. Malaria should be included in the differential diagnosis of any patient with a fever of unknown origin. If a malaria infection is diagnosed, a history of recent travel, previous malaria infections, intravenous drug use, and blood transfusions should be obtained. Reporting of confirmed malaria infections will permit prompt investigation of potential local transmission of malaria.

Malaria Deaths

Two deaths due to malaria were reported.

Case 1—A 34-year-old female resident of Texas visited her native Nigeria for a few months while pregnant. She used pyrimethamine for prophylaxis. On July 17, 1990, she was brought to the hospital with a fever, which was diagnosed as an upper respiratory tract infection. Because of fetal distress, a Caesarean section was performed, during which the patient lost 2000 cc of blood. On the admission differential blood slide, *P. falciparum* parasitemia of more than 60% was diagnosed. The patient was promptly treated with IV quinidine and exchange transfusions. The parasitemia disappeared in a few days. The patient developed adult respiratory distress syndrome and died on July 26.

(Reported by: M. Nunoz, M.D., Ben Taub General Hospital, Dallas; Texas Department of Health, Austin, Texas.)

Case 2—An 18-year-old woman from Sierra Leone developed headache, fever, and vomiting during her plane trip to the United States, and these symptoms continued until she was admitted to a Texas hospital 6 days later. On the morning of admission, April 1, the patient began moaning and had a gradual change in mental status with a possible seizure. In the emergency room, the patient was found to be comatose, responsive to painful stimuli, and drooling. A peripheral blood smear contained *P. falciparum* parasites, with 20% parasitemia. She was treated with IV quinidine gluconate, exchange transfusions, and anticonvulsive therapy but remained comatose. An EEG showed no cortical or brain activity on April 2 although the parasitemia cleared 15 hours after admission. The patient died on April 3. Microscope examination of the brain sections of the cerebral cortex, hippocampus, and midbrain revealed thrombosis of small vessels with *P. falciparum* parasites and extensive areas of ischemia.

(Reported by: E. Piercey, M.D., F. Goodman, M.D., Dallas; Texas Department of Health, Austin, Texas.)

Microscopic Diagnosis of Malaria

Early diagnosis of malaria requires that physicians include malaria in the differential diagnosis and take a comprehensive travel history from every patient with a fever of unknown origin. Once malaria is suspected, a Giemsa-stained smear of peripheral blood should be examined for parasites. Since the accuracy of diagnosis depends on the quality of the blood film, the following guide is offered for the proper preparation of thick and thin blood smears.

1. Manufacturers' "precleaned" slides are not considered clean enough for use in malaria diagnosis. Before using them, wash the slides in mild detergent, rinse them thoroughly in warm running water and then in distilled water, and dip them in ethyl alcohol (90%-95%). Then, wipe the slides dry with a

lintless cloth or tissue for immediate use or store them in 95% alcohol until needed.

2. Clean the patient's finger with alcohol and wipe the finger dry with a clean cloth or gauze.

3. Puncture the finger with the blood lancet and allow a large globule of blood to form.

4. Place the cleaned surface of the slide against the drop of blood and, with a quick circular motion, make a film the size of a dime in one third of the area of the slide. Ordinary newsprint should be barely legible through such a wet drop (Fig. 3). (Excessive mixing or stirring with a second slide leads to distortion of blood cells and parasites.)

5. Wipe the finger dry and gently squeeze a *small* drop of blood from the puncture. Place the drop at the middle of the same slide.

6. Apply a clean "spreader" slide to the edge of the small drop at a 45° angle and allow the blood to extend about two thirds of the distance to the back of the slide. Then, keeping even contact, push the spreader forward along the slide. This will produce an even layer of red blood cells with a "feathering" at the lower edge (Fig. 4).

7. While the thick blood film dries (minimum of 6 hours at room temperature), keep the slide flat and protected from dust and insects.

8. Label the slide in the upper part of the thin film with the date and the name or initials of the patient, as illustrated (Fig. 5).

Note: For rapid diagnosis, make the thick and thin films on separate slides. Air dry the thin film, fix it with methyl alcohol, and stain it immediately. If no parasites are found on the thin film, wait until the thick film is dry and examine it for organisms not detected on the thin preparation.

Acknowledgment

The annual Centers for Disease Control Malaria Surveillance Report is based on information provided in individual case reports. The excellent support given to malaria surveillance by state and local health departments and personnel of the preventive medicine services of the U.S. Army, Navy, and Air Force is greatly appreciated.

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Fig. 3

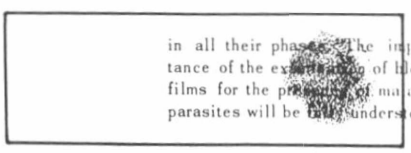


Fig. 4

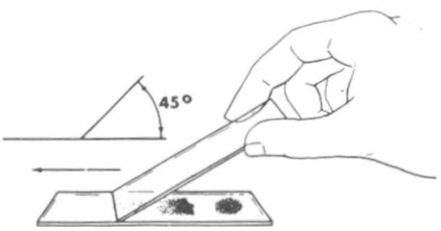
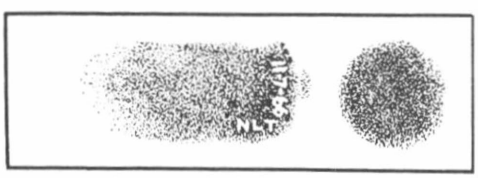


Fig. 5



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