ANNUAL SUMMARY 1987
Issued November 1988

CENTERS FOR DISEASE CONTROL

MALARIA

SURVEILLANCE

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

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:

Centers for Disease Control
Attn: Malaria Branch
Division of Parasitic Diseases
Center for Infectious Diseases
Atlanta, Georgia 30333
Telephone: (404) 488-4046
(FTS) 236-4046

Guidelines for the prevention of malaria in travelers are published in HHS Publication No. (CDC) 88-8280, Health Information for International Travel 1988, May 1988. 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 1987
Issued November 1988

Centers for Disease Control . . . . . James O. Mason, M.D., Dr.P.H., Director

Center for Infectious Diseases . Frederick A. Murphy, D.V.M., Ph.D., Director

Division of Parasitic Diseases . . . . . Robert L. Kaiser, M.D., Director

Malaria Branch . . . . . Carlos C. Campbell, M.D., M.P.H., Chief

Malaria Surveillance . . . . . Hans O. Lobel, M.D., M.P.H.
Bernard Nahlen, M.D.
Lawrence M. Slutsker, M.D.
Jacquelin M. Roberts, M.S., Statistician

Fluorescent Antibody Laboratory . . . . . Albert Turner
Alexander J. Sulzer, Ph.D.

Publications & Graphics Activity, OD, CID. . Frances H. Porcher, M.A., Chief
Barbara Sajor Gray, M.Ln., Writer-Editor
Patricia A. Tyson, Illustrator

I. SUMMARY

A total of 932 cases of malaria with onset of illness in 1987 in the United States and its territories were reported to the Centers for Disease Control (CDC). This compares with 1,091 cases in 1986, a decrease of 15%.

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

U.S. military personnel	23
U.S. civilians	421
foreign civilians	488

Plasmodium vivax was the parasite identified in 44% of the 932 cases, and *P. falciparum* was identified in 43%. *P. malariae* and *P. ovale* were reported in 4% and 3% of the cases, respectively. The species was not determined in the other 6%.

None of the 932 persons acquired the infection in the United States.

Three deaths attributed to malaria were reported for 1987, the same as for 1986.

II. 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.

A. 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.

B. Imported

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

C. Induced

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

D. 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.

E. Cryptic

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

III. GENERAL SURVEILLANCE

This section covers four topics: the incidence of malaria cases, the *Plasmodium* species involved in these cases, the area in which infection was acquired and in which the onset of illness occurred, and how long it took for clinical malaria to develop after the patient's arrival in the United States.

A. Incidence

A total of 932 malaria cases with onset of illness in 1987 in the United States were reported to the Division of Parasitic Diseases, Center for Infectious Diseases, Centers for Disease Control (CDC) compared with 1,091 cases in 1986. In 1987, none of the 932 patients acquired the infection in the United States; however, in 1986, 36 persons did. Three fatal malaria infections were reported in 1987, the same number as in 1986. These cases are discussed in section VII.

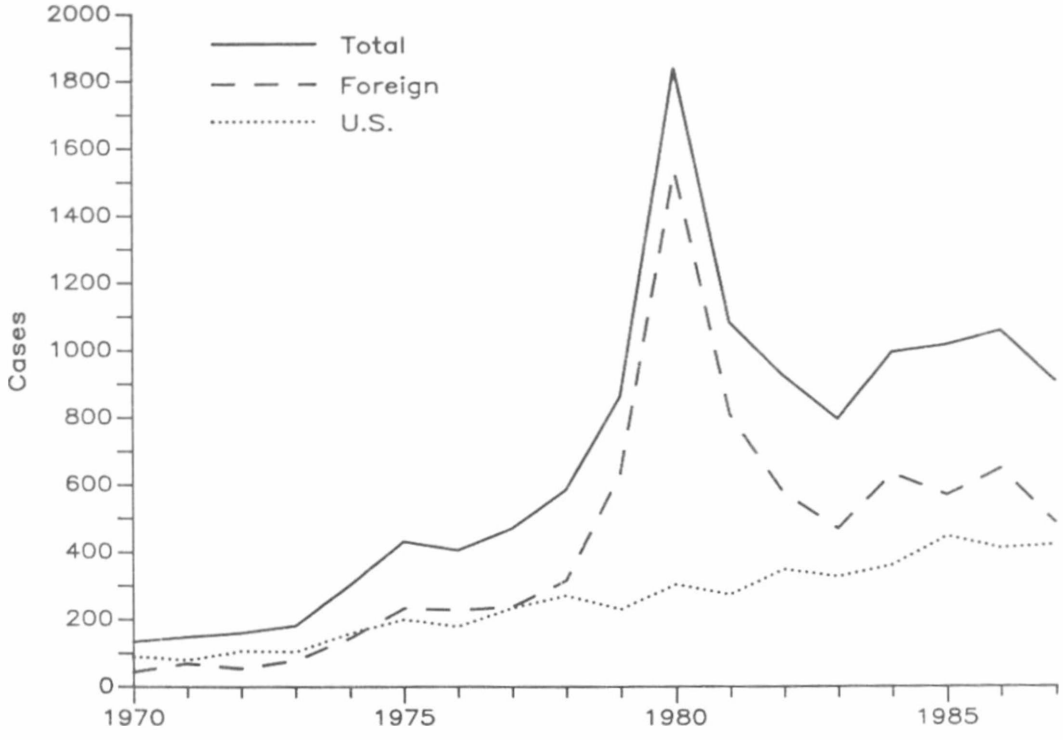
Table 1. All primary malaria cases* in civilians and U.S. military personnel with onset of illness in the United States, 1966-1987

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

*A "case" is defined as: 1) a person's first attack of malaria in the United States, whether or not he/she 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. Inconclusive blood smears were referred to the National Malaria Repository, CDC, for confirmation. 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.

Only 23 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 increased from 410 in 1986 to 421 in 1987, a 2% increase (Figure 1). Malaria in foreign civilians decreased from 646 reported cases in 1986 to 488 in 1987, a decrease of 25% .

Fig. 1. Cases of malaria in U.S. and foreign civilians, United States, 1970-1987



B. Plasmodium Species

The Plasmodium species was identified in 874 (93.8%) of the 932 cases. In 1987, P. vivax was identified in blood from 44% of the infected persons and P. falciparum in blood from 43% (Table 2).

Table 2. Malaria cases by Plasmodium species, United States, 1986-1987

	1986		1987	
Species	Total	Percent	Total	Percent
P. vivax	692	63.4	409	43.9
P. falciparum	281	25.8	399	42.9
P. malariae	44	4.0	37	4.0
P. ovale	21	1.9	27	2.9
Mixed	3	0.3	2	0.2
Undetermined	50	4.6	58	6.4
TOTAL	1,088	100.0	932	100.0

C. Area of Acquisition and of Onset of Illness

The area in which each of the 932 patients acquired the infection is listed in Table 3. From 1986 to 1987, cases imported from Mexico declined 38.7% and from Asia 25.7%. Importation of malaria from Africa increased 28.2%, continuing the upward trend observed during the past decade. From 1978 through 1987, malaria infections acquired in Africa increased from 176 cases to 427 cases, a 142% increase.

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

Fig. 2. Malaria cases with onset in the United States, by state, 1987

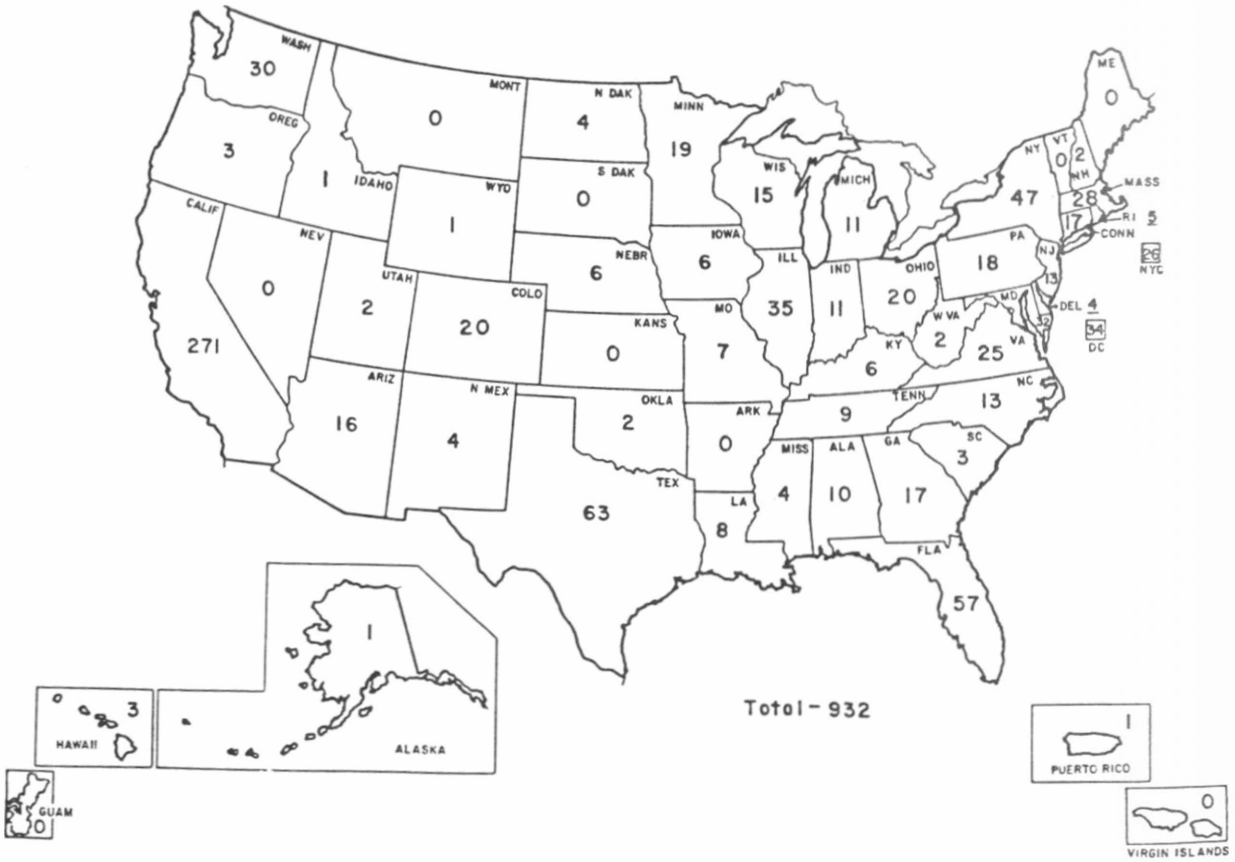


Table 3. Malaria cases by distribution of Plasmodium species and area of acquisition, United States, 1987

Area of Acquisition	vivax	falciparum	malariae	ovale	mixed	unknown	Total
AFRICA	**46**	**319**	**15**	**25**	**0**	**22**	**427**
Africa, East*	2	13	0	0	0	0	15
Africa, West*	6	9	0	0	0	0	15
Africa, South*	0	1	0	0	0	0	1
Africa, Central*	0	2	0	0	0	0	2
Africa, Unspecified*	3	15	0	0	0	3	21
Angola	1	1	0	0	0	0	2
Benin	0	3	0	0	0	0	3
Burkina Faso	1	1	0	0	0	0	2
Burundi	0	2	0	0	0	0	2
Cameroon	1	15	0	2	0	2	20
Central African Rep.	0	5	0	1	0	0	6
Comoros	0	1	0	0	0	0	1
Egypt	1	0	0	0	0	0	1
Ethiopia	7	1	0	0	0	2	10
Gabon	0	4	0	0	0	0	4
Gambia	0	1	0	0	0	0	1
Ghana	0	23	1	1	0	1	26
Ivory Coast	0	5	2	3	0	1	11
Kenya	5	50	3	5	0	3	66
Liberia	3	15	1	0	0	0	19
Madagascar	2	5	0	0	0	0	7
Malawi	0	1	0	0	0	0	1
Nigeria	10	76	8	3	0	4	101
Senegal	0	2	0	0	0	0	2
Sierra Leone	0	10	0	3	0	2	15
Somalia	1	4	0	0	0	0	5
Sudan	2	8	0	1	0	0	11
Swaziland	0	1	0	0	0	0	1
Tanzania	0	10	0	3	0	1	14
Togo	0	3	0	0	0	0	3
Uganda	1	13	0	0	0	0	14
Zaire	0	16	0	2	0	0	18
Zambia	0	3	0	0	0	3	6
Zimbabwe	0	0	0	1	0	0	1
ASIA	**235**	**49**	**17**	**1**	**0**	**21**	**323**
Asia, Southeast*	13	6	2	0	0	2	23
Asia, Unspecified*	1	0	0	0	0	0	1
Afghanistan	1	0	0	0	0	0	1
China	1	0	0	1	0	0	2
India	148	30	12	0	0	13	203
Indonesia	3	3	0	0	0	2	8
Lao People's Dem. Rep.	1	0	0	0	0	0	1
Malaysia	2	0	0	0	0	0	2
Pakistan	31	1	1	0	0	2	35
Philippines	21	5	1	0	0	1	28
Sri Lanka	1	1	0	0	0	0	2
Thailand	3	3	1	0	0	0	7
Viet Nam	9	0	0	0	0	1	10
CENTRAL AMERICA AND CARIBBEAN	**46**	**11**	**2**	**1**	**0**	**2**	**62**
Central Amer. Unspec.*	6	0	0	0	0	0	6
Belize	7	2	0	0	0	0	9
El Salvador	15	0	0	0	0	0	15
Guatemala	7	2	0	0	0	2	11
Haiti	0	7	0	1	0	0	8
Honduras	6	0	1	0	0	0	7
Nicaragua	5	0	1	0	0	0	6
NORTH AMERICA	**59**	**6**	**3**	**0**	**0**	**6**	**74**
Mexico	59	6	3	0	0	6	74
SOUTH AMERICA	**10**	**6**	**0**	**0**	**1**	**0**	**17**
South America, Unspec.*	1	0	0	0	0	0	1
Brazil	1	0	0	0	0	0	1
Colombia	2	1	0	0	0	0	3
Ecuador	1	2	0	0	1	0	4
French Guiana	1	1	0	0	0	0	2
Guyana	1	1	0	0	0	0	2
Peru	1	0	0	0	0	0	1
Suriname	1	1	0	0	0	0	2
Venezuela	1	0	0	0	0	0	1
OCEANIA	**10**	**6**	**0**	**0**	**0**	**3**	**19**
Papua New Guinea	9	5	0	0	0	3	17
Solomon Islands	1	0	0	0	0	0	1
Vanuatu	0	1	0	0	0	0	1
UNKNOWN	**3**	**3**	**0**	**0**	**1**	**3**	**10**
TOTAL	**409**	**399**	**37**	**27**	**2**	**58**	**932**

*Country unspecified.

D. 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 580 of the patients for which the infecting Plasmodium species was also identified. Clinical malaria developed within 1 month after the patient's arrival in 80.2% of the P. falciparum cases and in 25.3% of the P. vivax cases (Table 4). Only 19 (3.3%) of the 580 patients became ill 1 year or more after their arrival in the United States.

Table 4. Imported malaria cases by interval between date of entry and onset of illness and by Plasmodium species, United States, 1987

Interval (in months)	PLASMODIUM SPECIES									
	vivax	(%)	falciparum	(%)	malariae	(%)	ovale	(%)	Total	(%)
< 1	64	(25.3)	231	(80.2)	9	(45.0)	4	(20.0)	308	(53.1)
1-2	61	(24.1)	26	(9.0)	2	(10.0)	2	(10.0)	91	(15.7)
3-5	51	(20.2)	5	(1.7)	3	(15.0)	6	(30.0)	65	(11.2)
6-11	61	(24.1)	6	(2.0)	5	(25.0)	5	(25.0)	77	(13.3)
≥12	9	(3.6)	7	(2.4)	0	(0.0)	3	(15.0)	19	(3.3)
TOTAL	253	(100.0)	287	(100.0)	20	(100.0)	20	(100.0)	580	(100.0)

IV. IMPORTED MALARIA IN MILITARY PERSONNEL

Twenty-three cases of imported malaria in U.S. military personnel were reported for 1987. The Army accounted for 8 cases, the Navy for 5, the Air Force for 2, and the Marine Corps for 5; for 3 cases, the branch of service is not known.

V. IMPORTED MALARIA IN CIVILIANS

Of the 909 imported malaria cases in civilians, 421 (44.9%) were in U.S. citizens, whereas 488 (53.7%) were in citizens of other countries (Table 5).

Table 5. Imported malaria cases in civilians, by area of acquisition, United States, 1987

Area of Acquisition	United States		Foreign		Total	
	Cases	Percent	Cases	Percent	Cases	Percent
Africa	264	62.7	158	32.4	422	46.4
Asia	77	18.3	237	48.6	314	34.5
Central America	19	4.5	30	6.1	49	5.4
Caribbean	3	0.7	5	1.0	8	0.8
Mexico	23	5.5	49	10.0	72	7.9
South America	13	3.1	3	0.6	16	1.8
Oceania	18	4.3	0	0	18	2.0
Unknown	4	0.9	6	1.2	10	1.1
TOTAL	421	100.0	488	100.0	909	100.0

A. U.S. Civilians

Of the 421 cases in U.S. civilians, 264 (62.7%) were acquired in Africa and 77 (18.3%) were acquired in Asia (Table 5).

Imported malaria caused by P. falciparum in U.S. civilians infected in Africa has increased each year since 1981. For 1987, 211 such infections were reported, an increase of 49.6% over 1986, when 141 such cases were reported. Since 1981, these cases have increased 252%.

Most of the U.S. civilians were tourists (Table 6).

Table 6. Imported malaria cases in U.S. civilians, by category, United States, 1987

Category	Cases	Percent
Tourist	129	30.6
Business Representative	52	12.4
Government Employee	5	1.2
Missionary	65	15.6
Peace Corps	12	2.9
Seamen/Aircrew	4	1.0
Teacher/Student	28	6.7
Other	31	7.4
Unknown	95	22.6
TOTAL	421	100.0

B. Foreign Civilians

Of the 488 cases in foreign civilians, 237 (49%) were acquired in Asia; infections acquired in India accounted for 149 (31%). A marked decline in infections acquired in Mexico and El Salvador was observed: from 142 to 60 cases (58%) between 1986 and 1987.

VI. MALARIA ACQUIRED IN THE UNITED STATES

No cases of malaria acquired in the United States were reported for 1987.

VII. MALARIA DEATHS

Three deaths due to malaria were reported.

Case 1--A 31-year-old male resident of New York returned from a 3-week visit to India on November 3, 1987. On November 4, he sought medical consultation for fever, rigors, chills, myalgia, headaches, lethargy, and diarrhea, and was placed on erythromycin. His condition did not improve and he was admitted to a hospital on November 13. Blood slide examination revealed a P. falciparum parasitemia level of 50%. He was treated with quinine, sulfadiazine, and pyrimethamine. His parasitemia decreased to 16% on the day after admission and to 5% on November 15. He had anemia, thrombocytopenia, renal insufficiency, metabolic acidosis, and pulmonary edema. Despite the decline of the parasitemia, the patient died on November 15. Autopsy findings

included pulmonary edema, cerebral edema, and malaria pigment in liver and spleen.

The patient had not used chemoprophylaxis during his trip to India. It is not known which areas he visited.

(Reported by R. Weininger, M.D., South Cairo, New York, and P. Drabkin, M.P.H., Regional Epidemiologist, New York State Department of Health.)

Case 2--A 62-year-old female resident of California was admitted to a hospital in Hawaii on November 23, 1987, with a 1-day history of fever and right elbow pain. Initial treatment was intravenous nafcillin for presumed right elbow cellulitis. However, fever persisted and subsequent malaria smears done on the third hospital day were read as consistent with P. vivax infection.

Chloroquine phosphate and primaquine phosphate were administered, but progressive dyspnea, anemia, and renal failure occurred over the next 2 days.

On November 28, a review of the original blood smears suggested the diagnosis of P. falciparum. She was transferred to the intensive care unit and given intravenous quinidine and doxycycline. A 12-unit exchange transfusion resulted in a decrease of the parasitemia from 15%-25% to 4%. However, she developed acute respiratory insufficiency and rapidly progressive renal failure, and died on November 29.

She was returning from a 2-month trip that included visits to Sumatra, Java, Irian Jaya, Borneo, Malaysia, Thailand, and Burma. No malaria chemoprophylaxis was taken.

(Reported by Col. J. Brown, MC, USA; Capt. J.L. Calagan, MC, USA; E.K. Taniguchi, Epidemiologist, Tripler Army Medical Center, Hawaii; and the Hawaii Department of Health.)

Case 3--A 71-year-old male resident of Georgia was admitted to a hospital in Dublin, Georgia, on December 17, 1987, with a history of low back pain for one month and of chills and headaches for one week. He had hematuria and a temperature of 102^{0}F on the day before admission.

Upon admission, the patient was conscious but drowsy and disoriented. A peripheral blood smear showed very heavy infestation of P. falciparum. Treatment was initiated with intravenous quinidine gluconate and an exchange transfusion. However, the patient died after the exchange of the first unit of blood. No autopsy was performed.

He had returned 2 days before admission from a 6-week missionary tour of western Kenya. It is not known whether he had used any chemoprophylaxis.

(Reported by S. Rajan, M.D., Veterans Administration Hospital, Dublin, Georgia, and the Georgia Department of Human Resources.)

VIII. MICROSCOPIC DIAGNOSIS OF MALARIA

Early diagnosis of malaria requires physicians to include malaria in the differential diagnosis and to 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, rinse them 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 slide. Ordinary newsprint should be barely legible through such a wet drop (Figure 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 (Figure 4).
6. Apply a clean "spreader" slide to the edge of the small drop at a 45^{o} angle, and allow the blood to extend about two-thirds, 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 (Figure 5).
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 (Figure 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.

Fig. 3

in all their phases. The importance of the examination of blood films for the presence of malaria parasites will be fully understood

Fig. 4

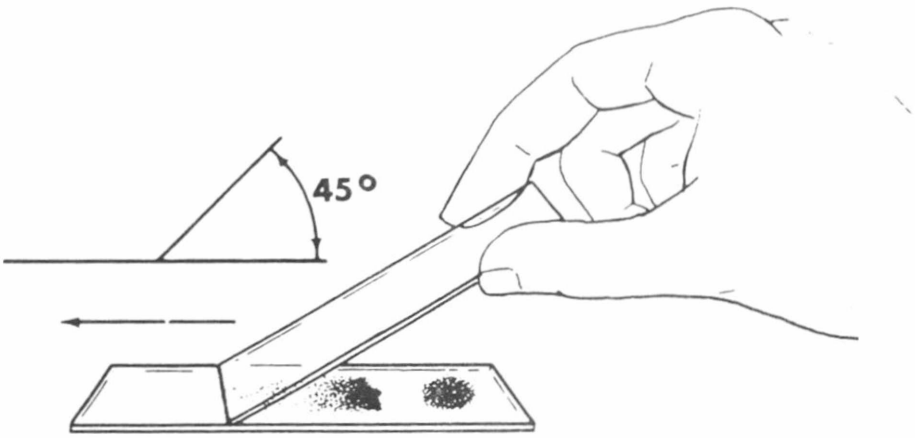
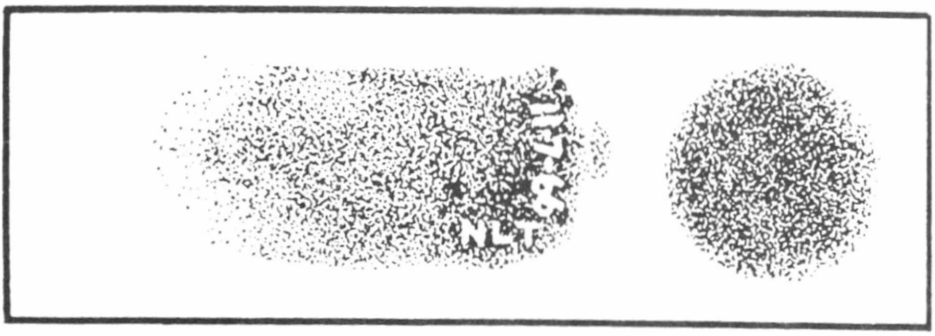


Fig. 5



ACKNOWLEDGMENT

The Malaria Surveillance Report, CDC, 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.

REFERENCE

1. World Health Organization. Terminology of malaria and of malaria eradication, 1963, World Health Organization, Geneva, p 32.

STATE AND TERRITORIAL EPIDEMIOLOGISTS

The key to all disease surveillance activities are the state and territorial epidemiologists. Their contributions to this report are gratefully acknowledged. The persons listed were in the positions shown as of May 1988.

Alabama	Charles H. Woernle, MD
Alaska	John P. Middaugh, MD
Arizona	Steven J. Englender, MD, MPH
Arkansas	Thomas C. McChesney, DVM
California	Kathleen H. Acree, MDCM, MPH, JD (Acting)
Colorado	Richard E. Hoffman, MD, MPH
Connecticut	James L. Hadler, MD, MPH
Delaware	Paul R. Silverman, DrPH
District of Columbia	Martin E. Levy, MD, MPH
Florida	Michael H. Wilder, MD
Georgia	R. Keith Sikes, DVM, MPH
Hawaii	Christine Nevin-Woods, DO, MPH (Acting)
Idaho	Charles D. Brokopp, DrPH
Illinois	Byron J. Francis, MD, DrPH
Indiana	Gordon R. Reeve, PhD, MPH
Iowa	Laverne A. Wintermeyer, MD
Kansas	Cindy Wood, MD, MPH
Kentucky	James Michael Moser, MD, MPH
Louisiana	Joyce B. Mathison, MD, MPH&TM
Maine	Kathleen F. Gensheimer, MD
Maryland	Ebenezer Israel, MD, MPH
Massachusetts	George F. Grady, MD
Michigan	Kenneth R. Wilcox, Jr., MD, DrPH
Minnesota	Michael T. Osterholm, PhD, MPH
Mississippi	Fred Edgar Thompson, MD
Missouri	H. Denny Donnell, Jr., MD, MPH
Montana	Judith K. Gedrose, RN, MN
Nebraska	J. Douglas Campbell (Acting)
Nevada	Joseph Q. Jarvis, MD (Acting)
New Hampshire	Frederic E. Shaw, Jr., MD
New Jersey	William E. Parkin, DVM
New Mexico	Harry F. Hull, MD
New York State	Dale L. Morse, MD, MS
New York City	Stephen Schultz, MD
North Carolina	J.N. MacCormack, MD, MPH
North Dakota	Steven McDonough, MD (Acting)
Ohio	Thomas J. Halpin, MD, MPH
Oklahoma	Gregory R. Istre, MD
Oregon	Laurence R. Foster, MD, MPH
Pennsylvania	Ronald David, MD (Acting)
Rhode Island	Barbara A. DeBuono, MD, MPH
South Carolina	Clark W. Heath, Jr., MD (Acting)
South Dakota	Kenneth A. Senger, BS
Tennessee	Robert H. Hutcheson, MD
Texas	Thomas G. Betz, MD, MPH
Utah	Craig R. Nichols, MPA
Vermont	Richard L. Vogt, MD
Virginia	Grayson B. Miller, Jr., MD
Washington	John M. Kobayashi, MD
West Virginia	Roy C. Baron, MD, MPH (Acting)
Wisconsin	Jeffrey P. Davis, MD
Wyoming	R.L. Meuli, MD (Acting)
Guam	Robert L. Haddock, DVM
Federated States of Micronesia	Eliuel K. Pretrick, MO
Marshall Islands	Tony de Brum
American Samoa	Julia L. Lyons, MD, MPH
Palau	Anthony H. Polloi, MO
Puerto Rico	John V. Rullan, MD
Virgin Islands	John N. Lewis, MD

☆U.S. GOVERNMENT PRINTING OFFICE: 1989 - 631-009/84838