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Hysterectomy Surveillance — United States, 1994–1999

Malaria Surveillance — United States, 2000

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Hysterectomy Surveillance — United States, 1994–1999

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Abstract

Problem/Condition: Hysterectomy is the second most frequently performed surgical procedure, after cesarean section, for women of reproductive age in the United States. Approximately 600,000 hysterectomies are performed annually in the United States, and approximately 20 million U.S. women have had a hysterectomy.

Reporting Period Covered: This report covers data from 1994 through 1999

Description of System: Estimates of the population of U.S. female, civilian residents were used to compute rates for this study. Population denominators were obtained from the U.S. Bureau of the Census. The National Hospital Discharge Survey (NHDS) was the data source for this report. NHDS is conducted by CDC's National Center for Health Statistics. NHDS is an annual, multistage probability sample of short-stay patients (those hospitalized <30 days) discharged from nonfederal hospitals in the United States.

Results and Interpretation: From 1994 through 1999, an estimated 3,525,237 hysterectomies were performed among U.S. women aged ≥15 years, and the overall hysterectomy rate for U.S. female, civilian residents was 5.5 per 1,000 women. Although statistically significant increases for hysterectomy rates were observed from 1994 (5.1/1,000) through 1998 (5.8/1,000), the increase was limited and the curve remained nearly flat.

Women aged 40–44 years had a significantly higher hysterectomy rate compared with any other age group. During the study period, 52% of all hysterectomies were performed among women aged ≤44 years. In addition, hysterectomy rates per 1,000 in women aged 45–54 years increased significantly, from 8.9 in 1994 to 10 in 1999. The overall hysterectomy rate for women living in the South was 6.5 per 1,000, which was significantly higher than the rate among women who lived in either the Northeast (4.3) or the West (4.8) but not significantly higher than the rate among women who lived in the Midwest (5.4). Uterine leiomyoma, endometriosis, and uterine prolapse were the most frequent diagnoses for women aged ≥15 years. The percentage of uterine leiomyoma as a primary diagnosis for hysterectomy increased 10.2% for white women, 7.8% for black women, and 23% for women of other races. Among women who had a hysterectomy during the study period, 55% also had a bilateral oophorectomy. The proportion of all vaginal hysterectomies with concomitant laparoscopy (LAVH) increased significantly, from 13% in 1994 to 28% in 1999. During this same period, the percentage of cases of LAVH with concomitant bilateral oophorectomy increased significantly, from 20.4% in 1994 to 42.5% in 1999.

Public Health Actions: Continued monitoring of hysterectomy trends will be necessary to evaluate differences in hysterectomy rates by age, most commonly associated diagnoses, whether leiomyomata as a primary discharge diagnosis continues to increase, and whether the increase in LAVH that occurred during the previous decade continues.

Introduction

After cesarean section, hysterectomy is the second most frequently performed major surgical procedure for women of reproductive age in the United States. Approximately 600,000 hysterectomies are performed annually in the United States, and an estimated 20 million U.S. women have had a hysterectomy (*1,2*).

The previous summary of hysterectomy surveillance in the United States described trends during 1980–1993 (*3*). Hysterectomy rates declined during 1980–1986 and increased steadily during 1988–1993. However, during the latter period, the rates of vaginal hysterectomy, concomitant bilateral oophorectomy, and laparoscopically assisted vaginal hysterectomy (LAVH) increased (*3*). To monitor recent increasing trends in the number of hysterectomies performed in the United States, data from the 1994–1999 National Hospital Discharge Survey (NHDS) were analyzed.

Methods

Study Population, NHDS Data, and Sampling

The population studied comprised women aged ≥15 years who had a hysterectomy during 1994–1999. The estimated population of U.S. female, civilian residents was used to compute rates for this study. The population sample was obtained from the U.S. Bureau of the Census and included in a documentation package from NHDS (*4*). Data from the NHDS conducted by CDC's National Center for Health Statistics were analyzed. NHDS is an annual, multistage probability sample of short-stay patients (those hospitalized <30 days) discharged from nonfederal hospitals in the United States. NHDS uses a modified three-stage probability design. The stages are 1) primary sampling units (PSUs), 2) hospitals within PSUs, and 3) discharges within hospitals. The modification was characterized by the selection with certainty of the largest PSUs and hospitals (*5*).

Definition of Variables

Age

The study participants were grouped by ages 15–24, 25–29, 30–34, 35–39, 40–44, 45–54, and ≥55 years. This strategy ensured stable estimates in each age group and matched the age groups used in the previous report (*3*).

Race

Participants were also grouped by race into white, black, or other category, on the basis of medical record abstraction. The other category included Asians, Pacific Islanders, American Indians, Alaskan Natives, and other races not already specified. Missing race information ranged from 17.1% in 1995 to 20.5% in 1997.

In this report, patients of unknown race were allocated proportionate to the racial distribution of known cases. When examining proportions, the point estimates based on proportional allocation would not differ from those based only on known race. However, if rates were calculated where the numerators were based only on patients with known race, rates would be understated in all cases.

Geographic Region

The geographic areas included in the study were based on the U.S. Bureau of the Census definition of the four regions of the United States: Northeast (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont); Midwest (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin); South (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia); and West (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming).

Medical Classification

Estimates of diagnoses and procedures in NHDS were derived from the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM). Women with codes 68.3–68.5 were classified as having undergone hysterectomy. ICD-9-CM code 65.5 or 65.6 identified concomitant bilateral oophorectomy; ICD-9-CM code 54.21 indicated laparoscopy as a procedure before 1997; and the new ICD-9-CM code 68.51 identified LAVH since 1997. NHDS also provides information regarding whether the surgical approach was an abdominal or vaginal hysterectomy. Radical hysterectomy, ICD-9-CM 68.6 or 68.7, and pelvic evisceration performed for advanced pelvic cancer treatment (ICD-9-CM 68.8) were excluded.

Because NHDS includes seven diagnostic codes, the following algorithm was used to define the leading cause of hysterectomy: 1) cancer was assigned as the leading cause of hysterectomy if reproductive tract cancer or debulked cancer of the urinary or intestinal tract were listed as a diagnosis; 2) precancerous condition was assigned as the cause of hysterectomy if a precancerous condition was listed as a diagnosis (e.g., endometrial hyperplasia or carcinoma in situ of the cervix); 3) uterine leiomyoma, endometriosis, or uterine prolapse, whichever was listed first, was assigned as the primary diagnosis if cancer or a precancerous condition was not listed; and 4) "other" was assigned as the primary diagnosis for the remaining recorded diagnoses (*6,7*).

Statistical Analysis

Rates per 1,000 women aged ≥15 years in the U.S. civilian resident population were computed. SUDAAN software was used to account for the complex survey design (*8*). Data were weighted to produce national estimates. Because discharges were reallocated in cases where race was not reported, SUDAAN could not be used to compute standard errors directly for race-specific estimates. Therefore, the relative standard error computed with SUDAAN for participants of known race was applied to each reallocated total. Trends in both discharge rates and proportions were computed by using SUDAAN and SAS (*8,9*). The yearly estimates and corresponding covariance matrices were computed with SUDAAN

and then put into SAS's PROC CATMOD, where weighted least-squares estimation was used to test for trends over time.

Results

From 1994 through 1999, an estimated 3,525,237 hysterectomies were performed in the United States for women aged ≥15 years. The overall hysterectomy rate was 5.5 per 1,000 women per year (95% confidence interval [CI] = 5–5.9) during the 6-year study period (Table 1). Although statistically significant increases were observed in rates from 1994 through 1998 (p for trend = 0.04), the increase was limited, and the overall curve during this period was nearly flat. Rates appeared to decline in 1999 (Figure 1).

The overall estimated hysterectomy rate for blacks was 6.2 per 1,000 and 5.9 per 1,000 for other races. The hysterectomy rate for whites was 5.3 per 1,000. Differences in overall rates by race were not statistically significant (Table 2). However, differences in hysterectomy rates among black and white women aged 35–39 and 40–44 years were statistically significant (p<0.05).

TABLE 1. Estimated numbers and rates* of hysterectomies, by year — United States, 1994–1999

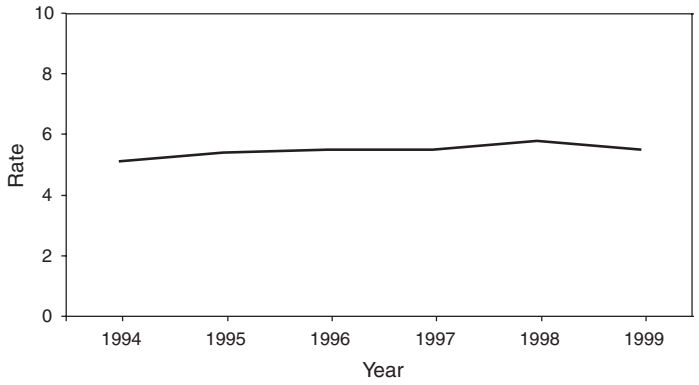
Year	No.	Rate	SE†
1994	536,496	5.1	0.25
1995	572,866	5.4	0.25
1996	584,359	5.5	0.27
1997	592,298	5.5	0.28
1998	633,836	5.8	0.32
1999	605,382	5.5	0.29
Total	**3,525,237**	**5.5**	**0.22**

* Per 1,000 female, civilian residents aged ≥15 years.
† Standard error.

Women aged 40–44 years had a significantly higher rate of hysterectomy (11.7; 95% CI = 10.7–12.6) than did any other age group. During the study period, 52% of all hysterectomies were performed among women aged ≤44 years. Hysterectomy rates among women aged 45–54 years increased significantly, from 8.9 per 1,000 in 1994 to 10 per 1,000 in 1999 (p for trend = 0.009) (Figure 2). The highest hysterectomy rate was 16.8 per 1,000 in black women aged 40–44 years. White women aged 40–44 years had a hysterectomy rate of 10.8 per 1,000, and women of other races aged 40–44 years had a hysterectomy rate of 12.4 per 1,000 (Table 2).

The overall hysterectomy rate for women living in the South was 6.5 per 1,000 (95% CI = 5.6–7.5), which was significantly higher than the rate for women living in either the Northeast (4.3; 95% CI = 3.7–5) or the West (4.8; 95% CI = 4.2–5.4), but not significantly higher than the rate among women who lived in the Midwest (5.4; 95% CI = 4.6–6.1) (Figure 3). The average age at which women in the South

FIGURE 1. Hysterectomy rates* — United States, 1994–1999



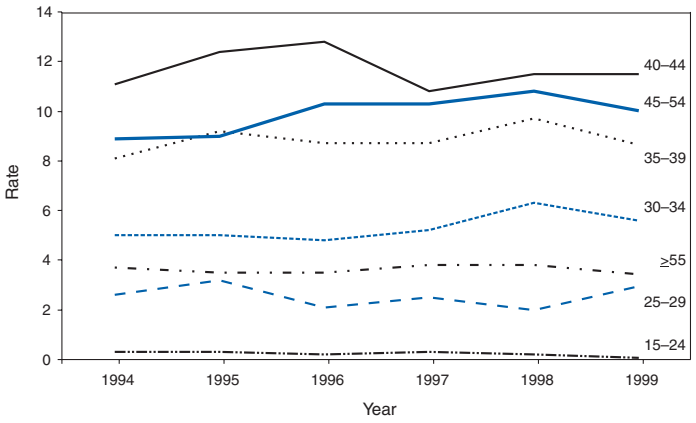
* Per 1,000 female, civilian residents aged ≥15 years.

TABLE 2. Estimated rates* of hysterectomy, by age and race of women who obtained the procedure — United States, 1994–1999

	Race											
	White			Black			Other†			All races		
Age (yrs)	Rate	SE§	No.	Rate	SE	No.	Rate	SE	No.	Rate	SE	No.
15–24	0.3	0.05	22,846	¶	¶	¶	¶	¶	¶	0.2	0.03	24,556
25–29	2.8	0.30	123,658	1.9	0.34	15,399	1.7	0.44	5,467**	2.6	0.20	144,524
30–34	5.4	0.46	276,421	5.4	0.50	47,741	3.5	0.90	11,722	5.3	0.33	335,884
35–39	8.3	0.62	459,502	12.5	1.06	111,971	7.8	1.20	25,679	8.9	0.48	597,152
40–44	10.8	0.74	569,735	16.8	1.36	135,755	12.4	1.51	38,087	11.7	0.49	743,577
45–54	9.6	0.55	812,734	11.2	0.82	128,229	12.9	1.59	57,514	9.9	0.40	998,476
≥55	3.6	0.21	599,765	3.0	0.29	52,151	5.3	0.88	29,152	3.6	0.15	681,068
Total	**5.3**	**0.32**	**2,864,661**	**6.2**	**0.37**	**492,743**	**5.9**	**0.67**	**167,834**	**5.5**	**0.22**	**3,525,237**

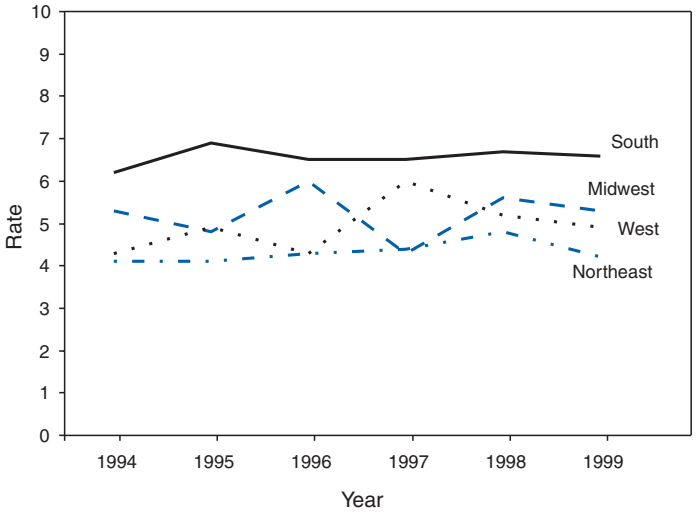
* Per 1,000 female, civilian residents in each age and race category. Rates by race were adjusted by redistributing the number of women for whom race was unknown according to the known distribution of race in the National Hospital Discharge Survey. Rates were calculated by applying population weights to the sum of the number of hysterectomies obtained each year, and then dividing this value by the sum of the population estimates for each year. Population estimates were obtained from the U.S. Department of Commerce, U.S. Bureau of the Census.
† Includes Asian, Pacific Islander, American Indian, Alaskan Native, and other races.
§ Standard error.
¶ Fewer than 30 women in the sample; numbers were too small for meaningful analysis.
** Based on 30–59 women in the sample; number was unreliable.

FIGURE 2. Hysterectomy rates,* by age group — United States, 1994–1999



* Per 1,000 female, civilian residents in each age group.

FIGURE 3. Hysterectomy rates,* by geographic region† — United States, 1994–1999



* Per 1,000 female, civilian residents aged ≥15 years.
† Regions are defined as follows: **Northeast** (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont); **Midwest** (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin); **South** (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia); and **West** (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming).

underwent a hysterectomy was 44.5 years (95% CI = 44–45), which was significantly younger than the average age of women living in all other regions ($p<0.05$). The highest average age was 49.1 years (95% CI = 48.4–49.9) for women in the Northeast.

Uterine leiomyoma, endometriosis, and uterine prolapse were the most frequent diagnoses for women undergoing hysterectomy and accounted for 73% of all hysterectomies during 1994–1999. The percentage of hysterectomies with a diagnosis of uterine leiomyoma was 68% among black women, 33% in white women, and 45% among women of other races (Table 3). Women in the ≥55-year age group had higher numbers of diagnoses of hyperplasia, cancer, and uterine prolapse, whereas women in the age groups from 30 through 54 years had higher numbers of cases of leiomyomata and endometriosis (Table 4). From 1994 through 1999, the percentage of cancer as a primary diagnosis for hysterectomy significantly decreased by 20% (p for trend = 0.01), and uterine leiomyoma increased significantly by 11% (p for trend = 0.02) (Figure 4). The percentage of uterine leiomyoma as a primary diagnosis for hysterectomy increased 10.2% among white women (p for trend = 0.20), 7.8% among black women (p for trend = 0.08), and 23% among women of other races (p for trend = 0.42).

TABLE 3. Estimated rates* of hysterectomy, by race of women who obtained the procedure and primary discharge diagnosis — United States, 1994–1999

	Race											
	White			Black			Other†			All races		
Diagnosis	Rate	SE§	No.	Rate	SE	No.	Rate	SE	No.	Rate	SE	No.
Endometrial hyperplasia	0.2	0.02	108,486	0.1	0.02	8,615	0.2	0.04	4,550¶	0.2	0.01	121,651
Endometriosis	1.1	0.08	564,191	0.6	0.09	46,806	0.7	0.10	19,837	1.0	0.06	630,834
Uterine leiomyoma	1.8	0.10	954,166	4.2	0.29	332,786	2.6	0.33	74,834	2.1	0.08	1,361,786
Uterine prolapse	1.0	0.08	547,933	0.3	0.04	19,792	0.9	0.15	25,894	0.9	0.05	593,619
Other	0.7	0.06	391,112	0.6	0.05	44,662	0.8	0.13	21,376	0.7	0.04	457,150
Total	**5.3**	**0.32**	**2,868,666**	**6.2**	**0.36**	**489,165**	**5.9**	**0.67**	**167,406**	**5.5**	**0.22**	**3,525,237**

* Per 1,000 female, civilian residents aged ≥15 years in each diagnosis and race category. Rates by race were adjusted by redistributing the number of women for whom race was unknown according to the known distribution of race in the National Hospital Discharge Survey. Rates were calculated by applying population weights to the sum of the number of hysterectomies obtained each year, and then dividing this value by the sum of the population estimates for each year. Population estimates were obtained from the U.S. Department of Commerce, U.S. Bureau of the Census.
† Includes Asian, Pacific Islander, American Indian, Alaskan Native, and other races.
§ Standard error.
¶ Based on 30–59 women in the sample; number was unreliable.

TABLE 4. Estimated rates* of hysterectomy, by age group of women who obtained the procedure and primary discharge diagnosis — United States, 1994–1999

	Diagnosis								
	Cancer			Endometrial hyperplasis			Endometriosis		
Age (yrs)	Rate	SE†	No.	Rate	SE	No.	Rate	SE	No.
15–24	§	§	§	§	§	§	0.1	0.02	7,485¶
25–29	0.2	0.04	13,193	§	§	§	0.8	0.10	46,178
30–34	0.3	0.05	20,318	0.1	0.02	3,533¶	1.7	0.16	106,575¶
35–39	0.4	0.04	29,246	0.1	0.02	8,026	2.3	0.17	156,330
40–44	0.6	0.06	36,906	0.2	0.04	13,792	2.3	0.16	143,718
45–54	0.6	0.05	64,802	0.5	0.05	44,990	1.4	0.10	136,060
≥55	1.0	0.05	192,596	0.3	0.02	49,990	0.2	0.02	34,488
Total	**0.6**	**0.03**	**360,197**	**0.2**	**0.01**	**121,651**	**1.0**	**0.06**	**630,834**

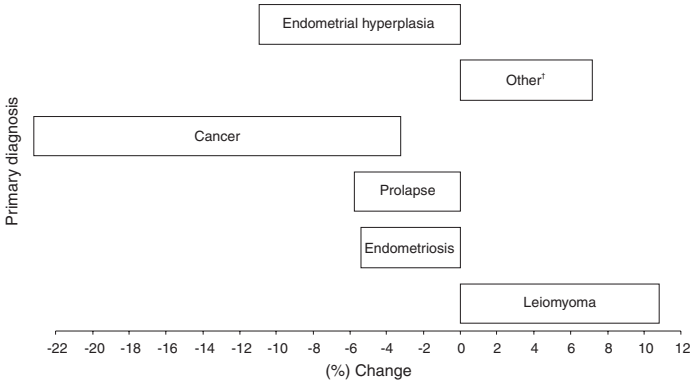
	Diagnosis											
	Uterine leiomyoma			Uterine prolapse			Other**			Total		
Age (yrs)	Rate	SE	No.	Rate	SE	No.	Rate	SE	No.	Rate	SE	No.
15–24	§	§	§	§	§	§	0.1	0.02	10,772	**0.2**	**0.03**	**24,556**
25–29	0.2	0.04	12,312	0.3	0.05	17,173	1.0	0.10	54,348	**2.6**	**0.20**	**144,524**
30–34	1.1	0.10	69,836	0.8	0.09	47,816	1.4	0.11	87,806	**5.3**	**0.33**	**335,884**
35–39	3.3	0.19	222,206	1.2	0.12	77,818	1.5	0.13	103,526	**8.9**	**0.48**	**597,152**
40–44	6.3	0.26	399,277	1.3	0.14	80,342	1.1	0.09	69,542	**11.7**	**0.49**	**743,577**
45–54	5.5	0.22	553,641	1.3	0.08	126,851	0.7	0.06	72,132	**9.9**	**0.40**	**998,476**
≥55	0.6	0.04	103,805	1.3	0.08	241,165	0.3	0.02	59,024	**3.6**	**0.15**	**681,068**
Total	**2.1**	**0.08**	**1,361,786**	**0.9**	**0.05**	**593,619**	**0.7**	**0.04**	**457,150**	**5.5**	**0.22**	**3,525,237**

* Per 1,000 female, civilian residents in each age category and diagnosis category. Rates were calculated by applying population weights to the sum of the number of hysterectomies obtained each year, and then dividing this value by the sum of the population estimates for each year. Population estimates were obtained from the U.S. Department of Commerce, U.S. Bureau of the Census.
† Standard error.
§ Fewer than 30 women in the sample; numbers were too small for meaningful analysis.
¶ Based on 30–59 women in the sample; number was unreliable.
** Includes cervical dysplasia and menstrual disturbances.

Abdominal hysterectomies were performed more frequently than vaginal hysterectomies for all races. Black women were more likely to undergo abdominal hysterectomy than white women; conversely, white women were more likely to undergo vaginal hysterectomy than black women (Figure 5). The higher prevalence of leiomyoma among black women might contribute to the higher proportion of abdominal hysterectomies in this group.

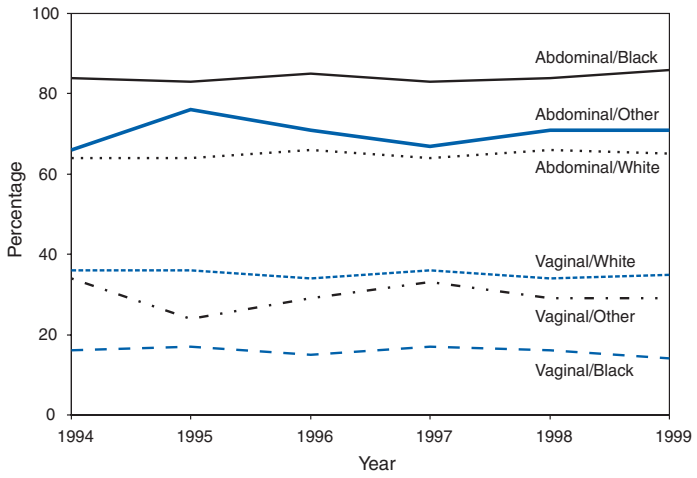
Among women who had a hysterectomy during 1994–1999, 55% had a bilateral oophorectomy. Among women aged

FIGURE 4. Percentage change in primary diagnosis of hysterectomies performed* — United States, 1994–1999



* Among female, civilian residents aged ≥15 years.
† Include cervical dysplasia and menstrual disturbances.

FIGURE 5. Percentage of hysterectomies performed,* by type of surgical approach and race of women who obtained the procedure — United States, 1994–1999



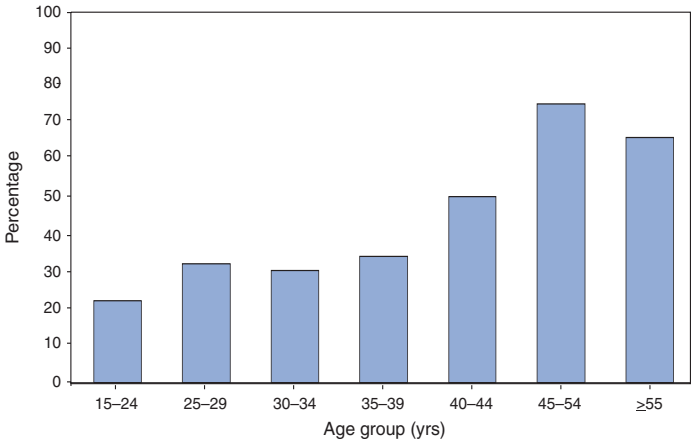
* Among female, civilian residents aged ≥15 years.

15–44 years who underwent a hysterectomy, approximately one third (40%) had a concomitant bilateral oophorectomy, and these women can be considered to have undergone surgical menopause. The percentage of bilateral oophorectomy was highest (75%) for women aged 45–54 years. The proportion of hysterectomies with concomitant bilateral oophorectomies tended to increase with increasing age (Figure 6). Women who had a bilateral oophorectomy were 4.4 times as likely to have an abdominal, rather than a vaginal hysterectomy. Seventy-one percent of bilateral oophorectomies were performed on women whose primary diagnoses were benign (e.g., leiomyoma, endometriosis, or uterine prolapse).

The trends for all hysterectomies performed vaginally and the percentage of all vaginal hysterectomies with concomitant bilateral oophorectomies remained stable during 1994–1999 (Figure 7). However, the proportion of all vaginal hysterectomies with concomitant LAVH increased significantly, from 13% in 1994 to 28% in 1999 (p for trend <0.0001).

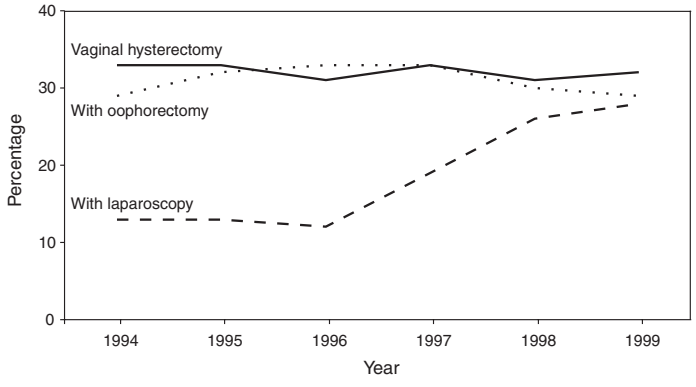
Further analyses were performed to assess LAVH trends. During the study, the number of vaginal hysterectomies with concomitant bilateral oophorectomies remained stable (Figure 8). However, the percentage of vaginal hysterectomies with concomitant bilateral oophorectomies that were assisted by laparoscopy increased significantly, from 20.4% in 1994 to 42.5% in 1999 (p for trend <0.0001).

FIGURE 6. Percentage of hysterectomies with bilateral oophorectomy,* by age group — United States, 1994–1999



* Among female, civilian residents in each age group.

FIGURE 7. Percentage of all hysterectomies performed* by vaginal route, percentage of vaginal hysterectomies with concomitant oophorectomy, and percentage of vagnial hysterectomies with concomitant laparoscopy — United States, 1994–1999



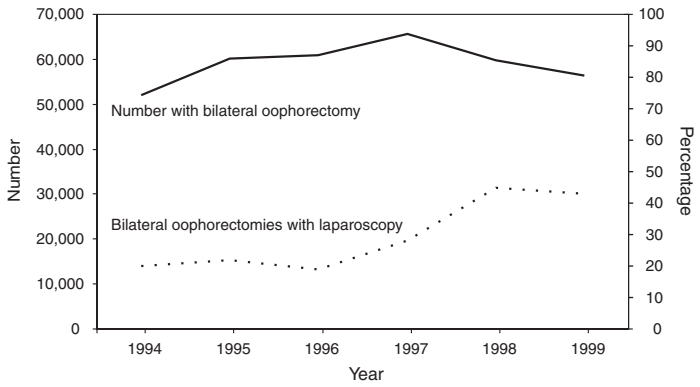
* Among female, civilian residents aged ≥15 years.

Discussion

Study findings indicated a limited, yet significant increase in the rate of hysterectomies during 1994–1998. From 1994 through 1999, one in every nine women aged 35–45 years had a hysterectomy. Women aged 40–44 years had a significantly higher rate of hysterectomies than all other age groups. The most common primary diagnoses for a hysterectomy were uterine leiomyoma, endometriosis, and uterine prolapse (*3*). Approximately one half of the women who had a hysterectomy also had a bilateral oophorectomy. Rates of vaginal hysterectomies remained stable, although the proportion of women who had an LAVH increased significantly by >2-fold. Furthermore, the proportion of vaginal hysterectomies with concomitant oophorectomies performed that were assisted by LAVH approximately doubled during 1994–1999.

The findings in this report confirm and extend those noted in previous reports: rates of hysterectomy were higher among black women than among white women. Although differences in overall hysterectomy rates among black and white women were not significant, differences in age-specific rates (35–39 years and 40–44 years) were significant (*3,10–13*). Rates of

FIGURE 8. Numbers of vaginal hysterectomies with bilateral oophorectomies and percentage that are accompanied by laparoscopy* — United States, 1994–1999



* Among female, civilian residents aged ≥15 years.

hysterectomy were also higher among women aged 40–44 years (*3,10,12–15*) and women living in the South (*3,10,12–14,16*). The availability of obstetricians and gynecologists, the number of hospital beds per capita, and the type of health-care insurance available might vary by region; these factors might influence regional variation (*17,18*).

Uterine leiomyoma, which is the most common uterine tumor, was the most frequent diagnosis associated with hysterectomy. In addition, the overall rate of hysterectomy attributable to uterine leiomyoma during 1994–1999 (2.1 per 1,000) increased by 17% over the rate for the previous study period (1988–1993: 1.8 per 1,000) (*3*). More widespread availability of ultrasound in obstetrician-gynecologist clinics might have increased the diagnosis of uterine leiomyoma (*19*). Findings in this report do not include data to help explain reasons for observed racial differences in the occurrence of leiomyoma or hysterectomy rates among women aged 30–44 years. However, family history has been associated with leiomyoma, prompting an ongoing search for genetic and other potential risk factors shared by women from the same families (*20*). In contrast with leiomyomas, cancer as a primary diagnosis for hysterectomy decreased by 21% during the study period. A recent report demonstrates that the reduction occurred primarily in cervical cancers as a primary diagnosis for hysterectomy. Data in this report indicate that the reduction might be a consequence of increased detection of precancerous lesions by Papanicolaou smear programs (*21*) and of changes in choice of treatment for early lesions (*22,23*).

Although trends for bilateral oophorectomy remained stable during 1994–1999, the percentage of hysterectomy with concomitant bilateral oophorectomy more than doubled from 1965 (25%) to the time of this evaluation (55%) (*15*). More than one half of hysterectomies were accompanied by bilateral oophorectomies, the majority of which were performed abdominally. An evaluation of the indications for oophorectomies is beyond the scope of this report. When vaginal hysterectomies included concomitant bilateral oophorectomy, increases in the use of laparoscopic assistance were observed. These increases might indicate a preference by surgeons for increased visibility of the ovaries when oophorectomy is performed (*24*). Bilateral oophorectomy might have diverse implications for women's health (e.g., ovarian cancer prevention, need for hormone replacement therapy).

According to the analysis in this report, LAVH approximately doubled from 1994 to 1999, although rates of vaginal hysterectomy remained stable. Since 1989, when LAVH was first introduced, to 1999, the percentage of all hysterectomies that were LAVHs increased significantly from 1% to 28%. LAVHs are controversial, partly because of cost concerns (*25,26*), although LAVH-associated benefits might include shorter hospital stays, less pain, more rapid recovery, and fewer complications. These benefits are relevant, however, only when LAVH replaces abdominal hysterectomy, rather than substituting for unassisted vaginal hysterectomy (*2,27*).

Limitations

Several limitations exist in the data presented in this report. For example, the denominator included all U.S. women, rather than only those women who had not previously undergone a hysterectomy, resulting in an underestimate of the true rates of hysterectomy among those at risk in the United States. This limitation, however, should not affect the ability to detect trends over time as long as rates remain stable. Another limitation was the assumption that the racial distribution of discharges where race was not reported is the same as for discharges where race was reported. This assumption is tenuous because a recent evaluation indicates that race data might be more likely to be missing for white women (*28*). Furthermore, random assignment would attenuate any differences by race. Therefore, the race-specific estimates presented in this report should be interpreted with caution. In addition, pathology reports were not available to help confirm indications for the performance of hysterectomy. Finally, data regarding socioeconomic status and parity were not available.

In summary, the data demonstrate limited but significant increases in hysterectomy rates from 1994 through 1998, followed by a decrease in 1999. During the study period, significant increases were observed in the occurrence of leiomyomas as a primary diagnosis for hysterectomy, whereas significant decreases occurred in the reporting of cancer as a primary diagnosis. Continued monitoring of hysterectomy trends will be necessary to evaluate differences in hysterectomy rates by age, most commonly associated diagnoses, whether leiomyomata as a primary discharge diagnosis continues to increase, and whether the increase in LAVH that occurred during the previous decade will continue.

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Malaria Surveillance — United States, 2000

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Abstract

Problem/Condition: Malaria is caused by four species of intraerythrocytic protozoa of the genus *Plasmodium* (i.e., *P. falciparum*, *P. vivax*, *P. ovale*, or *P. malariae*). Malaria is transmitted by the bite of an infective female *Anopheles* sp. mosquito. The majority of malaria infections in the United States occur among persons who have traveled to areas with ongoing transmission. In the United States, cases can occur through exposure to infected blood products, by congenital transmission, or locally through mosquitoborne transmission. Malaria surveillance is conducted to identify episodes of local transmission and to guide prevention recommendations for travelers.

Period Covered: Cases with onset of illness during 2000.

Description of System: Malaria cases confirmed by blood smear are reported to local and state health departments by health-care providers or laboratory staff. Case investigations are conducted by local and state health departments, and reports are transmitted to CDC through the National Malaria Surveillance System (NMSS). Data from NMSS serve as the basis for this report.

Results: CDC received reports of 1,402 cases of malaria with an onset of symptoms during 2000 among persons in the United States or one of its territories. This number represents a decrease of 9.0% from the 1,540 cases reported for 1999. *P. falciparum*, *P. vivax*, *P. malariae*, and *P. ovale* were identified in 43.6%, 37.2%, 4.8%, and 2.3% of cases, respectively. Nine patients (0.6% of total) were infected by ≥2 species. The infecting species was unreported or undetermined in 161 (11.5%) cases. Compared with 1999, the number of reported malaria cases acquired in Africa decreased by 13.1% (n = 783), and a decrease of 3.3% (n = 238) occurred in cases acquired in Asia. Cases from the Americas decreased by 1.1% (n = 271) from 1999. Of 825 U.S. civilians who acquired malaria abroad, 190 (23.0%) reported that they had followed a chemoprophylactic drug regimen recommended by CDC for the area to which they had traveled. Four patients became infected in the United States, two through congenital transmission and two through probable induced transmission. Six deaths were attributed to malaria, four caused by *P. falciparum*, one caused by *P. malariae*, and one by *P. ovale*.

Interpretation: The 9.0% decrease in malaria cases in 2000, compared with 1999, resulted primarily from decreases in cases acquired in Africa and Asia. This decrease could have resulted from local changes in disease transmission, decreased travel to these regions, fluctuation in reporting to state and local health departments, or an increased use of effective antimalarial chemoprophylaxis. In the majority of reported cases, U.S. civilians who acquired infection abroad were not on an appropriate chemoprophylaxis regimen for the country in which they acquired malaria.

Public Health Actions: Additional information was obtained concerning the six fatal cases and the four infections acquired in the United States. Persons traveling to a malarious area should take one of the recommended chemoprophylaxis regimens appropriate for the region of travel, and travelers should use personal protection measures to prevent mosquito bites. Any person who has been to a malarious area and who subsequently develops a fever or influenza-like symptoms should seek medical care immediately and report their travel history to the clinician; investigation should include a blood-film test for malaria. Malaria infections can be fatal if not diagnosed and treated promptly. Recommendations concerning malaria prevention can be obtained from CDC by calling the Malaria Hotline at 770-488-7788 or by accessing CDC's Internet site at http://www.cdc.gov/travel.

Introduction

Malaria is caused by infection with one or more of four species of *Plasmodium* (i.e., *P. falciparum*, *P. vivax*, *P. ovale*, and *P. malariae*) that can infect humans. The infection is transmitted by the bite of an infective female *Anopheles* sp. mosquito. Malaria infection remains a devastating global problem, with an estimated 300–500 million cases occurring annually (*1*). Forty-one percent of the world's population lives in areas where malaria is transmitted (e.g., parts of Africa, Asia, the Middle East, Central and South America, Hispaniola, and Oceania) (*1*), and 700,000–2.7 million persons die of malaria each year, 75% of them African children (*2*). In previous years, malaria was endemic throughout much of the continental United States; an estimated 600,000 cases occurred during 1914 (*3*). During the late 1940s, a combination of improved socioeconomic conditions, water 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 antimalarial drug resistance that guide prevention recommendations for U.S. travelers. Anopheline mosquitos remain seasonally present in all states except Hawaii.

Through 2000, the majority of cases of malaria diagnosed in the United States have been imported from regions of the world where malaria transmission is known to occur, although congenital infections and infections resulting from exposure to blood or blood products are reported in the United States also. In addition, a limited number of cases are reported that might have been acquired through local mosquitoborne transmission (*4*).

State and local health departments and CDC investigate malaria cases acquired in the United States, and CDC analyzes data from imported cases to detect acquisition trends. This information is used to guide malaria prevention recommendations for travelers abroad. For example, an increase in *P. falciparum* malaria among U.S. travelers to Africa, an area with increasing chloroquine resistance, prompted CDC to change the recommended chemoprophylaxis regimen from chloroquine to mefloquine in 1990 (*5*).

The signs and symptoms of malaria illness are varied, but the majority of patients experience fever. Other common symptoms include headache, back pain, chills, increased sweating, myalgia, nausea, vomiting, diarrhea, and cough. The diagnosis of malaria should be considered for persons who experience these symptoms and who have traveled to an area with known malaria transmission. Malaria should also be considered in the differential diagnoses of persons who experience fevers of unknown origin, regardless of their travel history. Untreated *P. falciparum* infections can rapidly progress to coma, renal failure, pulmonary edema, and death. Asymptomatic parasitemia can occur among persons who have been long-term residents of malarious areas. This report summarizes malaria cases reported to CDC with onset of symptoms in 2000.

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 between the two systems because of differences in collection and transmission of data. A major difference in 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). This report presents only data regarding cases reported to NMSS.

Cases of blood-film–confirmed malaria among civilians and military personnel are identified by health-care providers or laboratories. Each slide-confirmed 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 staff review all report forms when received and request additional information, if necessary (e.g., when no recent travel to a malarious country is reported). Reports of other cases are telephoned directly by health-care providers to CDC, usually when assistance with diagnosis or treatment is requested. All cases that have been acquired in the United States are investigated, 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.

Definitions

The following definitions are used in this report:

- **Laboratory criteria for diagnosis:** Demonstration of malaria parasites in blood films.
- **Confirmed case:** Symptomatic or asymptomatic infection that occurs in a person in the United States who has microscopically confirmed malaria parasitemia, regardless of whether the person had previous episodes of malaria while in other countries. A subsequent episode of malaria is counted as an additional case if the identified *Plasmodium* sp. 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 identified *Plasmodium* sp. is the same species identified previously.

This report also uses terminology derived from the recommendations of the World Health Organization (*7*). 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 an imported case in an area where malaria does not occur regularly.
- **Imported malaria:** Malaria acquired outside a specific area. In this report, imported cases are those acquired outside the United States and its territories (Puerto Rico, Guam, and the U.S. Virgin Islands).
- **Induced malaria:** Malaria acquired through artificial means (e.g., blood transfusion or using shared common syringes).
- **Relapsing malaria:** Renewed manifestations (i.e., clinical symptoms or parasitemia) of malarial infection that is separated from previous manifestations of the same infection by an interval greater than the usual periodicity of the paroxysms.
- **Cryptic malaria:** An isolated malaria case that cannot be linked epidemiologically to secondary cases.

Microscopic Diagnosis of Malaria

The early diagnosis of malaria requires that physicians consider malaria in the differential diagnosis of every patient who is experiencing fever; the evaluation of such a patient should include taking a comprehensive travel history. If malaria is suspected, a Giemsa-stained smear of the patient's peripheral blood should be examined for parasites. Thick and thin blood films must be prepared correctly because diagnostic accuracy depends on blood-film quality and examination by experienced laboratory personnel* (see Appendix for procedures for accurately diagnosing malaria).

Results

General Surveillance

During 2000, CDC received 1,402 malaria case reports occurring among persons in the United States and its territories, representing a 9.0% decrease from the 1,540 cases reported for 1999 (*8*). This incidence is the third highest number of reported cases since 1980 and represents the second highest number of U.S. civilian cases reported in the past 30 years (Table 1). In 2000, a total of 827 cases occurred among U.S. civilians, compared with 833 cases reported for 1999, and the number of cases among foreign civilians also decreased from 381 cases to 354 (Figure 1). Cases among U.S. military personnel decreased from 55 to 46 in 2000. In 175 cases, information was insufficient to determine civilian or military status.

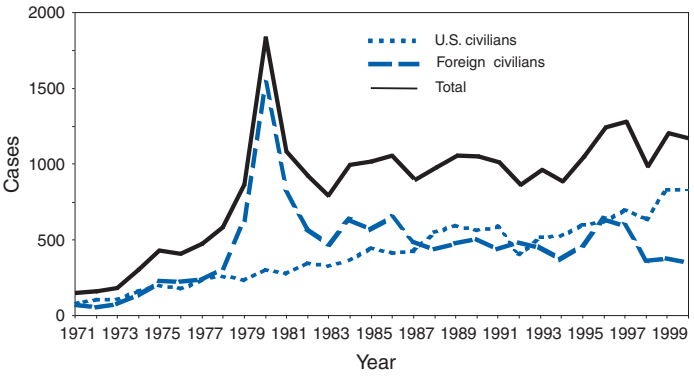
TABLE 1. Number of malaria cases* among U.S. and foreign civilians and U.S. military personnel — United States, 1971–2000

Year	U.S. military personnel	U.S. civilians	Foreign civilians	Status not recorded	Total
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**
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**

* A case was defined as symptomatic or asymptomatic illness that occurs in the United States in a person who has microscopy-confirmed malaria parasitemia, regardless of whether the person had previous attacks of malaria while in other countries. A subsequent attack of malaria occurring in a person is counted as an additional case if the demonstrated *Plasmodium* species differs from the initially identified species. A subsequent attack 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 demonstrated *Plasmodium* species is the same species identified previously.

* To obtain confirmation diagnosis of blood films from questionable cases and to obtain appropriate treatment recommendations, contact either your state or local health department or CDC's National Center for Infectious Diseases, Division of Parasitic Diseases, Malaria Epidemiology Branch at 770-488-7788.

FIGURE 1. Number of malaria cases among U.S. and foreign civilians — United States,* 1971–2000†



* Includes Puerto Rico, Guam, and the U.S. Virgin Islands.
† The substantial increase in the number of cases reported for 1980 primarily reflects cases diagnosed among immigrants from Southeast Asia.

Plasmodium Species

The infecting species of *Plasmodium* was identified in 1,241 (88.5%) of the cases reported in 2000. *P. falciparum* and *P. vivax* were identified in blood smears from 43.6% and 37.2% of infected persons, respectively (Table 2). The 611 *P. falciparum* cases reported for 2000 represented a 13.7% decrease from the 708 cases in 1999, whereas the number of *P. vivax* infections increased by 10.6% (from 472 in 1999 to 522 in 2000). Among 1,181 cases in which both the region of acquisition and the infecting species were known, 75.6% of infections acquired in Africa were attributed to *P. falciparum*; 13.2% were attributed to *P. vivax*. The converse was true of infections acquired in the Americas and Asia: 86.5% and 85.9% were attributed to *P. vivax*, and only 7.3% and 8.3% were attributed to *P. falciparum*, respectively.

Region of Acquisition and Diagnosis

Approximately 99% (n = 1,398) of reported cases were imported. Of 1,330 imported cases in which the region of acquisition was known, the majority (58.9%; n = 783) were acquired in Africa; 20.1% (n = 271) and 17.9% (n = 238) were acquired in the Americas and Asia, respectively (Table 3). The highest concentration of cases acquired in Africa came from countries in West Africa (66.7%; n = 522), whereas the majority of cases acquired in Asia came from the Indian subcontinent (67.2%; n = 160). The other regions where imported cases of malaria were acquired were Central America and the Caribbean (15.0%; n = 200), South America (4.3%; n = 57), and Oceania (1.7%; n = 22). Information regarding region of acquisition was missing for 68 (4.9%) of the imported cases. The number of reported malaria cases acquired in Africa decreased by 13.1% (n = 783), compared with 1999. The same number of cases acquired in the Americas (n = 271) were reported for 2000 as compared with 1999. Cases from Asia decreased by 3.3% (n = 238), compared with 1999.

In the United States, the five health departments reporting the highest number of malaria cases were New York City (n = 220), California (n = 194), New York State (n = 77), Texas (n = 70), and Illinois (n = 67) (Figure 2). All of these health departments reported a decrease in cases compared with 1999. This overall decrease in reported number of cases might reflect a decreased rate of international travel, a reduced risk for malaria among travelers, poorer access to health care, or fluctuation in surveillance by state and local health departments.

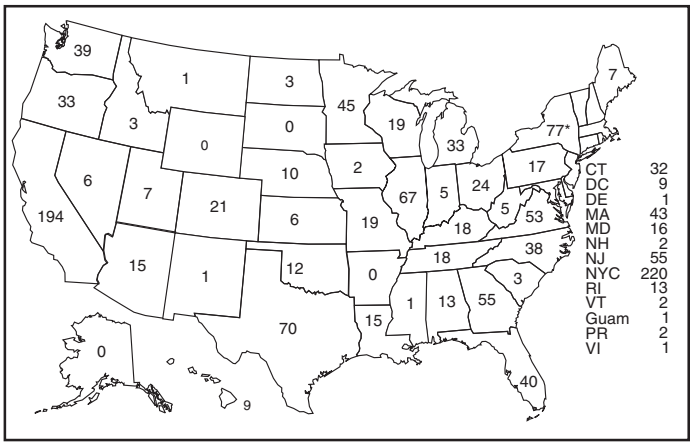
TABLE 2. Number of malaria cases, by *Plasmodium* species — United States, 1999 and 2000

Plasmodium	1999		2000	
Species	No.	(%)	No.	(%)
P. falciparum	708	(46.0)	611	(43.6)
P. vivax	472	(30.7)	522	(37.2)
P. malariae	70	(4.6)	67	(4.8)
P. ovale	55	(3.6)	32	(2.3)
Mixed	12	(0.8)	9	(0.6)
Undetermined	223	(14.5)	161	(11.5)
Total	**1,540**	**(100.0)**	**1,402**	**(100.0)**

Interval Between Arrival and Illness

The interval between date of arrival in the United States and onset of illness and the infecting *Plasmodium* species were known for 623 (44.6%) of the imported cases of malaria (Table 4). Symptoms began before arrival in the United States for 63 (10.1%) persons, whereas symptoms began after arrival in the United States for 560 (89.9%) of these patients. Clinical malaria developed within 1 month after arrival in 313 (80.9%) of the 387 *P. falciparum* cases and in 75 (38.9%) of the 193 *P. vivax* cases (Table 4). Only 5 (0.8%) of the 560 persons became ill >1 year after returning to the United States.

FIGURE 2. Number of malaria cases, by state in which the disease was diagnosed — United States, 2000



*Excludes New York City.

TABLE 3. Imported malaria cases, by country of acquisition and *Plasmodium* species — United States, 2000

Country of acquisition	*Plasmodium* species						
	P. falciparum	*P. vivax*	*P. malariae*	*P. ovale*	Unknown	Mixed	Total
Africa	**528**	**92**	**40**	**31**	**85**	**7**	**783**
Algeria	0	1	0	0	0	0	**1**
Angola	3	2	1	0	1	1	**8**
Benin	2	3	0	0	0	0	**5**
Botswana	0	0	0	0	1	0	**1**
Burkina Faso	3	1	0	0	0	0	**4**
Burundi	0	1	0	0	0	0	**1**
Cameroon	17	2	2	2	5	0	**28**
Central African Republic	1	0	0	0	0	0	**1**
Chad	1	0	0	0	0	0	**1**
Congo	3	4	1	1	1	0	**10**
Cote d'Ivoire	32	2	2	3	3	1	**43**
Democratic Republic of the Congo (Zaire)	2	0	0	0	0	0	**2**
Eritrea	0	1	0	0	1	0	**2**
Ethiopia	0	6	2	1	0	0	**9**
Gabon	2	2	0	1	2	0	**7**
Gambia	18	3	0	1	1	0	**23**
Ghana	97	10	4	3	16	0	**130**
Guinea	11	4	0	0	1	0	**16**
Kenya	19	8	4	5	3	0	**39**
Liberia	19	1	3	0	10	1	**34**
Libya	1	0	0	0	0	0	**1**
Madagascar	4	3	0	0	0	0	**7**
Malawi	2	0	0	1	0	0	**3**
Mali	16	1	1	0	0	0	**18**
Mauritania	1	3	1	0	0	1	**6**
Mozambique	4	2	0	0	1	0	**7**
Niger	2	1	0	0	0	0	**3**
Nigeria	143	7	5	5	17	0	**177**
Rwanda	0	1	1	0	0	1	**3**
Senegal	25	1	2	1	1	0	**30**
Sierra Leone	9	0	0	0	0	0	**9**
Somali Republic	2	0	0	0	0	0	**2**
South Africa	3	1	0	0	1	0	**5**
Sudan	5	1	2	0	0	0	**8**
Tanzania	11	3	1	0	4	0	**19**
Togo	2	2	0	2	0	0	**6**
Uganda	18	2	2	1	3	0	**26**
Zambia	6	1	0	0	0	0	**7**
Zimbabwe	3	1	0	0	3	0	**7**
West Africa, unspecified*	16	2	1	2	2	1	**24**
Central Africa, unspecified*	1	0	0	0	0	0	**1**
East Africa, unspecified*	0	0	0	0	1	0	**1**
Africa, unspecified	24	9	5	2	7	1	**48**
Asia	**17**	**176**	**11**	**1**	**33**	**0**	**238**
Afghanistan	0	2	0	0	0	0	**2**
Bangladesh	1	0	0	0	1	0	**2**
Bhutan	0	1	0	0	0	0	**1**
Burma (Myanmar)	0	1	0	0	0	0	**1**
Cambodia	0	1	0	0	0	0	**1**
China	0	1	0	0	1	0	**2**
India	6	104	8	1	20	0	**139**
Indonesia	3	15	1	0	4	0	**23**
Iran	0	2	0	0	0	0	**2**
Korea (South)	0	21	1	0	2	0	**24**
Laos	1	0	0	0	0	0	**1**
Pakistan	0	11	1	0	3	0	**15**
Philippines	0	6	0	0	0	0	**6**
Saudi Arabia	1	0	0	0	0	0	**1**
Sri Lanka	0	1	0	0	0	0	**1**
Thailand	2	5	0	0	1	0	**8**
Turkey	1	0	0	0	0	0	**1**
Yemen	1	2	0	0	0	0	**3**
Middle East	1	0	0	0	0	0	**1**
Southeast Asia, unspecified	0	3	0	0	1	0	**4**

TABLE 3. (*Continued*) Imported malaria cases, by country of acquisition and *Plasmodium* species — United States, 2000

Country of acquisition	*Plasmodium* species						
	P. falciparum	*P. vivax*	*P. malariae*	*P. ovale*	Unknown	Mixed	Total
Central America and the Caribbean	**22**	**147**	**8**	**0**	**22**	**1**	**200**
Belize	1	2	0	0	0	0	**3**
Costa Rica	0	3	0	0	1	0	**4**
El Salvador	2	27	1	0	5	1	**35**
Guadeloupe	1	0	0	0	0	0	**1**
Guatemala	0	26	1	0	1	0	**28**
Haiti	14	0	0	0	1	0	**15**
Honduras	3	73	6	0	12	1	**95**
Nicaragua	1	12	0	0	0	0	**13**
Central America, unspecified	0	4	0	0	2	0	**6**
North America	**2**	**24**	**1**	**0**	**3**	**0**	**30**
Mexico	2	24	1	0	3	0	**30**
South America	**9**	**41**	**3**	**0**	**4**	**0**	**57**
Bolivia	0	1	0	0	0	0	**1**
Brazil	1	9	1	0	1	0	**12**
Columbia	1	2	0	0	0	0	**3**
Ecuador	4	24	1	0	1	0	**30**
Guyana	3	3	1	0	1	0	**8**
Peru	0	1	0	0	1	0	**2**
Surinam	0	1	0	0	0	0	**1**
Oceania	**2**	**17**	**1**	**0**	**2**	**0**	**22**
Papua New Guinea	2	14	1	0	2	0	**19**
Solomon Islands	0	3	0	0	0	0	**3**
Europe/Newly Independent States	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Unknown	**29**	**24**	**2**	**0**	**12**	**1**	**68**
Total	**609**	**521**	**66**	**32**	**161**	**9**	**1,398**

* **East, West, and Central Africa:** Angola, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde Islands, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Réunion, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Togo, Uganda, Tanzania, Zambia, and Zimbabwe.

TABLE 4. Number of imported malaria cases, by interval between date of arrival in the United States and onset of illness and *Plasmodium* species* — United States, 2000

Interval (days)	*P. falciparum*		*P. vivax*		*P. malariae*		*P. ovale*		Mixed		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
<0†	46	(11.9)	15	(7.8)	1	(3.8)	1	(8.3)	0	(0)	**63**	**(10.1)**
0–29	313	(80.9)	75	(38.9)	8	(30.8)	3	(25.0)	3	(60.0)	**402**	**(64.5)**
30–89	19	(4.9)	45	(23.3)	7	(26.9)	1	(8.3)	2	(40.0)	**74**	**(11.9)**
90–179	7	(1.8)	28	(14.5)	7	(26.9)	4	(33.3)	0	(0)	**46**	**(7.4)**
180–364	1	(0.3)	28	(14.5)	2	(7.7)	2	(16.7)	0	(0)	**33**	**(5.3)**
≥365	1	(0.3)	2	(1.0)	1	(3.8)	1	(8.3)	0	(0)	**5**	**(0.8)**
Total	**387**	**(100.0)**	**193**	**(100.0)**	**26**	**(100.0)**	**12**	**(100.0)**	**5**	**(100.0)**	**623**	**(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.
† Persons in these cases had onset of illness before arriving in the United States.

Imported Malaria Cases

Imported Malaria Among U.S. Military Personnel

In 2000, a total of 46 cases of imported malaria were reported among U.S. military personnel. Of the 45 cases for whom information regarding chemoprophylaxis use was available, seven patients were not using any prophylaxis.

Imported Malaria Among Civilians

A total of 1,179 imported malaria cases were reported among civilians. Of these, 825 (70.0%) cases occurred among U.S. residents, and 354 (30.0%) cases occurred among residents of other countries (Table 5). Of the 825 imported malaria cases among U.S. civilians, 555 (67.3%) had been acquired in Africa, an increase of 1.1% from cases reported in 1999. Asia accounted for 106 (12.8%) cases of imported malaria among U.S. civilians, whereas travel to the Central American and Caribbean regions accounted for an additional 90 (10.9%) cases. Of the 354 imported cases among foreign civilians, the majority of cases were acquired in either Africa (n = 150; 42.4%) or Asia (n = 90; 25.4%).

TABLE 5. Number of imported malaria cases among U.S. and foreign civilians, by region of acquisition — United States, 2000*

Area or region	United States No.	United States (%)	Foreign No.	Foreign (%)	Total No.	Total (%)
Africa	555	(67.3)	150	(42.4)	**705**	**(59.8)**
Asia	106	(12.8)	90	(25.4)	**196**	**(16.6)**
Central America/the Caribbean	90	(10.9)	81	(22.9)	**171**	**(14.5)**
South America	37	(4.5)	14	(4.0)	**51**	**(4.3)**
North America	11	(1.3)	15	(4.2)	**26**	**(2.2)**
Oceania	21	(2.5)	0	(0)	**21**	**(1.8)**
Europe/Newly Independent States	0	(0)	0	(0)	**0**	**(0)**
Unknown†	5	(0.6)	4	(1.1)	**9**	**(0.8)**
Total	**825**	**(100.0)**	**354**	**(100.0)**	**1,179**	**(100.0)**

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

Antimalarial Chemoprophylaxis Use

Chemoprophylaxis Use Among U.S. Civilians

Information concerning chemoprophylaxis use and travel area was known for 758 (91.9%) of the 825 U.S. civilians who had imported malaria. Of these 758 persons, 452 (59.6%) had not taken any chemoprophylaxis, and 94 (12.4%) had not taken a CDC-recommended drug for the area visited (*9*). Only 190 (25.1%) U.S. civilians had taken a CDC-recommended medication (*9*). Data for the specific drug taken were missing for the remaining 22 (2.9%) travelers. A total of 128 (67.4%) patients on CDC-recommended prophylaxis had taken mefloquine weekly; 22 (11.6%) had taken doxycycline daily; and 21 (11.1%) who had traveled only in areas where chloroquine-resistant malaria has not been documented, had taken chloroquine weekly. Nineteen patients (10.0%) had taken combinations of drugs that included ≥1 CDC-recommended drugs for the travel region. Of the 94 patients taking a nonrecommended drug, 54 (57.4%) reported taking chloroquine either alone or in combination with another ineffective drug during travel to an area where chloroquine resistance has been documented.

Malaria Infection After Recommended Prophylaxis Use

A total of 236 patients (i.e., 190 U.S. civilians, 32 persons in the U.S. military, 6 foreign civilians, and 8 persons whose information regarding their status was missing) experienced malaria after taking a recommended antimalarial drug for chemoprophylaxis. Information regarding infecting species was available for 209 (88.6%) patients taking a recommended antimalarial drug; the infecting species was undetermined for the remaining 27.

Cases of *P. vivax* or *P. ovale* After Recommended Prophylaxis Use. Of the 236 patients who experienced malaria after recommended chemoprophylaxis use, 121 cases (51.3%) were caused by *P. vivax* and 10 (4.2%) by *P. ovale*. Notes on the malaria case surveillance reports indicated that 25 (19.1%) of these 131 patients were noncompliant with antimalarial prophylaxis.

A total of 39 (29.8%) cases of *P. vivax* or *P. ovale* occurred >45 days after arrival in the United States. These cases were consistent with relapsing infections and, thus, do not indicate prophylaxis failures. Information was insufficient, because of missing data regarding symptom onset or return date, to assess whether 77 cases were relapsing infections. Fifteen cases, all caused by *P. vivax*, occurred ≤45 days after the patient returned (n = 12) or before return (n = 3) to the United States. Of these 15 patients, five were known to be noncompliant with their antimalarial chemoprophylaxis. Region of acquisition varied for the 10 remaining case patients who were not known to be noncompliant (one from West Africa, one from East Africa, one from Central Africa,† five from Central America, and two from Papua New Guinea). Blood samples were not available; therefore, serum drug levels were not measured for any of these patients. The probable explanations for these cases are either inappropriate dosing or noncompliance that was not reported. Evidence is lacking that would indicate any new area of chloroquine-resistant *P. vivax*.

Cases of *P. falciparum* and *P. malariae* After Recommended Prophylaxis Use. The remaining 105 cases of malaria reported among persons who had taken a recommended antimalarial drug for chemoprophylaxis include 61 cases of *P. falciparum*, 16 cases of *P. malariae*, one case of mixed infection, and 27 cases in which the infecting species was unidentified.

† **East, West, and Central Africa:** Angola, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde Islands, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Réunion, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Togo, Uganda, Tanzania, Zambia, and Zimbabwe.

A total of 59 of the 61 *P. falciparum* cases among those who reported taking a recommended antimalarial drug were acquired in Africa, one in the Caribbean, and one in South America. In 24 (39.3%) of these 61 cases, noncompliance with antimalarials was reported. Of the remaining 37 cases of *P. falciparum* for which patient compliance was unknown, the majority were acquired in Africa (n = 35): 24 in West Africa, seven in East Africa, one in Central Africa, one in Southern Africa,[§] and two in an unspecified African region. Two cases were acquired outside Africa: one in the Caribbean (Haiti) and one in South America (Brazil). Serum drug levels were not available for any of these 37 patients.

Eight of the 16 *P. malariae* cases among those who reported taking a recommended antimalarial drug were acquired in Africa. In three (18.8%) of these 16 cases, noncompliance with antimalarials was reported. In the 13 remaining cases, whether the patient complied with prophylaxis was unknown; four had traveled in the Americas, five in Africa, three in Asia, and one in Oceania.

Purpose of Travel

Purpose of travel to malaria-endemic areas was reported for 635 (77.0%) of the 825 U.S. civilians with imported malaria (Table 6). Of the U.S. civilians with malaria, the largest percentage (35.9%) were persons who had visited friends or relatives in malarious areas; the second and third largest percentages, 10.3% and 10.2%, had traveled for tourism and to do missionary work, respectively.

Malaria During Pregnancy

A total of 35 cases of malaria were reported among pregnant women in 2000, representing 7.8% of cases among women. Fifteen (42.9%) were among U.S. civilians. Eleven of these 15 women (73.3%) had traveled to visit friends and relatives, of whom 72.7% traveled in Africa. Only 1 pregnant woman (6.9%) reported taking prophylaxis, compared with 31.1% of nonpregnant women. Twelve women (86.7%) were hospitalized, compared with 56.3% of nonpregnant women.

[§] **Southern Africa:** Botswana, Lesotho, Namibia, Saint Helena, South Africa, and Swaziland.

TABLE 6. Number of imported malaria cases among U.S. civilians, by purpose of travel at the time of acquisition — United States, 2000

	Imported Cases	
Category	**No.**	**(%)**
Visiting friends/relatives	296	(35.9)
Tourism	85	(10.3)
Missionary or dependent	84	(10.2)
Business representative	60	(7.3)
Student/teacher	48	(5.8)
Peace Corps volunteer	21	(2.6)
Refugee/immigrant	1	(0.1)
Air crew/sailor	3	(0.4)
Other/mixed purpose	37	(4.5)
Unknown	190	(23.0)
Total	**825**	**(100.0)**

Malaria Acquired in the United States

Congenital Malaria

Two cases of congenital malaria were reported in 2000 and are described in the following case reports:

- **Case 1.** On September 7, 2000, a previously healthy 10-week-old female infant residing in North Carolina experienced fever and dark urine (*10*). Examination revealed a temperature of 103.7°F but no other abnormal findings. Laboratory studies included an elevated white blood cell count (24,600/µL) and low hemoglobin (8.7 g/dL). She was admitted to a local hospital to rule out sepsis, and intravenous therapy with ampicillin and cefotaxime was begun. On September 8, blood films for malaria were obtained and were reported the next day to contain *P. malariae*. Treatment with chloroquine was initiated. Bacterial cultures of urine, blood, and cerebrospinal fluid obtained at admission indicated no growth. The child's clinical status improved, and she was discharged on September 13, having completed chloroquine treatment in the hospital.

  The mother reported that her pregnancy had been uncomplicated, and the neonate had been born by cesarean delivery because of failure to progress during labor. The infant had not traveled outside her home city or received any blood products. Both parents had emigrated from the Democratic Republic of the Congo (formerly Zaire), the father 5 years previously and the mother 4 years previously. The mother reported being treated for malaria with a full course of chloroquine before leaving the Congo in 1996. Both parents reported no episodes of malaria, febrile illness, foreign travel, or blood transfusion after arriving in the United States.

  Pretreatment malaria testing of the mother with thick and thin blood films prepared at four different times did not indicate malaria parasites (drawn September 10, 12, 13, and 21). Subsequent serologic testing revealed positive immunoglobulin G (IgG) titers against *P. falciparum* and *P. malariae* (both 1:16,384), and against *P. vivax* and *P. ovale* (both 1:1,024), indicating previous infection with malaria. Polymerase chain reaction (PCR) analysis on blood collected on September 22 was negative for *Plasmodium* species. However, she was presumptively treated with chloroquine.

- **Case 2.** In November 2000, a male infant, aged 1 month, was admitted to a Georgia hospital because of poor oral intake and pallor. On examination, the baby was irritable and pale, with a heart rate of 95 beats/minute and mild hepatosplenomegaly. Laboratory examination revealed a hemoglobin of 2.5 g/dL, and a malaria blood film indicated *P. vivax*. The infant was treated with oral chloroquine and recovered without complications.

  The infant was born by normal spontaneous vaginal delivery to a Guatemalan mother, who reported a history of malaria in Guatemala in November 1999, for which she was treated with proguanil. She immigrated to the United States in March 2000, where she continued to do well until April. At that time, she reportedly experienced fever and chills and self-medicated with an unknown oral medication. The mother's thick and thin blood smears were negative, as was PCR. Immunofluorescent assay titers performed on the mother's serology were 1:256 to *P. vivax*, 1:64 to *P. falciparum*, 1:64 to *P. malariae*, and 1:64 to *P. ovale*, indicating prior infection with malaria.

Induced Malaria

Two cases of induced malaria were reported in 2000 and are described in the following case reports:

- **Case 1.** On August 4, 2000, a female nurse aged 55 years, sustained a needle-stick injury while caring for a patient in a Massachusetts hospital emergency department. The patient had returned recently from Cote d'Ivoire and had a fever. Infection with *P. falciparum* was diagnosed, and the patient responded well to treatment with quinine and doxycycline.

  On September 11, the nurse experienced fever, chills, and vomiting. Infection with *P. falciparum* was diagnosed, and the nurse was admitted to the hospital and treated successfully with quinine and doxycycline. She reported no travel to malaria-endemic areas nor transfusion of blood products.
- **Case 2.** On September 23, 2000, a man aged 71 years who had a history of hypertension, hypercholesterolemia, diabetes mellitus, and endocarditis was admitted to a Massachusetts hospital because of progressive weakness, nausea, and vomiting. Acalculous cholecystitis was diagnosed. Review of the complete blood count was suspicious for *Babesia*. The patient was administered a single dose of intravenous doxycycline and started on intravenous clindamycin at a dosage of 600 mg every 8 hours. Blood films sent to CDC revealed *P. falciparum*. Therapy was changed to quinine and doxycycline and the patient improved.

  The patient reported no recent travel, having been housebound for the previous 4–5 months because of his chronic illnesses. He had received 1 unit of packed red blood cells (PRBC) on July 7 and 13; he had also received 1 unit of PRBC, 6 units of platelets, and 6 units of fresh frozen plasma during coronary artery bypass graft and mitral valve repair on August 8, and 1 unit of PRBC for gastrointestinal bleeding on September 8. Five of the six platelet donors and all four PRBC donors were traced, and their blood films, PCR, and serology did not indicate malaria. One donor refused to cooperate with the trace-back investigation.

  Investigation revealed that a nurse, who had cared for this patient during his emergency room visit on September 8, had previously experienced *P. falciparum* malaria (see case 1 in this section). The nurse's exposure was thought to be from a needle-stick injury sustained at another local hospital on August 4. At that time, she had been caring for a patient who was diagnosed with *P. falciparum* after a trip to Cote d'Ivoire.

  PCR analysis demonstrated that the parasite identified in induced cases 1 and 2 are clonal (i.e., related). These results strongly imply that malaria was transmitted between the two persons. Technical difficulties with specimens from the Cote d'Ivoire patient prohibited PCR analysis to determine clonal identity.

Deaths Attributed to Malaria

Six deaths attributable to malaria were reported during 2000 and are described in the following case reports:

- **Case 1.** On January 16, 2000, a female aged 91 years who was a resident of a long-term care facility in California was evaluated by her physician and determined to have microcytic anemia (hemoglobin 8.3 g/dL), thrombocytopenia (platelet count: 53,000/µL), and renal insufficiency (blood urea nitrogen: 39 mg/dL and creatinine: 1.4 mg/dL). A blood film indicated *P. malariae*, and she was treated with chloroquine. Years had passed since she had traveled to a malarious area (China). Her course was complicated by pneumonia, and she died on January 26.
- **Case 2.** On May 5, 2000, a female aged 47 years and a resident of Kenya arrived in California to visit family. She visited a physician on May 16 with complaints of nausea and abdominal pain; a urinary tract infection was diagnosed, and she was treated with nitrofurantoin. She was examined at a California hospital the following day; she was jaundiced, and hepatitis was diagnosed. She refused hospitalization and insisted on continuing her

travels to Canada on May 18. She required a wheelchair for transport in the airport but was able to walk onto the airplane. While on the airplane she felt ill, vomited, and collapsed in the airplane's bathroom. The airplane was diverted to an airport in Nevada, and she was transported to an emergency department where she was found to be comatose and in acute respiratory failure. Her laboratory examinations revealed *P. falciparum* malaria (9.3% parasitemia) as well as metabolic acidosis, thrombocytopenia (platelet count: 13,000/µL), and abnormal liver function (aspartate aminotransferase: 117 U/L; alanine aminotransferase: 71U/L; total bilirubin: 8.2 mg/dL). Computerized tomography of the head indicated probable cerebral edema. Therapy with intravenous quinidine gluconate was begun. Her condition deteriorated, necessitating assisted ventilation. Her course was further complicated by supraventricular tachycardia and later bradycardia and hypotension unresponsive to therapy with intravenous fluids and vasopressors, and she died in the emergency department. Blood cultures, taken on arrival at the hospital, later grew both *Staphylococcus aureus* and coagulase-negative staphylococcus.

- **Case 3.** On November 7, 2000, a woman aged 24 years was examined in the emergency department of a Vermont hospital and was prescribed antibiotics. She was not admitted to the hospital and was found deceased 4 days later. She had recently been on a 3-month trip to Ghana, and she had begun experiencing symptoms within days after returning to the United States. She did not take prophylaxis during her travel in Africa. Her blood films revealed *P. falciparum*, and the state medical examiner reported the cause of death as cerebral malaria secondary to *P. falciparum*.
- **Case 4.** On September 22, 2000, a Senegalese man aged 39 years who reported a history of congestive heart failure (CHF), peptic ulcer disease, and hepatitis, was treated at a Georgia hospital. The patient had arrived in the United States approximately 2 months earlier to visit friends. On examination, he was diaphoretic, but without fever, and in moderate respiratory distress; he also had signs and symptoms consistent with CHF. The patient was admitted with a diagnosis of CHF and was treated with intravenous diuretics and inotropic agents. After admission, he became nauseated and febrile. Laboratory studies demonstrated abnormal liver function, although viral hepatitis serology tests were negative. *Plasmodium* parasites were identified on a malaria blood film (September 24), and treatment with quinine and doxycycline was begun. The species was subsequently identified as nonfalciparum malaria, and the treatment was changed to chloroquine. On September 26, the patient was lethargic with altered mental status, and he was transferred to the medical intensive care unit. On September 27, the patient suffered a cardiac arrest and was unable to be resuscitated. Species confirmation of blood films, taken during his admission, occurred postmortem and revealed *P. ovale*.
- **Case 5.** On April 3, 2000, a man aged 55 years with multiple medical problems was examined at an emergency department of a Florida hospital. He complained of generalized weakness, cough, and fever, and on examination, he was hypotensive and febrile (105ºF). Malaria was diagnosed (species undetermined), and the patient was admitted to the intensive care unit. He was initially treated with oral chloroquine and then oral quinine sulfate.

  His medical history included atrial fibrillation, sleep apnea, liver disease, and morbid obesity. The patient had been noncompliant with his regular medications before hospitalization. Moreover, the patient, a U.S. civilian, had recently traveled to Mexico, Nicaragua, Honduras, and Ecuador, and he had not taken any prophylaxis during this 6-week trip. He returned to the United States on March 30, a total of 4 days before admission to the hospital. His course was complicated by pulmonary embolism, cardiac arrhythmia (supraventricular tachycardia and atrial fibrillation), congestive cardiac failure, disseminated intravascular coagulation, renal failure, retroperitoneal bleeding, and malignant hyperthermia. He received multiple transfusions of blood products. On April 20, as he was being prepared for insertion of an inferior vena cava filter, he suffered a cardiac arrest and died. Species confirmation of blood films taken during his admission occurred postmortem and demonstrated *P. falciparum*.
- **Case 6.** On December 17, 2000, a male sailor from West Africa, aged 37 years, was admitted to a Florida hospital after a fall onboard his ship. He complained of generalized weakness, cough, and loss of appetite during the previous weeks. He had recently traveled from Liberia through Ghana and the Cape Verde Islands and arrived in Baltimore, Maryland, on December 12. While in Baltimore, he was seen by a physician and was prescribed erythromycin for his symptoms. He had not been taking any prophylaxis for malaria.

  On examination, he was febrile (101.6ºF), tachycardic (138 beats/minute) and jaundiced. His laboratory test results revealed a normal white blood cell count (8,100/µL), thrombocytopenia (platelets: 68,000/µL), and anemia (hemoglobin: 12.2 g/dL). He was admitted with

a diagnosis of malaria (*P. falciparum*) and acute renal failure, and treated with quinine and doxycycline. His hospital course was further complicated by respiratory failure and gastrointestinal (GI) bleeding. He was placed on assisted ventilation, and he received multiple blood transfusions for anemia secondary to malaria and GI bleeding. Subsequent malaria blood films, on December 20 and 21, did not indicate malaria parasites. However, the patient's condition continued to deteriorate and he experienced multiorgan failure. Despite supportive therapy, the patient died on January 5, 2001.

Discussion

A total of 1,402 cases of malaria were reported to CDC for 2000, representing a 9.0% decrease from the 1,540 cases reported for 1999. This change primarily resulted from a decrease in cases acquired in Africa and the Americas. Beginning in 2000, CDC routinely contacts state health departments to ask for outstanding reports from the previous reporting year or for a statement that reporting is complete. The decrease in cases in 2000, compared with 1999, possibly is a result of expected variation in the reporting system, although other possibilities include decreased international travel, changing patterns of travel (e.g., immigration from malarious areas or adventure tourism), or an increased use of effective antimalarial chemoprophylaxis.

One reason for conducting malaria surveillance is to monitor for prophylaxis failures that might indicate emergence of drug resistance; however, >70% of imported malaria among U.S. civilians occurred among persons who were either not taking prophylaxis or were taking nonrecommended prophylaxis for the region to which they were traveling. Among the 117 cases where appropriate prophylaxis was reported, 60 (i.e., 37 *P. falciparum*, 10 *P. vivax*, and 13 *P. malariae*) had insufficient information to determine whether these represented problems with adherence while using correct antimalarial chemoprophylaxis or emerging drug resistance. No conclusive evidence existed 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 are encouraged to contact CDC rapidly whenever they suspect chemoprophylaxis failure, thus enabling measurement of serum drug levels of the antimalarial drugs in question.

In 2001, to be better able to evaluate chemoprophylaxis failures, CDC revised the NMSS case report form to facilitate collection of more thorough data regarding chemoprophylaxis. The current form solicits more detailed information regarding the prescribed regimen, the degree of compliance with the regimen, and the reasons for noncompliance, if any. Data gathered from the responses will be useful in generating public health messages to improve use of antimalarial chemoprophylaxis, and therefore decrease malaria-associated morbidity and mortality among U.S. civilians.

The importance of taking correct precautions and chemoprophylaxis is underscored by the six fatal cases of malaria that occurred in the United States in 2000. An earlier review of deaths attributed to malaria in the United States identified certain risk factors for fatal malaria, including failure to take recommended antimalarial chemoprophylaxis, refusal of or delay in seeking medical care, and misdiagnosis (*11*).

The occurrence of 15 cases of malaria among pregnant U.S. civilians is cause for concern also. Malaria during pregnancy among nonimmune women is more likely to result in severe disease or contribute to an adverse outcome for the woman than malaria in a nonpregnant woman (*12*); the fetus might be adversely affected as well (*13*). Pregnant travelers should be counseled to avoid travel to malarious areas, if possible. If deferral of travel is impossible, pregnant women should be informed that the risks for malaria outweigh those associated with prophylaxis and that safe chemoprophylaxis regimens are available. Specific guidance for pregnant travelers is available from CDC's website at http://www.cdc.gov/travel/mal_preg_pub.htm.

Signs and symptoms of malaria are often nonspecific, but fever is usually 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 when evaluating febrile illnesses among international visitors, immigrants, refugees, migrant laborers, and international travelers.

Treatment for malaria should be initiated immediately after the diagnosis has been confirmed by a positive blood film. 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 (*14*). Although nonfalciparum malaria rarely causes complications, persons with *P. falciparum* infection are at risk for developing life-threatening complications.

Health-care workers should be familiar with prevention, recognition, and treatment of malaria and are encouraged to consult appropriate sources (Table 7) for malaria treatment recommendations or call CDC's National Center for Infectious Diseases, Division of Parasitic Diseases at 770-488-7788. Detailed recommendations for preventing malaria are

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

Type of information	Source	Availability	Telephone number, Internet address, or electronic mail address
Prophylaxis	CDC's voice information system	24 hours/day	877-394-8747
Prophylaxis	CDC's malaria facsimile	24 hours/day	888-232-3299
Prophylaxis	CDC's traveler's health Internet site	24 hours/day	http://www.cdc.gov/travel
Prophylaxis	*Health Information for International Travel*	Order from Public Health Foundation Publication Sales P.O. Box 753 Waldorf, MD 20604	877-252-1200 or 301-645-7773 or http://www.phf.org
Prophylaxis	*Health Information for International Travel*	24 hours/day	http://www.cdc.gov/travel
Diagnosis	CDC's Division of Parasitic Diseases Diagnostic Internet site (DPDx)	24 hours/day	http://www.dpd.cdc.gov/dpdx
Diagnosis	CDC's Division of Parasitic Diseases diagnostic CD-ROM (DPDx)	Order by electronic mail from CDC Division of Parasitic Diseases	dpdx@cdc.gov
Treatment*	CDC's Malaria Epidemiology Branch	8:00 am–4:30 pm Eastern Time, Monday–Friday	770-488-7788*
Treatment (after routine business hours)*	CDC's Malaria Epidemiology Branch	4:30 pm–8:00 am Eastern Time, weekends and holidays	404-639-2888* (Ask operator to page person on call for Malaria Branch)

* These telephone numbers are intended for use by health-care professionals only.

available 24 hours/day from CDC by telephone at 877-394-8747 (toll-free voice information system) or 888-232-3299 (toll-free facsimile request line), or on the Internet at http://www.cdc.gov/travel/diseases.htm#malaria. In addition, CDC biannually publishes recommendations in the Health Information for International Travel (*9*), which is available for purchase from the Public Health Foundation at 877-252-1200 or 301-645-7773; it is also available and updated more frequently on CDC's Internet site at http://www.cdc.gov/travel.

CDC provides support for the diagnosis of malaria through DPDx, a program that enhances diagnosis of parasitic diseases throughout the world. It includes an Internet site, http://www.dpd.cdc.gov/dpdx, that contains information regarding laboratory diagnosis, geographic distribution, clinical features, treatment, and life cycles of >100 parasite species. The DPDx Internet site is also a portal for diagnostic assistance for health-care providers through telediagnosis. Digital images captured from diagnostic specimens are submitted for diagnostic consultation through electronic mail. Because laboratories can transmit images to CDC and rapidly obtain answers to their inquiries, this system allows more efficient diagnosis of difficult cases and more rapid dissemination of information. Approximately 36 laboratories in 34 states have or are in the process of acquiring the hardware to perform telediagnosis.

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Appendix

Microscopic Procedures for Diagnosing Malaria

To establish the diagnosis of malaria, a blood film must be prepared from fresh blood obtained by pricking the patient's finger (Figures A-1 and A-2).* The thin film is fixed in methanol before staining; the thick film is stained unfixed. Certain hospitals have a Wright-Giemsa stain available, which is acceptable; however, Wright stain alone will not reliably indicate *Plasmodium* parasites. For best results, the film should be stained with a 3% Giemsa solution (pH of 7.2) for 30–45 minutes. In *P. falciparum* infections, the parasite density should be estimated by counting the percentage of red blood cells infected — not the number of parasites — under an oil immersion lens on a thin film.

Thick blood films are more sensitive in detecting malaria parasites because the blood is concentrated, allowing a greater volume of blood to be examined. However, thick films are more difficult to read, and thin films might be preferred by laboratories that have limited experience. *Plasmodium* parasites are always intracellular, and they demonstrate, if stained correctly, blue cytoplasm with a red chromatin dot. Common errors in reading malaria films are caused by platelets overlying a red blood cell, concern regarding missing a positive slide, and misreading artifacts as parasites. Persons suspected of having malaria, but whose blood films do not indicate the presence of parasites, should have blood films repeated approximately every 12–24 hours for 3 consecutive days. If films remain negative, then the diagnosis of malaria is unlikely.

For rapid diagnosis, the thick and thin films should be made on separate slides. The thin film should be air-dried, fixed with methyl alcohol, and immediately stained. If no parasites are visible on the thin film, the laboratorian should wait until the thick film is dry, then examine it for organisms that might not have been detected on the thin preparation.

* In Figures A-1 and A-2, the hands are illustrated ungloved to better indicate their placement during the procedures. However, wearing gloves while processing blood specimens is recommended to prevent transmission of bloodborne pathogens (*MMWR 1988;37:377–82, 387–8* and *MMWR 1987;36[No. S2]*).

FIGURE A-1. Blood collection for thin or thick blood films

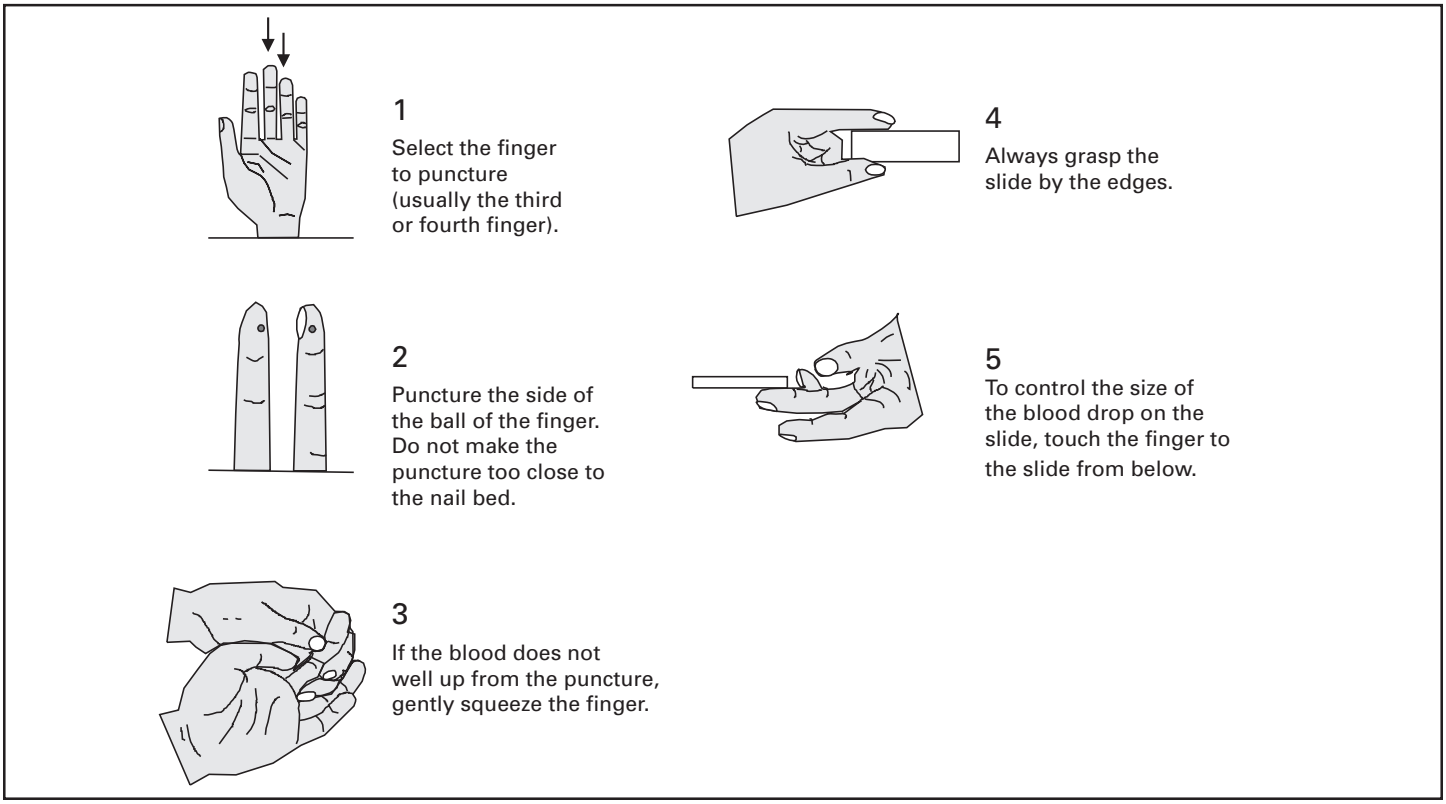
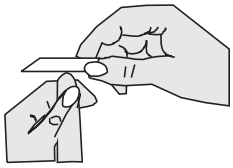
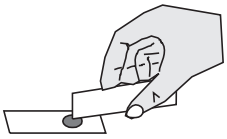


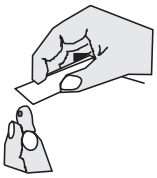
FIGURE A-2. Preparation of a thin and a thick blood film on the same slide



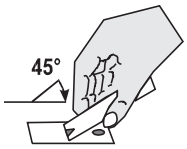
1
Touch the blood drop with a clean slide.



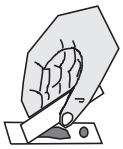
2
Using the corner of another slide, spread the blood drop into the shape of a circle or square of ~1cm^2.



3
Gently squeeze the patient's finger again, and touch the edge of a clean slide to the newly formed blood drop.



4
Take this slide and hold the edge that has the blood drop at an ~45º angle against the surface of the first slide. Wait until the blood completely spreads along the edge of the second slide.



5
While holding the second slide at the same angle, rapidly and smoothly push the slide forward.

6
Write the identification number on the slide. Wait until the thick film is completely dry before staining it.

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