

## Special Article

## THE CARE OF HIV-INFECTED ADULTS IN THE UNITED STATES

SAMUEL A. BOZZETTE, M.D., PH.D., SANDRA H. BERRY, M.A., NAIHUA DUAN, PH.D., MARTIN R. FRANKEL, PH.D., ARLEEN A. LEIBOWITZ, PH.D., DORIS LEFKOWITZ, PH.D., CAROL-ANN EMMONS, PH.D., J. WALTON SENTERFITT, R.N., M.P.H., MARC L. BERK, PH.D., SALLY C. MORTON, PH.D., AND MARTIN F. SHAPIRO, M.D., PH.D.,  
FOR THE HIV COST AND SERVICES UTILIZATION STUDY CONSORTIUM\*

**ABSTRACT**

**Background and Methods** In order to elucidate the medical care of patients with human immunodeficiency virus (HIV) infection in the United States, we randomly sampled HIV-infected adults receiving medical care in the contiguous United States at a facility other than a military, prison, or emergency department facility during the first two months of 1996. We interviewed 76 percent of 4042 patients selected from among the patients receiving care from 145 providers in 28 metropolitan areas and 51 providers in 25 rural areas.

**Results** During the first two months of 1996, an estimated 231,400 HIV-infected adults (95 percent confidence interval, 162,800 to 300,000) received care. Fifty-nine percent had the acquired immunodeficiency syndrome according to the case definition of the Centers for Disease Control and Prevention, and 91 percent had CD4+ cell counts of less than 500 per cubic millimeter. Eleven percent were 50 years of age or older, 23 percent were women, 33 percent were black, and 49 percent were men who had had sex with men. Forty-six percent had incomes of less than \$10,000 per year, 68 percent had public health insurance or no insurance, and 30 percent received care at teaching institutions. The estimated annual direct expenditures for the care of the patients seen during the first two months of 1996 were \$5.1 billion; the expenditures for the estimated 335,000 HIV-infected adults seen at least as often as every six months were \$6.7 billion, which is about \$20,000 per patient per year.

**Conclusions** In this national survey we found that most HIV-infected adults who were receiving medical care had advanced disease. The patient population was disproportionately male, black, and poor. Many Americans with diagnosed or undiagnosed HIV infection are not receiving medical care at least as often as every six months. The total cost of medical care for HIV-infected Americans accounts for less than 1 percent of all direct personal health expenditures in the United States. (N Engl J Med 1998;339:1897-904.)

©1998, Massachusetts Medical Society.

**A**LTHOUGH much has been learned about the care of persons with human immunodeficiency virus (HIV) infection, there are persistent questions about the population under care, how much care they receive, where they get it, what it costs, and who pays for it. Unbiased answers to questions such as these are crucial to understanding the care of HIV-infected people, whether new research is being translated into practice, and where future clinical and policy challenges will lie. The generalizability of available studies has been limited by the use of patient groups selected because of location, convenience of sampling, or some other arbitrary reason.<sup>1-3</sup> For example, the HIV Outpatient Study Investigators' report of clinical success with highly active antiretroviral regimens is valuable, but the experience in the elite clinics included in the study may be atypical of what happens in other settings.<sup>4</sup>

Data from representative national cohorts provide a context for the interpretation of studies of local or convenience cohorts. Only representative national data

From RAND Health, Santa Monica, Calif. (S.A.B., S.H.B., N.D., A.A.L., J.W.S., S.C.M., M.E.S.); the Veterans Affairs San Diego Healthcare System, San Diego, Calif., and the University of California at San Diego, La Jolla (S.A.B.); the University of California at Los Angeles (A.A.L., M.E.S.); the National Opinion Research Center, Chicago (M.R.F., C.-A.E.); Baruch College, City University of New York, New York (M.R.F.); Project Hope, Bethesda, Md. (M.L.B.); and the Agency for Health Care Policy and Research, Rockville, Md. (D.L.). Address reprint requests to Dr. Bozzette or Dr. Shapiro, HCSUS Office, RAND, 1700 Main St., Santa Monica, CA 90407-2138.

Other authors were Ronald M. Andersen, Ph.D., William E. Cunningham, M.D., M.P.H., Marvin Marcus, D.D.S., M.P.H., and Neil S. Wenger, M.D., University of California at Los Angeles; Leslie A. Athey, M.S., and Stephen M. Smith, M.A., National Opinion Research Center, Chicago; Eric G. Bing, M.D., Drew University, Los Angeles; Julie A. Brown, B.A., M. Audrey Burnham, Ph.D., Dana P. Goldman, Ph.D., David E. Kanouse, Ph.D., Joan W. Keesey, B.A., Daniel F. McCaffrey, Ph.D., Judith F. Perlman, M.A., and Mark A. Schuster, M.D., Ph.D., RAND Health, Santa Monica, Calif.; Paul D. Cleary, Ph.D., Harvard Medical School, Boston; John A. Fleishman, Ph.D., Agency for Health Care Policy and Research, Rockville, Md.; Ron D. Hays, Ph.D., RAND Health, Santa Monica, Calif., and the University of California at Los Angeles; J. Allan McCutchan, M.D., and Douglas Richman, M.D., University of California at San Diego, La Jolla.

\*The other members of the HIV Cost and Services Utilization Study Consortium are listed in the Appendix.

can directly address issues for the nation as a whole. For these reasons, the HIV Cost and Services Utilization Study used probability sampling to assemble a nationally representative cohort of HIV-infected persons receiving regular medical care and of their providers.<sup>5</sup>

## METHODS

### Study Sample

We used multistage national probability sampling to select the study cohort.<sup>6</sup> The reference population was made up of persons at least 18 years of age with known HIV infection who made at least one visit for regular care in the contiguous United States to a private, federal, or other government facility other than a military or prison hospital or emergency department between January 5 and February 29, 1996 — except for one city where sampling began and ended two months later.<sup>7,8</sup> In the first stage of sampling, we randomly selected 28 metropolitan statistical areas and 24 clusters of rural counties that, in the aggregate, contained nearly 70 percent of all U.S. cases of the acquired immunodeficiency syndrome (AIDS).<sup>7,8</sup> In the second stage, we randomly selected 58 institutional or individual providers known to care for patients with HIV infection (known HIV providers) in urban areas and 28 in rural areas, who had been identified by local physicians or public health officials, as well as 87 “other providers” in urban areas and 23 in rural areas, who had confirmed in a screening survey of approximately 4000 physicians that they cared for eligible patients with HIV. In the third stage, we randomly selected anonymous patients (identified by unique codes) from lists of all eligible patients seen at the outpatient or inpatient services of participating providers during January and February 1996.

In the first two stages, we set sampling rates proportionate to case load. In the third stage, we set sampling rates to equalize the probability of selection within subgroups while increasing the overall sampling rate for women and members of private staff-model health maintenance organizations. We removed duplicate codes from lists of patients so that each patient appeared only once on a list, regardless of the number of visits he or she made to the provider, and we used adjustment for multiplicity (discussed below) to compensate for the fact that some patients visited more than one provider.

After the replacement of a single urban provider with an equivalent one in the same community, we obtained agreement to participate from 100 percent of known providers in urban areas and 79 percent in rural areas, 70 percent of other providers in urban areas and 83 percent in rural areas, and 84 percent of the selected patients. We interviewed 76 percent of the 4042 patients selected, 2864 of whom provided full interviews. The coverage rate, or the ratio of the population directly represented to the population that would have been represented if all patients and providers had participated, was 68 percent for long-form interviews and 87 percent for the combination of long-form, short-form, and proxy interviews and forms completed by providers when no interview was possible (nonresponse forms).

For each respondent, we constructed an analytic weight to adjust the sample to represent the entire reference population. Each weight, which can be interpreted as the number of persons represented by that respondent, is the product of the sampling weight, which adjusts for differential sampling probabilities, a “multiplicity weight,” which adjusts for patients who could have entered the sample through their visits to multiple providers, and a “nonresponse weight,” which adjusts for differences in rates of cooperation.<sup>9</sup> We also developed alternative weights to extrapolate from the study reference population of persons seen in the first two months of 1996 to the population receiving care, which we defined as those who would have been seen during a typical six-month period in that year. That is, we used these alternative weights to adjust for the exclusion from the reference population of some persons who were seen at intervals greater than two months.

Centrally trained personnel from the National Opinion Re-

search Center used computer-assisted personal interviewing to conduct all interviews.<sup>10</sup> Ninety-two percent of interviews were conducted in person, and the remainder were conducted over the telephone. Shortened or proxy interviews were attempted or non-response forms obtained whenever full interviews were unobtainable. We approached subjects for interviews only after their providers obtained their permission. The RAND institutional review board and, if available, a local board reviewed all forms and materials.

### Statistical Analysis

We analyzed data from the base-line interview, which had a maximal recall period of six months, along with selected data from the first follow-up interview. Base-line interviews began in January 1996 and ended 15 months later. We incorporated the analytic weights mentioned above into all analyses. We adjusted all standard errors and statistical tests to compensate for the complex sample design and differential weighting by means of linearization methods available in the SUDAAN and Stata software packages.<sup>11</sup> We used randomly drawn “donor” responses within strata of respondents (“hot deck” imputation) to fill in less than 5 percent of CD4+ lymphocyte counts for which data were missing, less than 3 percent of insurance and income values, and less than 0.5 percent of other essential missing values.<sup>12</sup>

We estimated the use of pharmaceuticals from patients’ reports and estimates by experts of typical daily doses. We estimated costs on the basis of average prices for a monthly supply of the appropriate medication and dosage, including fees for dispensing or administration, from a national retail pharmacy, a university hospital participating in a buying consortium, and a federal distributor. Prices for services were estimated both on the basis of reimbursement data from the AIDS Cost and Service Utilization Study with adjustment for inflation according to the Medical Price Index and on the basis of current weighted average Medicare reimbursement rates for the cities in the study.<sup>3,13</sup> This procedure resulted in the assignment of costs of \$200, \$338, and \$1,606 to services associated with outpatient visits, emergency department visits, and hospital days, respectively.

## RESULTS

### Population Size and Characteristics

We estimated that 231,400 (95 percent confidence interval, 162,800 to 300,000) adults with known HIV infection received medical care at eligible sites during the first two months of 1996 (Table 1). On the basis of the patients’ reports, the lowest-ever CD4+ lymphocyte count was less than 50 cells per cubic millimeter for 54,600 patients (24 percent), 50 to 199 cells per cubic millimeter for 68,200 patients (29 percent), 200 to 499 cells per cubic millimeter for 86,700 patients (37 percent), and 500 cells per cubic millimeter or higher for 21,900 patients (10 percent). Clinical stage, sex, employment status, and type of insurance were most strikingly associated with the CD4+ lymphocyte count. Only 24,200 patients (10 percent) had asymptomatic disease (Centers for Disease Control and Prevention [CDC] stage A), whereas 118,400 (51 percent) had symptomatic disease (CDC stage B) and 88,800 (38 percent) reported a history of an AIDS-defining illness (CDC stage C). Overall, 135,500 (59 percent) met the CDC case definition for AIDS.

Seventy-seven percent (179,200) of the patients were men, and 89 percent (205,000) were less than

**TABLE 1.** CHARACTERISTICS OF THE 231,400 HIV-INFECTED PERSONS ACCORDING TO CD4+ CELL COUNT.\*

CHARACTERISTIC	ALL PATIENTS no. ±SE (%)	CD4+ COUNT/mm <sup>3</sup>		
		0-199	200-499	≥500
		percent		
CD4+ count				
0-199/mm <sup>3</sup>	122,800±18,500 (53)	—	—	—
200-499/mm <sup>3</sup>	86,700±13,700 (37)	—	—	—
≥500/mm <sup>3</sup>	21,900±3400 (10)	—	—	—
Clinical stage				
Asymptomatic (CDC stage A)	24,200±4300 (10)	27	53	20
Symptomatic (CDC stage B)	118,400±17,900 (51)	34	52	13
Clinical AIDS (CDC stage C)	88,800±13,400 (38)	85	13	1
Age				
18-34 yr	79,100±11,400 (34)	47	41	11
35-49 yr	125,900±19,000 (54)	56	35	9
≥50 yr	26,400±5300 (11)	56	36	8
Sex				
Male	179,200±23,700 (77)	56	36	8
Female	52,200±11,900 (23)	43	43	14
Race or ethnic group				
Non-Hispanic white	114,000±17,100 (49)	56	36	7
Non-Hispanic black	75,800±12,900 (33)	47	40	13
Hispanic	34,200±7800 (15)	55	35	10
Other	7400±1400 (3)	59	34	7
Risk category				
Injection-drug use	55,800±11,900 (24)	56	34	9
Men reporting sex with men	112,400±14,500 (49)	55	38	7
Heterosexual contact	42,700±10,500 (18)	41	44	15
Other	20,500±3900 (9)	58	31	11
Education				
High school or less	121,200±24,000 (52)	51	39	10
Some college or more	110,200±13,300 (48)	56	36	9
Employment status				
Employed	86,300±13,700 (37)	41	47	12
Unemployed	145,100±23,000 (63)	60	32	8
Household income				
<\$5,000	45,600±8700 (20)	45	44	11
\$5,000-9,999	59,700±10,300 (26)	58	32	10
\$10,000-24,999	60,200±8700 (26)	54	37	10
≥\$25,000	65,900±10,800 (28)	53	39	8
Insurance				
Medicare with or without other insurance	44,300±6600 (19)	65	29	6
Private	73,700±12,000 (32)	52	39	9
Medicaid alone	67,600±13,300 (29)	56	34	10
None	45,700±8800 (20)	39	49	13
Region†				
Northeast	57,100±17,100 (25)	58	33	10
Midwest	25,700±7100 (11)	58	32	11
South	83,000±31,000 (36)	51	41	8
West	65,700±13,900 (28)	51	39	11
Type of provider‡				
Known HIV provider	161,800±18,700 (70)	53	38	9
Other HIV provider	69,600±69,600 (30)	54	36	10

\*Numbers of patients are estimates based on a nationally representative sample consisting of 2864 HIV-infected persons. The associations between the CD4+ cell count and all other variables are significant (P<0.001). Because of rounding, percentages may not total 100.

†The regions correspond to those used in the U.S. Census.

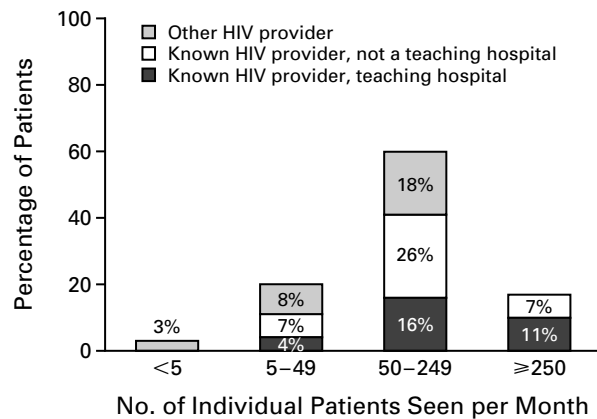
‡For an explanation of the categories, see the Methods section.

50 years old. Approximately half (114,000) were non-Hispanic whites, one third were non-Hispanic blacks (75,800), and almost one sixth (34,200) were Hispanic. Most of the others were Asian, Pacific Islanders, or Native Americans (1 percent each). Forty-nine percent (112,400) of patients were men who had had sex with men but reported no injection-drug use, and 24 percent (55,800) reported injection-drug use, with or without other risk behaviors. The remainder included 18 percent (42,700) who reported only heterosexual sex and 9 percent (20,500) who reported no known risk factors. Forty-eight percent of the patients (110,200) had some college education, and 37 percent (86,300) were employed. Forty-six percent (105,300) had annual household incomes of less than \$10,000 per year, and 72 percent (165,500) had household incomes of less than \$25,000 per year. Thirty-two percent of the patients (73,700) had private health insurance, 29 percent (67,600) were covered only by Medicaid, 20 percent (45,700) had no insurance, and 19 percent (44,300) of patients were covered by Medicare, usually in conjunction with Medicaid.

The Midwest accounted for 11 percent of the patients (25,700), for a rate of about 42 patients per 100,000 population.<sup>14</sup> The Northeast and the West accounted for 25 percent (57,100 patients) and 28 percent (65,700 patients), respectively, and similar rates of about 112 patients per 100,000. The South accounted for 36 percent of the patients (83,000), for a rate of about 90 per 100,000. Providers known to care for substantial numbers of patients with HIV (known providers) saw 70 percent of the patients (161,800); teaching institutions saw 42 percent of this group, or 30 percent of all patients (69,100) (Fig. 1). Practices with case loads of at least 250 individual HIV-infected patients per month saw 18 percent (41,700) of the patients, those with case loads of 50 to 249 saw 60 percent (138,600), those with case loads of between 5 and 49 saw 19 percent (43,600), and those with fewer than 5 patients saw only 3 percent (7500) of the patients.

#### Contrasts in the HIV-Infected Population

All the associations shown in Table 2 except that between type of provider and sex or risk group were significant at  $P \leq 0.05$ . As compared with men, women were less likely to have had an AIDS-defining illness (29 percent vs. 41 percent) and more likely to be young (age <35 years old, 44 percent vs. 31 percent) and black (54 percent vs. 27 percent) (Table 2). Women were also less highly educated (high school or less, 73 percent, vs. 46 percent for men) and less likely to be employed (not employed, 76 percent vs. 59 percent). Consequently, they were more often impoverished (annual household income <\$5,000 per year, 30 percent vs. 17 percent) and underinsured (no private insurance, 85 percent vs. 63 percent). As



**Figure 1.** Sources of Care Received by HIV-Infected Adults.

The categories of providers are explained in the Methods section. Teaching institutions are affiliates of medical schools or have their own accredited programs.

compared with the other risk groups, men who had had sex with men were more highly educated (some college, 65 percent vs. 27 to 39 percent), were more likely to be employed (50 percent vs. 21 to 30 percent), and had higher incomes (annual household income  $\geq$ \$25,000, 43 percent vs. 13 to 18 percent). They were also more likely to have private insurance (47 percent vs. 15 to 25 percent) and to live in the West (43 percent vs. 10 to 20 percent). The West was the only region where a majority of the patients represented (51 percent) had private insurance, but it was also common in the Midwest (41 percent). Private insurance was uncommon in the Northeast (19 percent), where most of the patients without private insurance were covered by Medicaid, and in the South (23 percent), where most of those without private insurance were uninsured. As expected, reliance on public insurance was associated with advanced disease.

#### Use and Direct Cost of Medical Care

The 231,400 patients in the reference population made 1.95 million outpatient visits, or 1.4 visits per person per month, in the six months before the base-line interview. One third of the population made at least 1 visit to an emergency department; there were a total of 154,000 visits over six months. Twenty percent of the population was hospitalized, using a total of 694,000 days of hospital care, or 10.4 days per hospitalized patient per six months. Eighty-five percent used at least one medication for HIV, and 79 percent used an antiretroviral drug during the six months before the interview. Sixty-one percent used antiretroviral drugs in combination, so that the population had a total of 61.6 million days of antiretroviral therapy in the six months before the interview. The pattern of use of protease inhibitors and non-nucleoside reverse-transcriptase

CARE OF HIV-INFECTED ADULTS IN THE UNITED STATES

TABLE 2. CHARACTERISTICS OF THE 231,400 HIV-INFECTED PERSONS, ACCORDING TO SEX, RISK CATEGORY, REGION, AND TYPE OF INSURANCE.\*

CHARACTERISTIC	SEX†		RISK CATEGORY‡				REGION§				TYPE OF INSURANCE¶			
	MALE	FEMALE	INJECTION- DRUG USE	MEN REPORTING SEX WITH MEN	HETERO- SEXUAL CONTACT	OTHER	NORTH- EAST	MID- WEST	SOUTH	WEST	MEDICARE WITH OR WITHOUT OTHER INSURANCE	PRIVATE	MEDICAID ALONE	NONE
percent														
Clinical stage														
Asymptomatic (CDC stage A)	11	8	7	11	11	14	11	8	11	9	4	14	8	14
Symptomatic (CDC stage B)	48	63	51	48	61	50	51	44	53	52	39	51	51	63
AIDS (CDC stage C)	41	29	42	41	28	36	38	48	36	39	57	35	41	23
CD4+ count														
0-199/mm <sup>3</sup>	56	43	56	55	41	58	57	58	51	51	65	52	56	39
200-499/mm <sup>3</sup>	36	43	34	38	44	31	33	32	41	39	29	39	34	49
≥500/mm <sup>3</sup>	8	14	9	7	15	11	10	11	8	11	6	9	10	13
Age														
18-34 yr	31	44	22	37	46	27	31	31	49	33	25	28	38	47
35-49 yr	56	48	67	54	44	45	58	58	41	53	57	61	52	45
≥50 yr	12	8	11	9	10	28	11	11	10	14	17	11	10	9
Sex														
Male	—	—	74	100	37	50	65	79	74	93	84	90	61	75
Female	—	—	26	0	63	50	35	21	26	7	16	10	39	25
Race or ethnic group														
Non-Hispanic white	56	25	39	67	23	32	33	61	42	68	53	70	30	41
Non-Hispanic black	27	54	39	16	58	53	42	36	44	9	34	15	48	37
Hispanic	14	18	19	12	18	13	23	3	11	17	10	11	19	18
Other	3	2	3	4	2	3	2	1	2	6	3	3	3	3
Risk category														
Injection-drug use	23	28	—	—	—	—	45	11	20	17	28	11	40	18
Men reporting sex with men	62	—	—	—	—	—	23	64	42	73	48	71	24	49
Heterosexual contact	9	51	—	—	—	—	25	16	24	6	15	11	27	22
Other	6	20	—	—	—	—	8	10	13	4	10	7	9	11
Education														
High school or less	46	73	68	35	73	61	63	49	63	31	56	26	73	60
Some college or more	54	27	32	65	27	39	37	51	37	69	44	74	27	40
Employment status														
Employed	41	24	21	50	30	27	21	40	36	53	8	72	9	51
Not employed	59	76	79	50	70	73	79	60	64	47	92	28	91	49
Household Income														
<\$5,000	17	30	29	11	27	26	23	16	27	10	16	3	33	31
\$5,000-9,999	24	34	34	19	30	32	36	25	25	18	43	5	40	22
\$10,000-24,999	26	26	24	26	28	24	23	29	28	25	28	4	22	33
≥\$25,000	34	10	13	43	14	18	18	30	20	47	13	68	5	14
Type of insurance														
Medicare with or without other insurance	21	13	22	19	15	21	20	22	19	17	—	—	—	—
Private	37	15	15	47	19	25	19	41	23	51	—	—	—	—
Medicaid alone	23	50	49	14	42	30	50	25	28	14	—	—	—	—
None	19	21	15	20	23	24	11	12	30	18	—	—	—	—
Region														
Northeast	21	39	46	12	34	21	—	—	—	—	26	15	42	13
Midwest	11	11	5	15	10	12	—	—	—	—	13	14	9	7
South	34	42	30	31	47	54	—	—	—	—	35	26	35	54
West	34	9	20	43	10	12	—	—	—	—	25	45	14	26
Type of provider														
Known HIV provider	70	71	69	70	73	66	63	97	71	64	69	58	70	89
Other HIV provider	30	29	31	30	28	34	37	3	29	36	31	42	30	11

\*Percentages shown are column percentages, which, because of rounding, do not always total 100.

†The associations of sex and risk category with type of provider were not significant at the P=0.05 level. All other characteristics were significantly associated with sex and risk category (P≤0.001).

‡For an explanation of the risk categories, see the Methods section.

§The regions correspond to those used in the U.S. Census. Region was significantly associated with clinical stage (P=0.05), type of provider (P<0.01), and all other characteristics shown (P≤0.001).

¶Type of insurance was significantly associated (P≤0.001) with all characteristics other than clinical stage and type of provider.

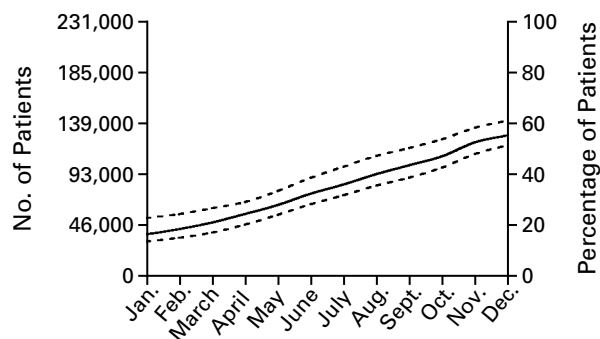
inhibitors changed rapidly during 1996. According to estimates of the date of first use for the whole cohort, about 16 percent of the patients had used one of the newer drugs by January 31, 36 percent by July 31, and 55 percent by December 31, 1996 (Fig. 2).

We used average prices for services to estimate the direct cost of medical care, which excludes the cost of home or domiciliary care, durable equipment, and the like. For the reference population, the estimated annual expenditures were \$5.1 billion, or \$22,200 per patient per year. This includes \$2.0 billion (40 percent of the total) for pharmaceuticals, \$2.2 billion (43 percent) for hospital care, \$0.1 billion (2 percent) for emergency department care, and \$0.8 billion (15 percent) for other outpatient care and associated tests.

#### The Population under Care

The models generating alternative weights that we used to extrapolate from the reference population to the population receiving care during a typical six-month period in 1996 yielded population size estimates ranging from 292,000 to 372,000 and centering on 335,000. This suggests that extending the sampling period to six months would have resulted in a sample that directly represented about 60,000 to 140,000 additional persons.

We used analyses incorporating the alternative weights to correct for the underrepresentation of persons in the reference population who made visits at intervals of more than two months. The results of these analyses suggest that the population seen during the six-month period varies from the reference population seen over a two-month period by no



**Figure 2.** Use of Protease Inhibitors and Non-Nucleoside Reverse-Transcriptase Inhibitors during 1996.

The solid line represents an estimate of the number and proportion of HIV-infected patients who were treated with protease inhibitors or non-nucleoside reverse-transcriptase inhibitors during each month. The lower dotted line shows patients who definitely used these drugs during each month, and the upper dotted line shows the maximal number that could have used these drugs each month.

more than 3 percent for all of the characteristics listed in Table 1 (data not shown). Moreover, a six-month population would have used about 2,080,000 outpatient visits, 214,500 emergency department visits, 963,500 hospital days, and 85.0 million patient-days of antiretroviral therapy per six months. Annual expenditures by this population would have been about \$6.7 billion, or roughly \$20,000 per patient per year.

#### DISCUSSION

The quarter-million adults who received care for HIV in the United States during the first two months of 1996 were strikingly different from the general population. As compared with others in the nonelderly population, adult patients with HIV were about half as likely to be women, to be employed, to have a household income above the 25th percentile, or to have private insurance.<sup>14-16</sup> Although adult patients with HIV were only about one fifth more likely to lack health insurance than the general population, they were three times as likely to be insured by Medicaid and nine times as likely to have Medicare coverage.<sup>16</sup> This is true despite the fact that the educational level of patients with HIV and the general population appears to be similar, with just less than half of both groups reporting some college education.<sup>17</sup>

There were large variations in the characteristics of the patients according to race, sex, stage of disease, and region of the United States. For example, as compared to HIV-infected men, HIV-infected women were about twice as likely to be black, to have an annual household income of less than \$5,000, or to lack private health insurance (Table 2). Overall, 68 percent of all patients relied on public programs or personal assets to finance their care, but patients in the Midwest and West were roughly twice as likely as others to have private insurance. Moreover, there were 2 uninsured patients for every 10 patients covered by Medicaid in the Northeast, but 11 for every 10 in the South. This variable and fragmented financing of care will be an increasingly important concern as survival improves and the prevalence of HIV infection increases in subgroups less likely to have private insurance.

Concern about patients' ability to pay for care does not imply that the total cost of care for HIV is inordinate. Data from both our study and the National Center for Health Statistics indicate that patients with HIV account for only about 1 percent of all hospital days in the United States.<sup>16</sup> Similarly, the \$6.7 billion in direct expenditures for care for HIV-infected adults seen every six months was less than 1 percent of the over \$700 billion in U.S. expenditures for personal health care in 1996.<sup>16</sup> This proportion is not excessive, considering that HIV infection, at its peak, accounted for about 7 percent of the total potential years of life lost in the United States,

or more than pneumonia, influenza, chronic obstructive pulmonary disease, diabetes mellitus, and chronic liver disease combined.<sup>16,18</sup> Therefore, the crisis in expenditures for patients with HIV disease appears to be one of financing, not cost.

The components of the expenditures for care for HIV-infected patients are also of interest. In 1996, hospital care was the most expensive component, but the costs of pharmaceuticals were already double the amount spent on all the components of outpatient care other than pharmaceuticals. We expect this proportion to increase and hospital expenditures to decline with the increasing use of highly effective combination antiretroviral therapy. Although the use of newer antiretroviral drugs across the country falls short of that achieved in the HIV Outpatient Study, the rapid increase in the use of these drugs during 1996 is impressive.<sup>4</sup> This rapid diffusion of new treatments is consistent with our finding that the vast majority of patients are seen by providers who are experienced in caring for patients with HIV infection and who are likely to adopt new antiretroviral regimens early on.

The majority of patients receiving care for HIV infection had indications for antiretroviral therapy.<sup>18,19</sup> That is, about 60 percent had AIDS according to the CDC case definition and for about 90 percent the lowest CD4+ lymphocyte count was below 500 cells per cubic millimeter. This contrasts with natural-history studies that estimate the respective proportions to be about one third and two thirds of all persons with known or unrecognized HIV infection.<sup>20,21</sup> Moreover, the extrapolations from our reference population to the population of HIV-infected persons seen by providers during a six-month period suggest that over 85 percent of adults estimated to have AIDS, as defined by the CDC, saw a doctor at least every six months.<sup>22</sup> This implies that the HIV-infected adults who are not receiving regular care are primarily those with early and quite possibly unrecognized HIV infection.

A comparison of the range of our point estimates of the number of adults seen every six months (292,000 to 372,000) with the range of CDC estimates of the number of persons with known or unknown HIV infection (650,000 to 900,000) gives a rough estimate of the adult population of HIV-infected persons not receiving care in the United States.<sup>23</sup> In making this comparison, we first removed those not included in the reference population from the CDC estimates. That is, we subtracted about 0.5 percent for adolescents, about 4 percent for Americans living outside the contiguous United States, a similar percentage for those in the military or in prison, and the estimated 10,000 children with HIV infection.<sup>22,24-26</sup> The resulting analysis suggested that 36 to 63 percent of all nonmilitary, nonincarcerated adults in the contiguous United States with known or unknown

HIV infection see a provider outside of an emergency room at least every six months.

In summary, we used national probability sampling to characterize a specified population of HIV-infected persons receiving regular medical care in the United States. The results demonstrate that it is feasible to obtain comprehensive, nationally representative data on particular chronic illnesses. Our most important initial findings are that the characteristics of those receiving care vary widely but are generally very different from those of the general population, that major teaching hospitals care for 30 percent of patients, that many Americans with early and probably unrecognized HIV infection are not receiving regular care, and that the cost of care for HIV infection is not inordinate, considering the morbidity and mortality associated with the disease.

Supported by a cooperative agreement (U-01HS08578) between RAND and the Agency for Health Care Policy and Research and by the Health Resources and Services Administration, the National Institute of Mental Health, the National Institute on Drug Abuse, and the National Institutes of Health Office of Research on Minority Health through the National Institute of Dental Research, the Robert Wood Johnson Foundation, Merck and Company, Glaxo Wellcome, Bristol-Myers Squibb, Quest Diagnostics, the National Institute on Aging, and the Office of the Assistant Secretary for Planning and Evaluation in the U.S. Department of Health and Human Services. Dr. Duan is a senior fellow in statistics at RAND. Dr. Bozzette is a Health Services Research and Development Senior Research Associate of the Department of Veterans Affairs.

*We are indebted to the participating subjects and sites, the staff at RAND, the RAND Survey Research Group, the University of California at Los Angeles, the University of California at San Diego, and the National Opinion Research Center.*

## APPENDIX

In addition to the authors, the members of the HIV Cost and Services Utilization Study Consortium were as follows: *Sponsor Representatives* — R. Arnett, L. Cohen, I. Garcia, S. Genser, F. Hellinger, D. Hsia, E. Kousvelari, W. Maas, K.M. Magruder, K. Malitz, K.M. Marconi, M. McKinney, S. Niemcryk, M. Ory, J. Polinicek, V. Smeriglio, B. Vitiello, and N. Weissman; *Collaborators* — B.L. Allen, K.M. Anastos, P. Arno, S. Asch, G. Bowie, R.L. Brandt, Jr., L.S. Brown, Jr., R. Bussing, A.D. Carter, M. Chesney, D. Cleri, D.L. Cohn, S.E. Cohn, A.C. Collier, R. Collins, I. Coulter, S. Crystal, J. Currier, P. DePoy, F. Demarest, A. Espinoza, C.J. Fichtenbaum, M.A. Fischl, N.M. Flynn, P. Francis, J. Freed, K.A. Freedberg, G. Fulop, T. Gerst, A.L. Gifford, C. Golin, C. Good, N. Halfon, M. Heck, R. Hiatt, L. Hill, P. Hoy, S.C. Hunt, B. Jaworski, L.G. Kaplowitz, G. Karam, M. Katz, M. Kitahata, B. Landon, J. Leon, D. Lieu, A.S. London, D. Longshore, R.R. MacGregor, C.A. Maida, T. Mark, C. Mathews, C. McLaughlin-Miley, E.N. Miller, S. Miller, V. Mor, F. Palella, Jr., G. Perez, P. Pierce, W.G. Powderly, S.M. Puentes, C.A. Reitmeier, D.D. Richman, H.S. Sacks, R. Santos, C. Schur, M. Schuster, A. Scitovsky, G. Scott, J. Shaul, S. Sheehy, C.D. Sherbourne, M. Stein, S. Strong, S. Thompson, J. Toney, B. Turner, L. von Behren, I.B. Wilson, C. Winslow, A. Wu, S. Zierler, and P. Zinner; *Community Advisory Board* — J. Alford, D. Bryan, K. Cylar, M. Diaz, F. Eggan, R. Milet Hernandez, K. Kuromiya, M. Lucey, C. Nelson, R. Presley, and G. Haas (deceased); *Scientific Advisory Committee* — J.E. Osborn (chair), L. Aday, J. Bartlett, G. DeFries, C. Eisdorfer, N. Jewell, L. Kish, J. Lave, H.S. Luft, W.G. Manning, D. Mechanic, J. Newhouse, J. Phair, M. Smith, and P.A. Volberding.

## REFERENCES

1. Kaslow RA, Ostrow DG, Detels R, Phair JP, Polk BF, Rinaldo CR Jr. The Multicenter AIDS Cohort Study: rationale, organization, and selected characteristics of the participants. *Am J Epidemiol* 1987;126:310-8.
2. Smith D. The HIV Epidemiology Research Study, HIV Out-Patient

- Study, and the Spectrum of Disease Studies. *J Acquir Immune Defic Syndr Hum Retrovirol* 1998;17:Suppl 1:S17-S19.
3. Hellinger FJ, Fleishman JA, Hsia DC. AIDS treatment costs during the last months of life: evidence from the ACSUS. *Health Serv Res* 1994;29:569-81.
  4. Palella JF Jr, Delaney KM, Moorman AC, et al. Declining morbidity and mortality among patients with advanced human immunodeficiency virus infection. *N Engl J Med* 1998;338:853-60.
  5. Shapiro MF, Berk ML, Berry SH, et al. National probability samples in studies of low-prevalence diseases. I. Perspectives and lessons from the HIV Cost and Services Utilization Study. *Health Serv Res* 1997.
  6. Frankel MR, Shapiro MF, Duan N, et al. National probability samples in studies of low-prevalence diseases. II. Designing and implementing the HIV Cost and Services Utilization Study Sample. *Health Serv Res* (in press).
  7. Kish L. *Survey sampling*. New York: John Wiley, 1965:xvi, 643.
  8. Lam NSN, Liu KB. Use of space-filling curves in generating a national rural sampling frame for HIV/AIDS research. *Professional Geographer* 1996;48:321-32.
  9. Duan N, McCaffrey DF, Frankel MR, et al. HCSUS baseline methods technical report. Santa Monica, Calif: RAND (in press).
  10. Berry SH, Brown JA, Athey L, et al. HCSUS baseline patient questionnaire documentation. Santa Monica, Calif: RAND (in press).
  11. Kish L, Frankel MR. Inference from complex samples. *J R Stat Soc B* 1974;36:1-37.
  12. Kalton G. Compensating for missing survey data. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan, 1983.
  13. Winslow C, Cassens B, Lieu D, Jaworski B, Timberlake D, Bozzette S. Pricing HIV care. Santa Monica, Calif: RAND (in press).
  14. Campbell P. *Population projections: states, 1995-2025*. Washington, D.C.: Government Printing Office, 1997.
  15. Bureau of the Census. Money income in the United States: 1996 (with separate data on valuation of noncash benefits). Current population reports, Series P-60. No. 197. Washington, D.C.: Government Printing Office, 1997.
  16. Fingerhut LA, Warner M. *Injury chartbook: health, United States, 1996-97*. Hyattsville, Md.: National Center for Health Statistics, 1997.
  17. Day J, Curry A. *Educational attainment in the United States: March 1995. Current population reports. Series P-20. No. 489*. Washington, D.C.: Government Printing Office, 1996.
  18. Pamuk E, Makuc D, Heck K, Reuben C, Lochner K. *Socioeconomic status and health chartbook: health, United States, 1998*. Hyattsville, Md.: National Center for Health Statistics, 1998.
  19. Carpenter CC, Fischl MA, Hammer SM, et al. Antiretroviral therapy for HIV infection in 1998: updated recommendations of the International AIDS Society-USA Panel. *JAMA* 1998;280:78-86.
  20. Guidelines for the use of antiretroviral agents in HIV-infected adults and adolescents: Department of Health and Human Services and the Henry J. Kaiser Family Foundation. *Ann Intern Med* 1998;128:1079-100.
  21. HIV prevalence estimates and AIDS case projections for the United States: report based upon a workshop. *MMWR Morb Mortal Wkly Rep* 1990;39(RR-16):1-31.
  22. Projections of the number of persons diagnosed with AIDS and the number of immunosuppressed HIV-infected persons — United States, 1992-1994. *MMWR Morb Mortal Wkly Rep* 1992;41(RR-18):1-29.
  23. Centers for Disease Control and Prevention. *HIV/AIDS surveillance report. Vol. 9. 1997:24*.
  24. Karon JM, Rosenberg PS, McQuillan G, Khare M, Gwinn M, Petersen LR. Prevalence of HIV infection in the United States, 1984 to 1992. *JAMA* 1996;276:126-31.
  25. Hammett TM, Widom R, Epstein J, Gross M, Sifre S, Enos T. 1994 Update: HIV/AIDS and STDs in correctional facilities. Washington, D.C.: Office of Justice Programs, National Institute of Justice, 1995.
  26. *Correctional populations in the United States, 1995*. Bureau of Justice statistics. Washington, D.C.: Department of Justice, Office of Justice Programs, 1997.

---

FULL TEXT OF ALL *JOURNAL* ARTICLES ON THE WORLD WIDE WEB

---

Access to the complete text of the *Journal* on the Internet is free to all subscribers. To use this Web site, subscribers should go to the *Journal's* home page ([www.nejm.org](http://www.nejm.org)) and register by entering their names and subscriber numbers as they appear on their mailing labels. After this one-time registration, subscribers can use their passwords to log on for electronic access to the entire *Journal* from any computer that is connected to the Internet. Features include a library of all issues since January 1993, a full-text search capacity, a personal archive for saving articles and search results of interest, and free software for downloading articles so they can be printed in a format that is virtually identical to that of the typeset pages.

---