Access/Use of Services

Access of Vulnerable Groups to Antiretroviral Therapy Among Persons in Care for HIV Disease in the United States

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Objective. To employ the behavioral model of health services use in examining the extent to which predisposing, enabling, and need factors explain the treatment of the HIV-positive population in the United States with highly active antiretroviral therapy (HAART).

Data Source. A national probability sample of 2,776 adults under treatment for human immunodeficiency virus (HIV) infection.

Study Design. The article uses data from the baseline and six-month follow-up surveys. The key independent variables describe vulnerable population groups including women, drug users, ethnic minorities, and the less educated. The dependent variable is whether or not a respondent received HAART by December 1996.

Data Collection. All interviews were conducted using computer-assisted personal interview instruments designed for this study. Ninety-two percent of the baseline interviews were conducted in person and the remainder over the telephone.

Principal Findings. A multistage logit regression shows that the predisposing factors that have previously described vulnerable groups in the general population with limited access to medical care also define HIV-positive groups who are less likely to gain early access to HAART including women, injection drug users, African Americans, and the least educated (odds ratios, controlling for need, ranged from 0.35 to 0.59).

Conclusions. Those HIV-positive persons with the greatest need (defined by a low CD4 count) are most likely to have early access to HAART, which suggests equitable access. However, some predisposing and enabling variables continue to be important as well, suggesting inequitable access, especially for African Americans and lower-income groups. Policymakers and clinicians need to be sensitized to the continued problems of African Americans and other vulnerable populations in gaining access to such potentially beneficial therapies. Higher income, anonymous test sites, and same-day appointments are important enabling resources.

Key Words. Antiretroviral therapy, HIV, vulnerable groups, African Americans, access, equitable

Multiple national surveys have documented the extent of access to medical care for the overall population of the United States (Aday et al. 1998; Andersen and Davidson 1996; Andersen, McCutcheon, Aday, et al. 1983; Hayward et al. 1988). Considerable effort has been made to describe variations in access to care for potentially disadvantaged subgroups of the population, as defined by characteristics that include gender, education, ethnicity, and drug use, as well as to develop conceptual schemes to help explain these variations (Aday, Lee, Spears, et al. 1993; Andersen 1995; Phillips et al. 1998). However, much less work has been done using national data to understand access to medical care for specific disease populations. This article is part of a national study of access to care (HIV Cost and Services Utilization Study, or HCSUS) for persons with one chronic health condition, human immunodeficiency virus (HIV) infection (Shapiro, Morton, McCaffrey, et al. 1999).

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There is substantial evidence that gaining access to medical care may make a difference for persons with HIV for a variety of outcomes, including mortality and quality of life (Curtis and Patrick 1993; Cunningham, Hays, Ettl, et al. 1998). Access to certain anti-HIV pharmaceutical regimens may be especially beneficial, and increasingly so, as new agents and combinations of agents become available (Carpenter, Fischl, Hammer, et al. 1997, 1998; Palella, Delaney, Moorman, et al. 1998). In the following analysis we consider whether or not HIV-positive people reported receiving any highly active antiretroviral therapy (HAART) by December 1996. Antiretroviral (ARV) drugs include protease inhibitors (PIs) such as ritonavir, indinavir, saquinavir, and nelfinavir; non-nucleoside reverse transcriptase inhibitors (NNRTIs) such as nevirapine, delavirdine, and lovirdine; and nucleoside reverse transcriptor inhibitors (NRTIs) such as zidovudine (AZT), ddI, ddC, D4T, 3TC, and adefovir. Certain combinations of ARV drugs considered to be particularly beneficial—and designated as HAART for this article—are:

> 1 PI or 1 NNRTI (PI/NNRTI) + NRTIs (AZT + ddI, AZT + ddC, AZT + 3TC, d4T + ddI, or d4T + 3TC are considered acceptable).
>
> This definition of HAART is based on recommendations published by the Centers for Disease Control and Prevention (CDC) (1998a,b).

Our underlying assumption in analyzing who received HAART by December 1996 is that access to HAART by this time was appropriate for most of the HCSUS sample, but was most necessary for those with lower CD4 counts. This might seem to be a relatively early time period in which to be judging access to HAART given the relatively recent recommendations for its use. However, by July 1996, a 13-member panel, which had been selected by the International AIDS Society–USA as representative of international expertise in ARV research and HIV patient care, had published recommendations for the use of HAART in the *Journal of the American Medical Association* (Carpenter, Fischl, Hammer, et al. 1996). The panel recommended the initiation of HAART-type therapy for patients with CD4 counts below 500 as well as for all patients with symptomatic HIV disease (e.g., recurrent mucosal candidiasis; oral hairy leukoplakia, chronic or otherwise; unexplained fever; night sweats; or weight loss) regardless of CD4 count. Thus, even though the use of HAART by December 1996 is considered "early access" in this article, clinicians had had several months to learn about and prescribe HAART; subsequent evidence supports the position that "recent declines in morbidity and mortality due to AIDS are attributable to the use of more intensive antiretroviral therapies" (Palella, Delaney, Moorman, et al. 1998: 853). Although

undoubtedly not all physicians who were treating HIV patients at that time recognized or followed the HAART guidelines, HAART was the "state-of-the-art" treatment by the end of 1996. About 80 percent of all HIV patients treated in the major elite HIV treatment centers of the HIV Outpatient Study had received HAART by that time, as had 38 percent of all patients enrolled in the HCSUS study (Palella, Delaney, Moorman, et al. 1998).

THE LITERATURE

By now a number of studies have examined the costs and use of services associated with HIV disease (Mor et al. 1992; Stein and Mor 1993; Mauskopf, Turner, Markson, et al. 1994; Zucconi, Jacobson, Schrager, et al. 1994; Fleishman, Hsia, and Hellinger 1994; Fleishman, Mor, and Laliberte 1995; Andrulis et al. 1992; Palella, Delaney, Moorman, et al. 1998). Evidence suggests, for example, that traditionally vulnerable groups such as African Americans, Hispanics, and injection drug users (IDUs) are less likely to receive appropriate HIV treatment and more likely to experience delays in receiving appropriate HIV treatment (Moore et al. 1991,1994; Lemp, Hirozawa, Cohen, et al. 1992; Easterbrook, Keruly, Creagh-Kirk, et al. 1991; Stein, Piette, Mor, et al. 1991). Further evidence suggests that this lack of access might lead to poorer outcomes for vulnerable populations (Curtis and Patrick 1993; Moore et al. 1991; Lemp, Hirozawa, Cohen, et al. 1992; Cunningham, Hays, Ettl, et al. 1998). Gender differences also were noted, for instance, in the diffusion of AZT treatment in the first two years after AZT's approval. Work by Turner and colleagues (1994) suggests that such lags may be related to limited access to specialists.

Some previous research that has dealt specifically with pharmaceutical treatments in HIV also has shown substantial socioeconomic differences in access. Stein, Piette, Mor, and colleagues (1991) found during the era of AZT monotherapy that women, African Americans, and IDUs were less likely to be offered AZT. Moore and colleagues (1991) found similar differences in the incidence of AZT treatment. Crystal, Sambamoorthi, and Merzel (1995) found racial and gender differences in diffusion of AZT treatment in the first two years after AZT's approval. Work by Turner and colleagues (1994) suggests that such lags may be related to limited access to specialists.

More recent studies have compared access to care for those tested "anonymously" (assigning a number rather than a name for test sample identification) with those tested "confidentially" (retaining the name with the

testing sample). A CDC study in six states found that the total number of persons tested actually rose in four states after the names-tracking system went into effect (Nakashima, Horsley, Frey, et al. 1998). However, another study of 895 AIDS patients in seven states found that those tested anonymously received an HIV diagnosis 528 days before those tested in confidential names-based systems (Bindman, Osmond Hecht, et al. 1998). Further, persons tested anonymously received 918 days of medical care before developing AIDS compared with 531 days for those confidentially tested. Still, a great deal remains to be known about the processes and variables that describe access to more recent pharmaceutical treatments, particularly because treatment since 1996 differs considerably from treatment at the time of these earlier studies.

Applications of the behavioral model to pharmaceutical use by HIV populations have come largely through analyses of data from the AIDS Costs and Utilization Survey (ACSUS), a longitudinal study conducted over six waves from March 1991 to November 1992 (Fleishman, Hsia, and Hellinger 1994). Smith (1996) applied the behavioral model to ACSUS data to test three hypotheses about drug utilization. He found that social class and enabling variables were more strongly associated with drug use than were demographic characteristics; women, however, did have lower adjusted odds of using ARV drugs. He also found that individuals who lose their health insurance coverage (an enabling variable) had a significantly lower rate of ARV drug use than those who had stable health insurance coverage.

Although the ACSUS was a most important precursor to HCSUS, it represents an earlier era of HIV treatment and was limited by the lack of a representative sample of the HIV-positive population under treatment in the United States. Further, ACSUS did not collect data on all of the categories of the behavioral model, for example, on health beliefs. The HCSUS provides an opportunity to examine the use of ARV agents in a national sample with predictors that represent all major components of a comprehensive utilization model. These analyses are particularly timely because the HCSUS baseline coincides roughly with the initial period when protease inhibitors became available as part of ARV regimens. It is particularly important to understand the determinants of access to these treatments because of their high costs, potential for greater effectiveness than previous treatments, and complex management and adherence issues. As treatment for HIV continues to evolve, differences in early access to improved treatment are likely to recur with potentially important consequences for health. This analysis also serves as an initial step to subsequent studies of utilization, costs, and adherence to treatment.

THE MODEL

Our analysis focuses on access to HAART for subgroups of the HIV population who, in the general population, have received considerable attention in terms of whether or not they have appropriate access to the services they need (Aday et al. 1998; Blendon et al. 1989; Freeman, Blendon, Aiken, et al. 1987). These subgroups include women, less-educated persons, minorities, and injection drug users (IDUs). In this article we refer to these subgroups as "vulnerable populations." Do these same groups experience the particular access problems in the HIV population that they have been shown to experience in the general population? What other factors might help to explain variations in access to HAART for the HIV population in general, and for these subgroups in particular?

To help explore these questions we employ the behavioral model of health services use depicted in Figure 1 (Andersen 1968, 1995), which suggests that people's exposure to HAART can be explained by a series of variables representing (1) their predisposition to use care; (2) factors that enable or impede use; and, finally, (3) the extent of their need for care both as they perceive it and as medical care providers evaluate it. We measure all the components of the model with the variables listed in Figure 1. Our general expectation is that each component will make an independent contribution to explaining use and, further, that the effects of components and variables seen earlier in the series might be explained by those introduced later in the series. We consider the independent variables that define the vulnerable subgroups of particular interest (gender, ethnicity, education, and recreational drug use) as predisposing factors for early access to HAART. We subsequently explore the effects of other need, predisposing, and enabling factors.

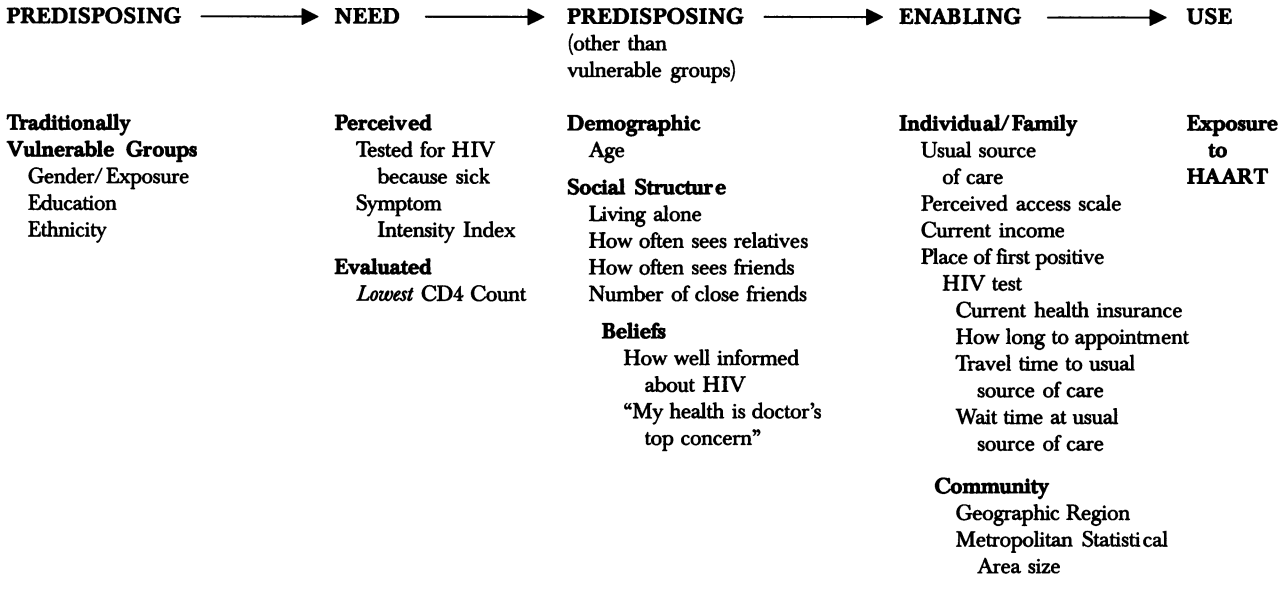
HYPOTHESES

This article examines specific hypotheses concerning access to care for vulnerable groups (IDUs, the less educated, and ethnic minorities):

H1. Traditionally disadvantaged groups will be less likely to obtain HAART in simple logistic models and in multivariate models controlling for the other predisposing disadvantage variables.

H2. The introduction of need variables will increase the differences between the disadvantaged and other groups in the likelihood of obtaining HAART.

Figure 1: Modeling Determinants of Early Exposure to HAART for HIV-Positive Population Under Treatment



H3. The introduction of other predisposing variables will reduce differences between the disadvantaged and other groups in the likelihood of obtaining HAART.

H4. The introduction of enabling variables will reduce the differences between the disadvantaged and other groups in the likelihood of obtaining HAART.

We consider the predisposing variables that describe vulnerable populations to be exogenous in the model and expect the vulnerable groups to be less likely to receive early HAART, as reflected in Hypothesis 1. Hypothesis 2 is based on the expectation that traditionally disadvantaged groups will tend to have more need than other groups; consequently, the gap in access may be underestimated in bivariate models, and estimates of the gap may actually increase rather than decrease when statistical controls for need characteristics are included in the model. We propose in Hypothesis 3 that other predisposing factors representing the demography, social structure, and beliefs of disadvantaged persons might explain some of their limited access to HAART. Hypothesis 4 further suggests that disadvantaged populations may have limited exposure to HAART because they lack the enabling factors or means to gain access to services.

The model and hypotheses suggest that a multistage, multivariate analytic approach is appropriate. Because we are using a dichotomous dependent variable (whether or not people were exposed to HAART by December 1996), straightforward multivariate logit regression was chosen. The first stage, which includes the predisposing variables (*PD*) that represent the traditionally disadvantaged groups as independent variables, provides a test of Hypothesis 1: $HAART = f(PD)$. The second stage includes the need variables (N) and allows consideration of Hypothesis 2: $HAART = f(PD + N)$. The third stage adds the other predisposing variables (PO) and provides the basis for testing Hypothesis 3: $HAART = f(PD + N + PO)$. The fourth stage adds the enabling variables (E) and provides a means for testing Hypothesis 4: $HAART = f(PD + N + PO + E)$.

THE DESIGN AND DATA COLLECTION

This article uses data from the baseline and six-month follow-up surveys of HCSUS. The HCSUS cohort is a nationally representative probability sample of people 18 years of age and older with known HIV infection who

made at least one visit to a medical provider in the population definition period from January 5 to February 29, 1996 (except for the cohort group for one city, in which sampling started two months later). Full details of the design are available elsewhere (Shapiro, Morton, McCaffrey, et al. 1999; Frankel, Shapiro, Duan, et al. 1999).

In the HCSUS multistage design, we randomly selected metropolitan statistical areas (MSAs) and clusters of rural counties in the first stage (Lam and Liu 1996), medical providers within selected areas in the second stage, and patients from selected providers in the third stage. Patients were sampled from anonymous lists of all eligible patients who visited participating providers during the population definition period. Patient sampling was conducted after the removal, where possible, of duplicate entries across provider lists. The overall selection rate was doubled for women and was increased again for members of staff and group model HMOs.

The coverage rate, or the ratio of the population that was directly represented, was 68 percent including only the long-form (full-length, comprehensive baseline interviews) and 87 percent including long-form, shorter-form, and proxy interviews, and provider-completed non-response forms. Shorter-form and proxy interviews included fewer questions and were used when the respondent was too sick to complete the full-length interview or when the respondent was unable to be interviewed at all but granted permission for a proxy to provide some information. Of the 4,042 eligible participants sampled, 76 percent were interviewed, with 71 percent (2,864 interviews) providing long-form interviews and 5 percent providing short-form or proxy interviews.

All interviews were conducted using computer-assisted personal interview instruments designed for this study (Berry, Brown, Athey, et al. 1998). Ninety-two percent of the baseline interviews were conducted in person and the remainder over the telephone. The long-form baseline interviews averaged about 90 minutes. Subjects were contacted for interview only after providers or providers' agents had obtained permission from the subject to be contacted. The RAND review board and a local institutional review board reviewed all consent forms and informational materials.

THE ANALYSIS

This article is based on 2,776 of the 2,864 respondents (97 percent) who completed the long-form interviews in the baseline field period from January

1996 to approximately 15 months later, and who were not missing certain data elements as described further on. The baseline information was supplemented by information from 2,466 respondents who were reinterviewed approximately six months later in the first follow-up interview.

An analysis weight was constructed for each respondent to adjust for (1) differential selection probabilities across subgroups of the population, (2) non-response, and (3) multiplicity (some patients may have been seen by more than one eligible provider). The analysis in this article incorporates the analysis weights as well as linearization methods, to correct for the multistage sampling design and differential weighting (Kish and Frankel 1974), which are available in the SUDAAN and Stata software packages (Duan, McCaffrey, Frankel, et al. 1998). These methods adjust the standard errors and statistical tests, and were implemented using analogous processing with the SAS statistical software package.

For the multivariate regression models, multiple imputations of the dependent variable were constructed as described below. Models were fit for each multiple imputation, and a sensitivity analysis was conducted. To produce the final model results reported in this article, the coefficients from each multiple imputation model were combined using the average coefficient method (Rubin 1987), and standard repeated imputation standard errors were produced (Schafer 1997).

THE VARIABLES

The dependent variable is whether or not the respondent reported taking HAART by December 1996. The variable was constructed in two stages with data from the baseline and first follow-up interviews. First, we determined whether or not a PI/NNRTI drug was used by December 1996. Given use of a PI/NNRTI, we then determined whether or not an appropriate combination of two NRTIs was used on the same date as the PI/NNRTI. Information on most respondents in the two interviews was sufficient to estimate the HAART variable; however, for some the information was insufficient because they could not be interviewed in the follow-up survey or because of uncertainty about the dates of drug use. Where sufficient respondent information was lacking, we used logistic regression analysis to impute values for exposure to PI/NNRTI, and for exposure to HAART given exposure to PI/NNRTI, based on respondents with complete information on drug use. The explanatory variables used in these

imputation equations included a range of basic predisposing, enabling, and need variables: race, gender, education, insurance, region, and CD4 count. For both PI/NNRTI and HAART, we used a random number generator to impute a 0/1 value (= 1 indicating exposure to therapy if random number is < predicted probability). The random number generator added some randomness to the distribution so that we did not underestimate the variance.

The results of the imputation procedure were:

Not imputed	2,472	86.3%
PI not/HAART imputed	101	3.5%
PI imputed/HAART not	28	1.0%
Both PI/HAART imputed	263	9.2%

Our final estimate of exposure to HAART by December 1996 was:

Exposed to HAART	1,086
Not exposed to HAART	1,778

We imputed the missing values for HAART because, without imputation, 14 percent of the cases would have been excluded from the analysis. If we excluded those cases, the observed relationships between the predicting variables and HAART could, potentially, have been significantly affected. We performed a sensitivity analysis of our imputation technique by selecting ten replicate bootstrap samples and developing ten independent estimates of exposure to HAART. The estimates of people exposed to HAART ranged from 1,064 to 1,086. We then used these alternative estimates of the HAART variable to conduct multiple analyses of the determinants of HAART exposure. The results of these sensitivity analyses were essentially robust to which estimate of the HAART variable was employed. Consequently, in our multivariate regression models we combined the results from each replicate analysis using the average coefficient method (Rubin 1987).

Table 1 shows the independent variables divided into (1) the predisposing factors that distinguish traditionally vulnerable groups with respect to access to medical care (or, in this study, HAART); (2) need factors that we expect to have a substantial bearing on early access to HAART; (3) other predisposing factors that will serve as controls in the subsequent analysis; and (4) enabling factors that might facilitate or impede access to HAART. All of these variables are measured using the baseline survey of HCSUS.

Table 1: Predisposing, Need, and Enabling Variables for Explaining Exposure to HAART

Variable Categories	*Unweighted* n	*Weighted Population* n	*Weighted Percent*
Predisposing Vulnerable Variables			
Gender/Exposure			
Female/IVDA	232	14,083	6.3
Male/IVDA	438	39,386	17.6
Female/Heterosexual	413	25,875	11.6
Male/Heterosexual	146	15,149	6.8
Female/Homosexual, Other†	176	10,608	4.7
Male/Homosexual, Other†	1,371	118,273	52.9
Education			
Some high school	689	54,481	24.4
High school diploma	779	61,095	27.4
Some college	793	64,277	28.8
Bachelor's degree or higher	515	43,521	19.5
Ethnicity			
White	1,359	110,235	49.3
African American	928	73,426	32.9
Hispanic	399	32,354	14.5
Other	90	7,359	3.3
Need Variables			
Tested for HIV Because Sick			
No	1,949	153,114	68.5
Yes	827	70,259	31.5
Symptom Intensity Index			
0–9 (Least bothersome)	713	62,945	28.2
10–22	659	53,454	23.9
23–37	705	53,962	24.2
38–100 (Most bothersome)	699	53,013	23.7
Lowest CD4 Count			
≥500	245	21,470	9.6
200–499	1,061	83,308	37.3
50–199	828	65,762	29.4
6–49	642	52,834	23.7
Other Predisposing Variables			
Age			
18–29	366	28,143	12.6
30–34	586	47,849	21.4
35–38	558	42,854	19.2
39–44	654	52,660	23.6
≥45	612	51,869	23.2

continued

Table 1: *Continued*

Variable Categories	*Unweighted* n	*Weighted Population* n	*Weighted Percent*
Living Alone?			
No	1,948	156,686	70.1
Yes	828	66,688	29.9
How Often Sees Relatives?			
≤ Once/month	610	50,032	22.4
Few times/month	557	45,464	20.4
Few times/week	733	60,171	26.9
Daily	876	67,707	30.3
How Often Sees Friends?			
≤ Once/month	496	38,255	17.1
Few times/month	387	30,695	13.7
Few times/week	870	69,519	31.1
Daily	1,023	84,905	38.0
Number of Close Friends			
None	797	64,244	28.8
One	528	40,937	18.3
Two	711	57,857	25.9
Three or more	740	60,335	27.0
How Well Informed about HIV			
Much better than most	937	75,574	33.8
Somewhat better than most	918	72,953	32.7
About as well as most	676	55,908	25.0
Somewhat/much less than most	245	18,939	8.5
My Health Is Doctor's Top Concern			
Agrees completely	1,381	116,895	52.3
Agrees mostly	864	65,481	29.3
Agrees somewhat	354	27,309	12.2
Agrees a little/not at all	177	13,688	6.1
Enabling Variables			
Usual Source of Care when First Tested HIV-Positive?			
Yes, changed after test	662	50,834	22.8
Yes, did not change	555	43,194	19.3
No	1,559	129,347	57.9
Perceived Access Scale			
0–50 (low)	321	25,826	11.6
51–75	791	63,661	28.5
76–90	674	54,071	24.2
91–99	528	43,065	19.3
100 (high)	462	36,750	16.5
Current income			
0–$5,000	588	44,055	19.7

continued

Table 1: *Continued*

Variable Categories	*Unweighted* n	*Weighted Population* n	*Weighted Percent*
Current Income (*continued*)			
$5,001–$10,000	710	57,175	25.6
$10,001–$25,000	715	57,914	25.9
≥$25,001	763	64,230	28.8
Place of First Positive HIV Test			
Clinic/MD's office	1,305	108,920	48.8
Hospital	648	48,039	21.5
Anonymous test site	424	33,565	15.0
Routine test/Other	399	32,850	14.7
Current Health Insurance			
No insurance	571	43,904	19.7
Medicaid	830	65,103	29.1
Private/HMO	470	35,196	15.8
Private/Other	379	36,933	16.5
Medicare	526	42,237	18.9
Geographic Region			
Northeast	691	55,891	25.0
Midwest	325	25,102	11.2
South	875	78,599	35.2
West	885	63,782	28.6
Metropolitan Statistical Area Size			
Rural/0–1.5 million	793	76,543	34.3
1.5–2.5 million	504	32,271	14.4
2.5–4.5 million	550	35,296	15.8
≥ 4.5 million	929	79,264	35.5
How Long to Appt. at Usual Source?			
Missing	175	14,151	6.3
Same day	1,948	160,962	72.1
2–6 days	265	20,463	9.2
7–13 days	211	15,655	7.0
≥ 14 days	177	12,143	5.4
Travel Time to Usual Source			
≤ 15 minutes	1,041	86,909	38.9
16–29 minutes	581	45,733	20.5
30–44 minutes	533	43,335	19.4
≥ 45 minutes	621	47,396	21.2
Wait at Usual Source			
≤ 10 minutes	732	57,561	25.8
11–29 minutes	887	71,833	32.2
30–59 minutes	677	54,018	24.2
≥ 60 minutes	480	39,962	17.9

†"Other" includes exposure through hemophilia treatment, blood transfer, or undefined. It accounts for most females in this category but fewer than 5 percent of the males.

We imputed missing values for essential independent variables (gender, exposure group, education, ethnicity, lowest CD4 count, age, perceived access scale, income, and health insurance) using a standard "hot deck" strategy (Brick and Kalton 1996). Further details regarding HCSUS imputations are given in a paper by Duan, McCaffrey, Frankel, et al. (1999). Briefly, for each variable being imputed we classified all respondents on the basis of observed values for other variables. Then, for each respondent missing a value for the variable being imputed, we randomly selected a donor value from those respondents not missing a value in the same imputation class. We imputed 4.9 percent of the CD4 cell count values, less than 4 percent of income values, less than 2 percent for insurance status, and less than 0.5 percent of missing values in the other variables.

We did not impute values for the remaining independent variables. This reduced our analysis sample size from 2,864 to 2,776 because we excluded all cases with values missing on one or more independent variables. We judged this loss of sample size (3 percent) as small enough not to be troublesome. We did another analysis of the determinants of HAART excluding 364 cases with an imputed HAART value and an additional 74 cases with imputed values on one or more of the independent variables. Comparisons of this final model (with the reduced number of cases) with the final model (shown in Table 2, further on) showed the coefficients for independent variables to have similar magnitudes and significance levels. Further, a comparison of the cases lost with the analysis sample on several essential independent variables (gender, exposure group, education, income, lowest CD4 count, and age) showed no significant differences ($p < .05$), with the exception of education where the excluded cases were more likely to have less than a high school education.

As a final test of the effect of our imputation process, we examined the ability of the variables used in imputing missing values of independent variables to predict HAART for the restricted sample that had no imputed values. The ratio of the pseudo R-squared for that model to the model with all variables included for the restricted sample is about 80 percent. This ratio is also about 80 percent for the total sample including imputed cases. Thus, the variables used to impute explain a large proportion, but not all, of the variance in the outcome. However, there is no indication that the imputation process biased the HAART estimations because the contribution of these variables to the prediction of HAART is similar for the samples that included and excluded the imputed cases.

The data in Table 1 show the unweighted number of cases for all categories of each independent variable. The sum of the unweighted cases shown

in Table 1 (2,776) is less than the total in the sample (2,864) because we have excluded from Table 1 all cases with a missing value for any of the independent variables included in the multivariate analyses shown in Table 2. Table 1 also shows the weighted population estimates of the U.S. HIV-positive population under treatment and the percentage of the population represented by each variable category. More details regarding the predisposing, enabling, need, and healthcare variables of the HCSUS sample can be found in Bozzette, Berry, Duan, et al. (1998).

FINDINGS

The predisposing variables describing vulnerable groups show that the majority of respondents are male, were exposed to HIV through homosexual contact, and have a high school education or more (see Table 1). The population is about equally divided between white non-Latinos and minority groups.

The need variables in Table 1 indicate that 32 percent of the respondents were tested for HIV because they perceived themselves to be sick. The symptom intensity index is based on the number of HIV symptoms people report weighted by the level of discomfort the symptoms cause. (Details regarding the construction of this index are available from the senior author.) Table 1 shows that 28 percent of the population experienced no symptoms or few that caused them discomfort, while at the other extreme, 24 percent experienced multiple symptoms that resulted in extreme discomfort. The majority reported that their lowest CD4 count was under 200, which is indicative of considerable need for HAART.

The other predisposing variables indicate that the majority of the sample is under age 40, lives with others, sees relatives and friends at least a few times a week, and reports having three or more close friends. With respect to predisposing beliefs, 67 percent consider themselves better informed about HIV than most people with HIV, and 82 percent agree with the statement "My health is a top concern of my doctors."

The enabling variables in Table 1 show that the majority had no usual source of care when they tested HIV positive and that they earn less than $25,000 per year. The perceived access index combines responses that indicate the extent of agreement with six statements regarding ease in obtaining service. (Details regarding the construction of this index are available from the senior author.) Sixteen percent scored 100 on the index indicating their strong agreement with all statements that suggest ready access, while 12 percent

scored 50 or less suggesting their low perceived access to medical care. The site in which they first tested positive for HIV is about equally divided between a doctor's office or clinic and other sites; 15 percent received their positive test results in an anonymous test site. One-fifth of the respondents are uninsured, and about one-third have private insurance. Almost two-thirds live in the South or West, and over one-half live in metropolitan areas with a population of 2.5 million or more. Most respondents (72 percent) report that they can get an appointment on the same day at their usual source of care, that they spend less than 45 minutes traveling to that source of care (79 percent), and that their wait to see the doctor is less than one hour (82 percent).

Column (1) in Table 2 presents the odds ratios for all independent variables in the full model based on simple logit regressions not adjusted for any other independent variables. The next four columns are from the multivariate logit regressions adjusting sequentially for additional sets of variables. Column (2) shows the odds ratios for the vulnerable group variables adjusted for each other. Column (3) shows odds ratios simultaneously adjusted for vulnerable group variables and need variables. Columns (4) and (5) add predisposing control and then enabling variables to the model. The excluded categories usually represent the groups expected to have the greatest likelihood of exposure to HAART. These models have been explored for problems of multicollinearity and interactions among the key predisposing vulnerable group variables. As a result, we have combined the variables for gender and HIV exposure mode.

Column (1) indicates that the traditionally vulnerable groups are less likely to have early access to HAART than are more traditionally advantaged groups (which supports Hypothesis 1). In general, the more advantaged group among the HIV-positive population is the group whose HIV exposure mode is males having sex with males. Female drug users are only one-third (O.R. = 0.34) as likely to have early access to HAART as homosexual males. All of the other groups as defined by combinations of gender and exposure are also less likely to have early exposure to HAART than are homosexual males. Further, patients having less than a high school education are only one-third as likely (O.R. = 0.31) to have early exposure to HAART as those who have completed college or have had graduate education. Of special import, African Americans are much less likely (O.R. = 0.28) to have early access to HAART than are non-Latino whites, and Latinos are only about three-fifths as likely (O.R. = 0.62).

Column (2) of Table 2 also supports Hypothesis 1 in showing that the most vulnerable groups are less likely to have access to HAART. However, the

Table 2: The Odds Ratios for Being Exposed to Highly Active Antiretroviral Therapy (HAART) by December 1996.

	Models				
	Bivariate	*Multivariate Adjusting for:*			
Variable (Excluded Category)	*(1)*	*Predisposing Vulnerable Variables (2)*	*Plus Need Variables (3)*	*Plus Predisposing Controls (4)*	*Plus Enabling Variables (5)*
Predisposing Vulnerable Variables					
Gender/Exposure (Male/Homosexual, Other†)					
Female/IVDA	.34***	.56**	.59**	.58**	.73
Male/IVDA	.69**	.94	.88	.94	1.07
Female/Heterosexual	.43***	.73	.87	.87	.97
Male/Heterosexual	.39***	.70	.74	.76	.82
Female/Homosexual, Other†	.42**	.75	.71	.71	.82
Education (Bachelor's Degree or Higher)					
Some high school	.31***	.52**	.51**	.57**	.72
High school diploma	.56**	.78	.78	.80	.97
Some college	.71*	.92	.94	.94	1.09
Ethnicity (White)					
African American	.28***	.35***	.35***	.37***	.44***
Hispanic	.62***	.79	.78	.80	.85
Other	.85	.87	.82	.84	.89
Need Variables					
Tested for HIV Because Sick (No)					
Yes	1.09		.96	.97	.97
Symptom Intensity Index					
Log of continuous variable	1.08***		1.04**	1.05**	1.07***
Lowest CD4 Count (≥500)					
200–499	2.11***		1.90**	1.91**	1.98**
50–199	4.81***		4.20***	4.13***	4.56***
0–49	6.33***		5.46***	5.46***	5.87***
Other Predisposing Variables					
Age (39–44)					
18–29	.67*			.82	.92
30–34	.99			.88	.93
35–38	1.00			.91	.87
≥45	.84			.77*	.77*
Living Alone? (No)					
Yes	1.00			.87	.93
How Often Sees Relatives (Daily)					
≤ Once/month	1.16			.97	.93
Few times/month	1.51**			1.18	1.11

(continued)

Table 2: *Continued*

	Models				
	Bivariate	*Multivariate Adjusting for:*			
Variable (Excluded Category)	*(1)*	*Predisposing Vulnerable Variables (2)*	*Plus Need Variables (3)*	*Plus Predisposing Controls (4)*	*Plus Enabling Variables (5)*
How Often Sees Relatives (Daily) (*continued*)					
Few times/week	1.51**			1.28	1.22
How Often Sees Friends (Daily)					
≤ Once/month	.71**			.88	.91
Few times/week	1.10			1.12	1.22
Few times/month	1.14			1.09	1.13
Number of Close Friends (Three or More)					
None	.51***			.86	.92
One	.78			1.12	1.16
Two	.89			1.05	1.05
How Well Informed About HIV (Much Better than Most)					
Somewhat better	.81**			.89	.88
About as well	.62***			.84	.85
Somewhat/Much less	.41***			.71	.72
My Health Is Doctor's Top Concern (Agrees Completely)					
Agrees mostly	1.11			1.03	1.09
Agrees somewhat	.71*			.78	.81
Agrees not at all	.64			.77	.86
Enabling Variables					
Usual Source of Care when HIV-Positive (Yes/Changed)					
Yes/Did not change	1.00				.99
No	.97				1.20
Perceived Access Scale					
Log of continuous variable	1.73**				1.20
Current Income (≥ $25,001)					
0–$5,000	.30***				.59
$5,001–$10,000	.42***				.60*
$10,001–$25,000	.52***				.64*
Place of First Positive HIV Test (MD's Office/Clinic)					
Hospital	.98				1.06
Anonymous test site	1.56***				1.28*
Routine test/Other	.71*				.84
Current Health Insurance (Private/Other)					
No insurance	.33***				.74
Medicaid	.35***				.83
Private/HMO	.62				.72
Medicare	.54**				.82

(*continued*)

Table 2: *Continued*

	Models				
	Bivariate	*Multivariate Adjusting for:*			
Variable (Excluded Category)	*(1)*	*Predisposing Vulnerable Variables (2)*	*Plus Need Variables (3)*	*Plus Predisposing Controls (4)*	*Plus Enabling Variables (5)*
Geographic Region (Northeast)					
Midwest	1.85***				1.36
South	1.24				1.23
West	2.24***				1.50
Metropolitan Statistical Area (≥ 4.5 Million)					
Rural/0–1.5 million	.97				1.00
1.5–2.5 million	.98				.82
2.5–4.5 million	1.01				1.13
How Long to Appointment at Usual Source of Care (Same Day)					
Missing	1.18				1.42*
2–6 days	.62*				.54**
7–13 days	.75				.83
≥ 14 days	.58**				.66*
Travel Time to Usual Source (≤ 15 Minutes)					
16–29 minutes	1.13				1.09
30–44 minutes	.86				.98
≥ 45 minutes	1.08				1.30
Wait at Usual Source (≤10 Minutes)					
11–29 minutes	.87				.88
30–59 minutes	.76				.95
≥60 minutes	.70*				1.04

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

†"Other" includes exposure through hemophilia treatment, blood transfer, or undefined. It accounts for most females in this category but fewer than 5 percent of the males.

odds ratios for the most vulnerable groups increase when they are adjusted for other vulnerable characteristics, and some of the variables that are significant in the first column are no longer significant in the second. Thus, when adjusted for education and ethnicity, the odds ratio for female/IDU increases from 0.34 to 0.56 and that for male/IDU increases from 0.69 to 0.94, and the latter is no longer significant. Similarly, the odds ratios for the other gender exposure groups in the second column increase but remain less than 1.00. This indicates that these groups are still less likely than homosexual men are to have early exposure to HAART, even after adjusting for differences in education and ethnicity. Also, the odds ratio for those with less than a high school education

increases from 0.31 to 0.52 when adjusted for gender, exposure, and ethnicity while the odds ratio for African Americans increases slightly from 0.28 to 0.35.

Column (3) in Table 2 introduces the need variables and does not support Hypothesis 2—that controlling for need or illness would increase the differences between the disadvantaged and more advantaged groups in the likelihood of receiving HAART (i.e., that it would decrease the odds ratios). After need variables are introduced, significant and substantively meaningful odds ratios remain, showing that less access to HAART is experienced by female/IDUs (O.R. = 0.59), by people who are least educated (O.R. = 0.51), and by African Americans (O.R. = 0.35) than by the less vulnerable groups.

The third column in Table 2 suggests clearly that the most important determinant of early access to HAART is level of need, as measured by the lowest CD4 count. The odds ratios suggest that those with a lowest CD4 count of 0–49 are several times (O.R. = 5.46) more likely to get HAART than are those whose CD4 count is 500 or greater. Further, the other, intermediate categories of CD4 count also have large, highly significant odds ratios (for CD4 count 50–199, O.R. = 4.13, and for CD4 count 200–499, O.R. = 1.90). Another need variable, the symptom intensity index, was also significant, although not as important as the CD4 count, indicating that the patients with HIV symptoms that are greater in number and more bothersome have a greater likelihood of attaining HAART by December 1996.

Despite the overwhelming importance of the need variables, it is important to note that the adjustment for need has practically no impact (neither decreasing nor increasing) on the odds ratios for the most vulnerable groups (female/IDUs, the least educated, and minority groups). Thus, it does not appear that increased need by these most vulnerable groups makes them even more vulnerable, as proposed by Hypothesis 2; however, they do continue to have less access to HAART than other groups after adjusting for need.

Column (4) in Table 2 adds the other predisposing variables and provides little support for Hypothesis 3—that, compared with more advantaged groups, the difference in the likelihood that the vulnerable groups would get HAART would be reduced (that is, the odds ratios would increase). While the most significant odds ratios for vulnerable groups in the third column remain significant at the same levels in the fourth column, the size of the odds ratio actually appears to increase somewhat for some of the vulnerable groups, including male/IDUs (from 0.88 to 0.94) and the least educated (from 0.51 to 0.57). The only other predisposing variable that remains significant after controlling for need is age. People age 45 and over have lower odds (O.R. = .77) of receiving early HAART therapy than do those age 39 to 44.

Column (5) in Table 2 introduces the enabling variables and provides support for Hypothesis 4—that enabling variables further reduce the differences between the vulnerable and more advantaged groups in the likelihood of receiving HAART. At this stage of the analysis, all of the odds ratios for the vulnerable groups appear to increase from the fourth to the fifth column. Among the groups for whom the odds ratios were significant in the fourth column, we found that the odds increase from 0.58 to 0.73 for female/IDUs receiving HAART compared with the odds for male/homosexuals; from 0.57 to 0.72 for the least educated compared with the most educated; and from 0.37 to 0.44 for African Americans compared with whites. These results suggest that the most vulnerable groups are less likely to receive HAART because they lack enabling resources—beyond differences that might be explained by need and other predisposing factors. The significant enabling factors for receiving HAART early are higher income, being tested for HIV in an anonymous test site, and being able to get an appointment on the same day as requested at the usual source of care. The reader should note that the "missing group" on the time to appointment variable are even more likely to get HAART than those who have same-day appointments (adjusted O.R. = 1.42). Most of these people were unable to answer the question, "If you need to visit your usual source of HIV care as soon as possible, about how long do you usually have to wait to get an appointment?" Comparing this missing group with those who knew how long it took to get an appointment, we found that the missing tended to be more "advantaged" within the HIV population (male, white, privately insured, more highly educated). Possibly, the missing are able to get appointments conveniently enough to not remember having to wait, or perhaps they have mostly regularly scheduled appointments or have relatively few urgent and unpredictable healthcare needs, so they rarely seek unscheduled appointments to find out how long the queue might be.

SUMMARY AND IMPLICATIONS

Early access to HAART by vulnerable subgroups of the HIV-positive population was severely limited, a finding in support of Hypothesis 1. Thus, female drug users, persons with less than a high school education, and African Americans were much less likely to receive HAART by December 1996 than were more advantaged groups (range of unadjusted odds ratios: 0.28 to 0.34). The increased odds ratios that result when gender, mode of HIV transmission, education, and ethnicity are examined simultaneously suggest

that many HIV-positive people with the most limited access to HAART have multiple characteristics of vulnerability. It should be noted further that these access estimates are probably conservative because they are based on people surveyed who were actually receiving care. It is likely that vulnerable groups are less likely to be in care until they have advanced disease. If this is so, women, African Americans, and other vulnerable groups have an even greater problem in receiving early treatment than is documented in these results. Nevertheless, the documented results do provide clear evidence of substantial inequities in terms of which people across the HIV population first receive the most efficacious drug therapies, and of the need to improve access for vulnerable populations. It is especially important that clinicians be educated through their training programs, continuing education, and journals about the discrepancies in treatment for these vulnerable groups they are serving.

The introduction of the CD4 counts and the symptom intensity index (marginally for the latter given its relatively small odds ratio) conclusively demonstrates that people most in need (e.g., with CD4 counts of less than 500) are most likely to get HAART early. Further, contrary to Hypothesis 2, the addition of the need variables does not substantially reduce the odds ratios for the vulnerable population groups. Thus, we cannot make the argument from these data that because the vulnerable are more needy, the apparent gap in early access to HAART would increase if we took these needs into account. However, substantial gaps remain for vulnerable populations after need variables have been introduced, as suggested by odds ratios of 0.59 for female/IDUs, 0.51 for those with less than a high school education, and 0.35 for African Americans. These odds ratios continue to support the conclusion that substantial inequities exist regarding one's "place in line" for receiving the most efficacious drug therapies.

The introduction of additional predisposing variables into the analysis does not substantially change the odds ratios for the vulnerable population groups and, consequently, does not support Hypothesis 3. Thus, after taking need into account, the addition of age, social relationships, and some health beliefs does not help us to further understand the relationships between vulnerable populations and access to HAART. However, people age 45 and over are less likely to receive HAART than those age 38 to 45 (O.R. = 0.77). These results suggest that older people might be considered an additional vulnerable group that faces barriers to receipt of HAART.

The introduction of enabling variables into the analysis eliminates the significant relationships between less education and the failure to obtain

HAART early on, thus supporting Hypothesis 4. These results suggest that limited access by the less educated may be related to their limited enabling resources. The apparent increase in the odds ratios for most other vulnerable groups when the enabling variables are introduced provides further support for Hypothesis 4. For example, the odds ratios increase from 0.58 to 0.73 for female drug users and from 0.37 to 0.44 for African Americans. These findings provide rather substantial evidence that the lack of enabling resources limits access to HAART for the vulnerable subgroups in the HIV population.

Our analyses suggest that among the most important enabling variables that facilitate access to HAART are higher income, HIV testing at an anonymous site, and not having to wait for an appointment at the usual source of care, as indicated by the continued significance of these variables after need and other predisposing variables were introduced into the analysis. The strong income effects (the odds that those with incomes of less than $25,000 will have early access to HAART is only one-half or less the odds of those with incomes of more than $25,000) may, in part, reflect the depressing impact of illness severity on earning ability—which ability, at the same time, is influential in increasing the likelihood that one will receive HAART. However, these income effects have already been adjusted for the effects of illness severity as measured by CD4 count and the symptom intensity index.

Testing site and appointment time suggest ways in which organizational factors might facilitate access to HAART. Those who received their first positive HIV test result at an anonymous site were considerably more likely (O.R. = 1.28) than those tested at a doctor's office or clinic to receive HAART by December 1996, even after adjusting for severity of illness and all other variables in the final model. It may be that testing at an anonymous site somehow facilitates contact with a proactive treatment source that is most likely to provide the newest drug therapies. It may also be, as suggested by other recent studies (Bindman, Osmond, Hecht, et al. 1998), that the very process of providing anonymity for testing (not attaching names to test results) might encourage testing and earlier treatment with ARV therapy. These possibilities require further exploration. The findings also suggest that the process of care subsequent to a positive HIV test result in a doctor's office or a clinic might be examined for possible barriers to early access to newer drug therapies.

The significant odds ratios for time to appointment at the usual source of care and the consistency of these ratios from the simple unadjusted analyses to those adjusted for predisposing, other enabling, and need factors (all in the range of 0.54 to 0.66) suggest an important association between getting

same-day service and access to HAART. Usual sources of care that enable HIV patients to have access to care on short notice may be more attuned to patients' changing needs, thereby promoting early access to HAART.

In conclusion, we wish to emphasize that even with the introduction of the important need variables, significant gaps in receipt of HAART continue to exist for vulnerable population groups defined by gender, HIV transmission mode, education, and ethnicity as well as by other predisposing variables, such as age, and by enabling variables such as income, site of HIV test, and wait time for appointment at the usual source of care.

These differences document substantial inequities in access to HAART. We wish to call particular attention to the strong and disturbing findings for African Americans. These findings show that, even after controlling for all of the other variables in the model, the odds that African Americans will receive early HAART is less than half that of whites (O.R. = 0.44). Factors not sufficiently measured in our model—including discrimination, beliefs about the benefits and potentially harmful effects of drug therapy, mistrust of providers, and providers' perspectives regarding differential adherence to therapeutic regimens according to ethnicity—might account for the poor access to HAART that African Americans experience. These findings coincide with President Clinton's recent declaration that the AIDS epidemic in African American communities is a severe and ongoing healthcare crisis, with an accompanying allocation of $156 million in new federal funds to fight AIDS in these communities (*Wall Street Journal* 1998). Our findings not only document serious access problems for African Americans but also suggest the pressing need to eliminate these barriers.

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