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HAART receipt and viral suppression among HIV-infected patients with co-occurring mental illness and illicit drug use

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Abstract

Mental illness (MI) and illicit drug use (DU) frequently co-occur. We sought to determine the individual and combined effects of MI and DU on highly active antiretroviral therapy (HAART) receipt and HIV-RNA suppression among individuals engaged in HIV care. Using 2004 data from the HIV Research Network (HIVRN), we performed a cross-sectional study of HIV-infected patients followed at seven primary care sites. Outcomes of interest were HAART receipt and virological suppression, defined as an HIV-RNA <400 copies/ml. Independent variables of interest were: (1) MI/DU; (2) DU only; (3) MI only; and (4) Neither. We used chi-squared analysis for comparison of categorical variables, and logistic regression to adjust for age, race, sex, frequency of outpatient visits, years in clinical care, CD4 nadir, and study site. During 2004, 10,284 individuals in the HIVRN were either on HAART or HAART eligible defined as a CD4 cell count ≤350. Nearly half had neither MI nor DU (41%), 22% MI only, 15% DU only, and 22% both MI and DU. In multivariate analysis, co-occurring MI/DU was associated with the lowest odds of HAART receipt (Adjusted Odds Ratio: 0.63 (95% CI: (0.55-0.72]), followed by those with DU only (0.75(0.63-0.87)), compared to those with neither. Among those on HAART, concurrent MI/DU (0.66 (0.58-0.75)), DU only (0.77 (0.67-0.88)), were also associated with a decreased odds of HIV-RNA suppression compared to those with neither. MI only was not associated with a statistically significant decrease in HAART receipt (0.93(0.81-1.07)) or viral suppression (0.93 (0.82-1.05)) compared to those with neither. Post-estimation testing revealed a significant difference between those with MI/DU and DU only, and MI/DU and MI only. Co-occurring MI and DU is associated with lower HAART receipt and viral suppression compared to individuals with either MI or DU or neither. Integrating HIV, substance abuse, and mental healthcare may improve outcomes in this population.

Keywords

HIV; mental health; illicit drug use; viral suppression

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Introduction

Illicit drug use (DU) and mental illness (MI) are prevalent among HIV-infected individuals, associated with HIV acquisition and transmission, and have the potential to impact HIV treatment adherence and viral suppression (Li et al., 2005; Palepu et al., 2003; Pence, Miller, Gaynes, & Eron, 2007; Spire et al., 2002; Wood et al., 2003; Wood et al., 2004). Virological suppression is critical not only to reduce morbidity and mortality among HIV-infected individuals, but also to reduce HIV transmission.

Mental and substance use disorders frequently co-occur (Cournos & McKirnan, 1997; Kessler et al., 2003; Regier et al., 1990; Substance Abuse and Mental Health Services Administration (SAMHSA), 2004). In the HIV Costs and Services Utilization Survey (HCSUS), a nationally representative survey of 2864 HIV-infected persons in care, the prevalence of co-occurring substance use (including alcohol or illicit drugs) and psychiatric symptoms in patients infected with HIV was 13% (Galvan, Burnam, & Bing, 2003). Comorbid psychiatric disorders have the potential to exacerbate the negative health and social consequences of DU and interfere with the successful treatment of DU. Similarly, substance used among individuals with MI can lead to symptom exacerbation, higher utilization of acute services, and decreased treatment adherence (RachBeisel, Scott, & Dixon, 1999).

Co-occurring severe mental illness (SMI) and DU has been associated with decreased receipt of highly active antiretroviral therapy (HAART) among HIV-infected individuals (Himelhoch et al., 2007). In addition, a recent study among HIV-infected women demonstrated an interaction between depression and DU that was significantly associated with decreased receipt of HAART (Cook et al., 2007). To date, however, there has been little research on how concurrent DU and MI affect response to HAART, such as viral suppression. Using 2004 data from the HIV Research Network (HIVRN), we sought to determine the individual and combined effects of any MI and DU on HAART receipt and HIV-RNA suppression among individuals engaged in HIV care.

Methods

Design

This is a multi-site cross-sectional study of HIV-infected individuals in primary care at HIV out-patient treatment facilities during calendar year 2004.

Site selection

The HIVRN is a consortium of 19 sites that provide primary and subspecialty care to HIV patients. To be included, a site must have at a minimum, data on the patients' age, sex, race, HIV transmission risk factor, AIDS-defining illnesses, CD4 level, HIV-1 RNA, and use of antiretroviral medication available in electronic format or paper abstraction. Fourteen of these sites are limited to adult patients, of which seven sites collect additional information regarding utilization of mental health and substance abuse services including psychiatric diagnosis, mental health office visits and substance abuse office visits. Data from these seven sites, located in the northeast, mid-Atlantic, south, west, and northwest of the USA, are included in the analysis. The sample size of these seven sites ranges from 199 to 4223 patients. These seven sites comprise 69% of the adult HIVRN population during calendar year 2004. Demographic and clinical characteristics of these sites compared to the seven excluded adult sites are as follows: mean age: 42 vs. 42; male: 74% vs. 67%, white: 32% vs. 27%, black: 43% vs. 56%, Hispanic: 23% vs. 15%, DU: 20% vs. 19%, on HAART: 74% vs. 70%, HIV-RNA <400: 37% vs. 32%.

Data collection

The data elements described above were abstracted from electronic or paper records at each site. Abstracted data were sent in electronic format to a data-coordinating center after personal identifying information was removed. For this analysis, data collection encompassed the calendar year 2004. The date of the encounter (not the date of billing or payment of claim) was used. Electronic data received by the coordinating center were reviewed to ensure that each data element was correctly formatted and that all elements were captured. Data elements with incorrect formatting, unknown or incomplete information, or other inaccuracies were reviewed with the site and corrected. After this verification process, the data were combined across sites to achieve a uniformly constructed multisite database. A variable identifying the site was included in the database.

Definitions of variables

HAART was defined as use of: (1) three or more nucleosides; (2) any use of one or more protease inhibitors (PI) or a non-nucleoside reverse transcriptase inhibitor (NNRTI); or (3) any use of a fusion inhibitor. Our measure of HAART reflects prescription in the medical record, and not necessarily actual use or complete adherence by the patient. Virological suppression was defined as an HIV-RNA <400 copies/ml at any point during 2004. The number of primary care visits was categorized into <4 visits, 4-6 visits and >6 visits during the calendar year. Years in clinical care at the participating HIVRN site was calculated based on each patient's recorded enrollment date. Nadir CD4 was dichotomized as ≤200 cells/mm^3 or >200 cells/mm^3.

MI was defined using the following ICD-9 codes for schizophrenia, bipolar disorder, non-organic psychosis, depressive disorder, anxiety disorder, post-traumatic stress disorder, and personality disorder (290.8-9; 293.0; 295.0-9; 296.0-9; 300.0-300.4;.301.0-301.9; 297.0-3, 297.8-9; 298.0-9; 308.3; 309.81, 311). DU was defined as non-prescription use of opioids, cocaine, amphetamines, sedatives, hypnotics, hallucinogens, and marijuana (ICD-9 codes 292; 304.0-304.9;305; 305.2-305.9; 965.0). For the seven sites listed above, these codes were generated by evaluations performed by psychiatrists, mental health and primary medical providers. Based on these definitions, four mutually exclusive categories were created: (1) those with MI and DU; (2) those with DU only (3); those with serious MI only; and (4) those with neither serious MI nor DU.

The study was approved by the institutional review boards of the Johns Hopkins University School of Medicine as well as each of the participating sites.

Data analysis

This analysis was limited to HAART eligible (defined by current DHHS guidelines as either being on HAART or having a CD4 count <350) (DHHS, 2006), adult patients (≥18 years old), with an HIV viral load test result, who were in HIV primary care, as indicated by at least one visit to a primary care provider at one of these sites, and one recorded CD4 test result.

We conducted descriptive analyses of demographic and clinical characteristics, including age, gender, race/ethnicity (White, Black, Hispanic, and Other), CD4 nadir, number of outpatient visits, years in clinical care, and MI/DU diagnostic category. Next, we examined the relationship between the four mutually exclusive categories: (1) MI and DU; (2) DU; (3) MI only; and (4) those with neither MI nor DU, with demographic and clinical factors. We then analyzed the association between our categories of MI and DU and HAART receipt using bivariate and multivariate logistic regression analysis. We then limited our sample to only individuals on HAART, and examined the associations between MI and DU and viral

suppression using bivariate and multivariate logistic regression analysis. Our multivariate analyses were adjusted for age, gender, race, nadir CD4 count, outpatient visits, years in clinical care, and site of care (to capture site specific variation and adjust for clustering). We tested the equality of the coefficients for the (1) DU only and the combined MI and DU groups; and (2) the MI only and the combined MI and DU groups. For both multivariate analyses, we reparameterized the model in terms of main effects for MI and DU and their interaction; we tested the interaction term for significance. All *p*-values were two sided.

Results

Sample characteristics

During calendar year 2004, there were 11,369 individuals participating in primary care at these seven sites. Of these participants, 10,284 (90%) were HAART eligible and met our inclusion criteria. Seventy three percent of this sample was male, 43% black (non-Hispanic), 32% white (non-Hispanic), 23% Hispanic, and the remaining 2% were Asian, Native American, or another race. The mean age was 42 (SD: 9) years. Nearly half had neither MI nor DU (41%), 22% were MI only, 15% were classified as DU only, and 22% were classified as both MI and DU. Of those with a psychiatric diagnosis, 84% were diagnosed with depression. Table 1 shows demographic and clinical characteristics across the four mutually exclusive categories. Individuals with MI and DU, and MI only, were significantly more likely to be female and more likely to have ≥7 outpatient visits per year. A lower proportion of patients of Hispanic ethnicity had DU alone and those with MI only were more likely to be white.

Mental illness (MI), illicit drug use (DU) and highly active antiretroviral therapy (HAART)

The results of bivariate and multivariate analyses of HAART receipt are shown in Table 2. In multivariate analysis, co-occurring MI and DU was associated with the lowest odds of HAART receipt (Adjusted Odds Ratio (AOR): 0.63 (95% CI: (0.55-0.72)), followed by those with DU only (0.75(0.63-0.87)), and then those with MI only (0.93 (0.81-1.07)) compared to those with neither. There was no statistically significant difference in HAART receipt between those with MI only and those with neither. Black race (compared to white) was also associated with decreased receipt of HAART, as was a CD4 nadir >200 cells/mm^3. Factors associated with higher odds of HAART receipt included male sex, older age, higher number of outpatient visits and increased years in clinical care.

We tested the equality of the MI/DU and the DU effects. The difference between these two groups was statistically significant (p=0.05). Both the MI/DU and DU groups were significantly different from MI alone. However, when the model was parameterized as two main effects and an interaction, the interaction between MI and DU was not significant, nor was the MI main effect. The DU main effect was statistically significant.

Mental illness (MI), illicit drug use (DU) and virological suppression

Seventy four percent of HAART-eligible individuals received HAART (n=8378). The results of bivariate and multivariate analyses of virological suppression among this group are shown in Table 3. In multivariate analysis, concurrent MI and DU (0.66 (0.58-0.75)), DU only (0.77 (0.67-0.88)), and MI only (0.93 (0.82-1.05)) were all associated with lower odds of HIV-RNA suppression, compared to those with neither. However, there was no statistically significant difference in viral suppression between those with MI only and those with neither. Factors positively associated with viral suppression included older age and CD4 nadir >200 cells/mm^3, while black race and attending seven or more outpatient visits per year were associated with lower likelihood of viral suppression.

Testing the equality of the MI/DU and the DU only effects demonstrated a significant difference between these two groups (p=0.05). Both MI/DU and DU were significantly different from MI alone. When the model was parameterized as two main effects and an interaction, the interaction between MI and DU was not significant, but both the MI main effect and the DU main effect were statistically significant.

Discussion

Among this HIV-infected cohort, concurrent MI and DU was associated with a lower odds of viral suppression compared to those with either MI or DU alone, or those with neither, suggesting that co-occurring substance use and MI are a significant barrier to positive treatment outcomes among HIV-infected individuals. The finding that MI alone was not significantly associated with lower HAART receipt or viral suppression suggests that a diagnosis of MI among individuals engaged in care should not impede appropriate treatment of HIV.

Our finding of decreased HAART receipt among individuals with co-occurring DU and MI is consistent with an earlier study in the HIVRN (Himelhoch et al., 2007). Using data from four HIVRN sites in 2001, Himelhoch and colleagues also found that patients with either DU or both DU and SMI were less likely to receive HAART than those with neither DU nor MI. Similar to our results, they found that patients with MI alone were not significantly less likely to receive HAART compared to those with neither MI nor DU.

In contrast to a recent study among HIV-infected women (15), we did not find an interaction between DU and MI suppressing HAART use. Cook and colleagues, using data from the Women's Interagency HIV Study (WIHS) examined the interaction of DU and depressive symptoms on the likelihood of HAART receipt among 1710 women. They found that probable depression plus crack, cocaine or heroin use was associated with 51% decrease in their odds of receiving HAART compared to those with neither. Moreover, they found that the effects of depression interacted with DU to suppress the initiation of HAART over time. There are several reasons our results may differ from the WIHS cohort. First, we did not limit our sample to women, and a previous study in both men and women did not find an interaction between MI and DU and HAART use (Turner et al., 2001). In addition, MI was defined more broadly and classified by a medical record diagnosis in our study, while the WIHS cohort used a depression symptom scale. Thus individuals in the HIVRN with a diagnosis of MI may have been more likely to be in care for their MI.

Individuals with concurrent MI and DU had decreased odds of viral suppression compared to those with MI alone and those with neither MI nor DU, which is consistent with mental health literature describing worse treatment outcomes in individuals with concurrent MI and DU compared to those with MI alone (Akincigil et al., 2007; Buckley, 2006; Drake & Wallach, 1989; Olfson et al., 2000; Watkins, Paddock, Zhang, & Wells, 2006; Wilk et al., 2006). Similarly, we found that HAART use and viral suppression was lower among those with MI and DU compared to DU only. Among DUs psychiatric illness has been found to be a barrier to HAART access and adherence (Wood, Kerr, Tyndall, & Montaner, 2008).

We limited our analysis of viral suppression to only those individuals receiving HAART. Part of the effect of MI and DU on viral suppression operates through affecting who receives HAART. MI and DU have an indirect effect on viral suppression by reducing the likelihood of receiving HAART in the first place. Thus, limiting the analysis of suppression to those on HAART likely underestimates the total effect of MI and DU.

MI independent of DU was not associated with decreased HAART receipt or viral suppression. That persons with MI alone did not differ in HAART receipt from those with neither MI nor DU is consistent with the WIHS study, where women with depression were as likely to receive

HAART compared to those without depression (Cook et al., 2007). Similarly, Himelhoch et al., using 2001 data from the HIVRN, found that SMI alone was not significantly associated with decreased HAART compared to neither SMI nor DU (Himelhoch et al., 2007). However, our finding of no difference in viral suppression among those with MI only compared to those with neither MI nor DU is in contrast to current literature focusing on HIV-infected individuals with depression (Anastos et al., 2005; Li et al., 2005; Parienti et al., 2004; Pence, Miller, Gaynes, & Eron, 2007). Pence and colleagues recently demonstrated delayed virological suppression among individuals with a higher probability of depression (Pence, Miller, Gaynes, & Eron, 2007). One possible explanation for the difference in viral suppression between our study and others may be level of engagement in care. MI diagnoses were made by practitioners within the clinical settings, which may be reflective of a high level of engagement in care and perhaps adherence among those with MI only.

Our finding of lower viral suppression among those with DU is consistent with the current literature on viral suppression among HIV-infected DUs (Lucas, Gebo, Chaisson, & Moore, 2002; Palepu et al., 2003; Wood et al., 2003). Wood and colleagues, longitudinally evaluating virological suppression among 1583 antiretroviral naïve individuals, 25% of whom had a history of DU, reported a 12 month cumulative suppression rate of 51% among DUs compared to 71% in non-DUs (Wood et al., 2003). Another study reported that on-going DU was associated with a 70% decrease in viral suppression in current DUs compared to non-DUs (Palepu et al., 2003).

Notably, four or greater outpatient visits was associated with increased odds of HAART use compared to those with three or fewer visits, implying greater engagement in care is associated with HAART utilization. However, when the sample was limited to individuals on HAART, seven or greater visits was associated with decreased odds of virological suppression, suggesting that very frequent visits may be secondary to viral failure and or non-adherence.

Our study has several implications. Individuals with substance abuse and MI experience several barriers that may affect their HAART uptake and response to HIV treatment, including difficulties with appointment and medication adherence, self-care, homelessness, and incarceration (Brunette & Mueser, 2006; Compton, Weiss, West, & Kaslow, 2005; Drake & Wallach, 1989; Hurlburt, Hough, & Wood, 1996). Consequently, interventions targeted toward the special needs of this population may be necessary. One such intervention that has been put forward in the literature is integrated HIV care, which has been described by Soto, Bell, and Pillen, et al. as follows: “Integrated HIV care combines HIV primary care with mental health and substance abuse services into a single coordinated treatment program that simultaneously, rather than in parallel or sequential fashion, addresses the clinical complexities associated with having multiple needs and conditions” (Soto et al., 2004). The literature on integrated care among this population is limited. However, simultaneously addressing psychiatric, substance use, HIV and psychosocial issues, using a multidisciplinary collaborative approach may result in better clinical outcomes in this population.

Limitations of our study include its cross-sectional design. Because this is a cross-sectional study, we cannot assess the directionality of the association between co-occurring MI and DU and viral suppression. Our study is also limited by the lack of a measure of adherence; thus, we could not assess if inadequate medication adherence accounted for the decreased viral suppression among those with MI and/or DU. In addition, it is possible that there was undiagnosed MI and substance use in this sample, leading to some misclassification of individuals in this study. In addition, years in clinical care may be an underestimate as our definition included years in care at an HIVRN site, and it is possible an individual received treatment at a different site prior to switching to an HIVRN site. In addition, the HIVRN sample is not nationally representative and does not generalize to all HIV care sites. The sites in the

HIVRN were all highly experienced in the treatment of HIV with high rates of HAART use (Gebo et al., 2005) and opportunistic infection prophylaxis (Gebo, Fleishman, Reilly, & Moore, 2005); results may differ at sites with less provider experience with HIV or a smaller caseload of patients with HIV. Finally, not all of the sites in the HIVRN collect comprehensive mental health and utilization data; therefore we were only able to include seven of the 19 adult sites in the Network. Although patients in these seven sites were similar to patients in the excluded sites in terms of demographic characteristics, differences in other (unmeasured) characteristics could limit generalizeability.

In summary, we found that the concurrent MI and DU was associated with decreased HAART receipt and virological suppression among HIV-infected individuals compared to those with either MI or DU or neither. These data suggest that targeted interventions incorporating integrated substance abuse, psychiatric, and HIV care among HIV-infected individuals may be useful in improving HIV treatment outcomes, but longitudinal studies are needed to accurately assess whether concurrent MI and DU is a risk factor for low HAART uptake and viral suppression.

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MPH, Liming Zhou, Alanna Zhou, MS, Michelande Ridoré, BA)

Appendix

Appendix 1

Participating sites

Alameda County Medical Center, Oakland, CA, USA (Silver Sisneros, DO)

Children’s Hospital of Philadelphia, Philadelphia, PA, USA (Richard Rutstein, MD)

Community Health Network, Rochester, New York, USA (Roberto Corales, DO)

Community Medical Alliance, Boston, MA, USA (James Hellinger, MD)

Drexel University, Philadelphia, PA, USA (Peter Sklar, MD)

Henry Ford Hospital Detroit, MI, USA (Norman Markowitz, MD)

Johns Hopkins University, Baltimore, MD, USA (Kelly Gebo, MD, Richard Moore, MD)

Montefiore Medical Group, Bronx, New York, USA (Robert Beil, MD)

Montefiore Medical Center, Bronx, New York, USA (Lawrence Hanau, MD)

Nemechek Health Renewal, Kansas City, MO, USA (Patrick Nemechek, DO)

Oregon Health and Science University, Portland, OR, USA (P. Todd Korthuis, MD)

Parkland Health and Hospital System, Dallas, TX, USA (Philip Keiser, MD)

St. Jude's Children's Hospital and University of Tennessee, Memphis, TN, USA (Aditya Gaur, MD)

St. Luke's Roosevelt Hospital Center, New York, NY, USA (Victoria Sharp, MD)

Tampa General Health Care, Tampa, FL, USA (Charurut Somboonwit, MD, Jeffrey Nadler, MD)

University of California, San Diego, La Jolla, CA, USA (Stephen Spector, MD)

University of California, San Diego, CA, USA (W. Christopher Mathews, MD)

Wayne State University, Detroit, MI, USA (Lawrence Crane, MD)

Sponsoring Agencies

Agency for Healthcare Research and Quality, Rockville, MD, USA (Fred Hellinger, PhD, John Fleishman, PhD, Irene Fraser, PhD)

Health Resources and Services Administration, Rockville, MD, USA (Alice Kroliczak, PhD, Robert Mills, PhD, Richard Conviser, PhD)

Substance Abuse and Mental Health Services Administration, Rockville, MD, USA (Laura House, Ph.D., Joan Dilonardo, PhD)

National Institutes of Health, Bethesda, MD, USA (Paul Gaist, PhD, MPH)

Data Coordinating Center

Johns Hopkins University (Richard Moore, MD, Jeanne Keruly, CRNP, Kelly Gebo, MD, Perrin Lawrence, MPH, Liming Zhou, Alanna Zhou, MS, Michelande Ridoré, BA)

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Table 1

Sample characteristics of 10,284 HAART eligible individuals stratified by presence or absence of mental illness (MI) and illicit drug use (DU)

Characteristic	Overall *N* = 10,284	MI and DU *N* = 2312	DU only *N* = 1526	MI only *N* = 2217	Neither MI nor DU *N* = 4229
Age (years) (%)*					
≤35	21.2	15.9	17.2	21.3	25.5
>35 & <45	39.0	42.0	40.0	37.8	37.6
≥45	39.8	42.1	42.8	40.9	36.9
Female (%)*	25.8	27.6	16.4	31.2	23.2
Race/Ethnicity (%)*					
White/Caucasian	31.6	34.9	30.3	36.6	27.7
Black/AA	42.6	44.0	53.5	34.5	42.3
Hispanic	23.4	19.7	14.9	26.8	26.7
Other	2.4	1.4	1.3	2.1	3.3
CD4 nadir ≤200 cells/mm^3(%)*	63.0	64.4	68.9	61.7	60.1
Outpatient medical visits during Calendar year 2004 (%)*					
<4 Visits	30.8	25.4	36.4	25.1	34.8
4-6 Visits	33.5	31.0	35.7	32.9	34.3
≥7 Visits	35.7	43.6	27.9	41.2	30.9
Years in clinical care (median (IQR[a]))	4 (2-7)	4 (2-7)	4 (1-6)	4 (2-7)	3 (1-6)

[a] Inter-Quartile Range.

* $p<0.05$.

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Table 2

Bivariate[a] and multivariate analysis[a] of the association between mental illness (MI) and illicit drug use (DU) and receipt of HAART (n = 10,284)

	HAART receipt odds ratio (95% confidence interval)		HAART receipt adjusted odds ratio (95% confidence interval)	
Characteristic	***Bivariate***	***p-Value***	***Multivariate***	***p-Value***
Category				
MI & DU	0.82 (0.72-0.93)	<0.01	0.63 (0.55-0.72)	<0.01
DU	0.87 (0.75-1.01)	0.08	0.75 (0.63-0.87)	<0.01
MI	1.14 (0.99-1.31)	0.06	0.93 (0.81-1.07)	0.35
Neither MI nor DU	1.00 (referent)		1.00 (referent)	
Age (years)				
≥45	1.81 (1.59-2.07)	<0.01	1.49 (1.29-1.72)	<0.01
>35 & <45	1.57 (1.39-1.79)	<0.01	1.44 (1.26-1.65)	<0.01
≤35	1.00 (referent)		1.00 (referent)	
Gender				
Male	1.39 (1.24-1.55)	<0.01	1.33 (1.18-1.50)	<0.01
Female	1.00 (referent)		1.00 (referent)	
Race/Ethnicity				
Black/African American	0.70 (0.62-0.80)	<0.01	0.72 (0.63-0.82)	<0.01
Hispanic	1.01 (0.87-1.18)	0.86	1.01 (0.86-1.18)	0.89
Other	1.16 (0.79-1.71)	0.45	1.21 (0.81-1.80)	0.35
White/Caucasian	1.00 (referent)		1.00 (referent)	
CD4 nadir (cells/mm^3)				
>200	0.53 (0.48-0.59)	<0.01	0.57 (0.51-0.63)	<0.01
≤200	1.00 (referent)		1.00 (referent)	
Outpatient medical visits during calendar year 2004				
≥7	2.94 (2.57-3.35)	<0.01	2.91 (2.54-3.34)	<0.01
4-6	2.07 (1.83-2.33)	<0.01	2.02 (1.79-2.28)	<0.01
<4	1.00 (referent)		1.00 (referent)	
Years in clinical care	1.07 (1.05-1.08)	<0.01	1.05 (1.03-2.69)	<0.01

[a]Analysis adjusted for site.

Table 3

Bivariate[a] and multivariate analysis[a] of the association between mental illness (MI) and illicit drug use (DU) and virological suppression among HIV infected individuals on HAART (n = 8378)

	Virological suppression odds ratio (95% confidence interval)		Virological suppression adjusted odds ratio (95% confidence interval)	
Characteristic	***Bivariate analysis***	***p-Value***	***Multivariate***	***p-Value***
Category				
MI & DU	0.67 (0.57-0.79)	<0.01	0.66 (0.58-0.75)	<0.01
DU	0.78 (0.66-0.92)	<0.01	0.77 (0.67-0.88)	<0.01
MI	0.84(0.76-0.93)	<0.01	0.93 (0.82-1.05)	0.24
Neither MI nor DU	1.00 (referent)		1.00 (referent)	
Age (years)				
≥45	1.89 (1.67-2.14)	<0.01	2.07 (1.87-2.37)	<0.01
>35 & <45	1.41 (1.25-1.60)	<0.01	1.49 (1.39-1.70)	<0.02
≤35	1.00 (referent)		1.00 (referent)	
Gender				
Male	1.12 (1.00-1.23)	0.06	0.99 (0.89-1.12)	0.98
Female	1.00 (referent)		1.00 (referent)	
Race/Ethnicity				
Black/African American	0.74 (0.66-0.83)	<0.01	0.81 (0.72-0.91)	<0.01
Hispanic	0.89 (0.79-1.01)	0.08	1.03 (0.90-1.18)	0.50
Other	1.42 (1.06-1.90)	0.02	1.46 (1.08-1.98)	0.01
White/Caucasian	1.00 (referent)		1.00 (referent)	
CD4 count (cells/mm^3)				
>200	1.87 (1.70-2.05)	<0.01	1.89 (1.71-2.07)	<0.01
≤200	1.00 (referent)		1.00 (referent)	
Outpatient medical visits during calendar year 2004				
≥7	0.51 (0.45-0.57)	<0.01	0.52 (0.46-0.59)	<0.01
4-6	0.88 (0.78-0.98)	0.02	0.87 (0.78-0.98)	0.02
<4	1.00 (referent)		1.00 (referent)	
Years in clinical care	1.03 (1.02-1.05)		1.03 (1.02-1.05)	<0.01

[a] Analysis adjusted for site.