ORIGINAL ARTICLE

Mental Health and Substance Use Among Patients in a North Carolina HIV Clinic

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BACKGROUND The HIV/AIDS epidemic is a significant public health concern in North Carolina, and previous research has pointed to elevated mental health distress and substance use among HIV-infected populations, which may impact patients' adherence to medications. The aims of this study were to describe the prevalence of mental health and substance use issues among patients of a North Carolina HIV clinic, to examine differences by demographic characteristics, and to examine factors associated with suboptimal adherence to HIV medications.

METHODS This study was a secondary analysis of clinical data routinely collected through a health behavior questionnaire at a large HIV clinic in North Carolina. We analyzed data collected from February 2011 to August 2012.

RESULTS The sample included 1,398 patients. Overall, 12.2% of patients endorsed current symptomology indicative of moderate or severe levels of depression, and 38.6% reported receiving a psychiatric diagnosis at some point in their life. Additionally, 19.1% had indications of current problematic drinking, and 8.2% reported problematic drug use. Nearly one-quarter (22.1%) reported suboptimal adherence to HIV medications. Factors associated with poor adherence included racial/ethnic minority, age less than 35 years, and indications of moderate or severe depression.

LIMITATIONS The questionnaire was not completed systematically in the clinic, which may limit generalizability, and self-reported measures may have introduced social desirability bias.

CONCLUSION Patients were willing to disclose mental health distress, substance use, and suboptimal medication adherence to providers, which highlights the importance of routinely assessing these behaviors during clinic visits. Our findings suggest that treating depression may be an effective strategy to improve adherence to HIV medications.

The HIV/AIDS epidemic disproportionately affects the Southern region of the United States. Southern states have a higher annual incidence of HIV (20.9 per 100,000 adults) compared with the Northeast (18.1), West (12.0), and Midwest (9.3) [1]. In North Carolina, estimates suggest that 36,500 individuals (304 per 100,000 adults and adolescents) are currently infected with HIV [2]. The prevalence of HIV infection in the state has clear racial disparities, with new HIV diagnoses being 3 times greater among Latinos and nearly 10 times greater among African Americans, compared to whites; HIV-associated mortality is also much higher among infected minority populations [2].

HIV-infected individuals have higher levels of depression and substance use than the general population. A meta-analysis examining the relationship between HIV infection and depressive disorders found the prevalence of major depression to be nearly 2 times higher in HIV-positive individuals than HIV-negative individuals [3]. More recently, a study that used structured clinical interviews to assess mental health in a large, nationally representative sample of adults found HIV-infected men to be more than 3 times more likely to have been depressed within the last 12 months than men without HIV [4].

Substance use is also high among HIV-infected individuals. In another nationally representative sample of patients receiving care for HIV, half of the HIV-infected sample reported illicit drug use during the previous 12 months, and 12% screened positive for drug dependence in structured clinical interviews [5]. In a subsequent national prevalence study, rates of heavy drinking were nearly twice as high among HIV-infected individuals compared to the general population [6]. Moreover, the comorbidity of depression and substance use has been well documented both in the general population [7, 8] and among HIV-infected individuals [9, 10], highlighting the interconnectedness of these 2 conditions.

The high prevalence of depression and substance use among HIV-infected individuals is particularly concerning due to the impact of these conditions on adherence to antiretroviral (ARV) therapy. A meta-analysis of the impact of alcohol use on ARV medication adherence revealed that individuals who drank alcohol regularly were half as likely to be adherent to their medication as those who abstained or drank very little, and those who met criteria for problematic drinking reported the poorest adherence to ARV therapy [11].

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Additionally, 2 recent systematic reviews linked depression to reduced adherence, and they found evidence that antidepressant treatment can effectively improve adherence [12, 13].

Poor adherence to ARV medications can have devastating health consequences for the individual. In particular, irregular adherence gives the virus an opportunity to replicate, which can lead to drug-resistant mutations that makes the virus even more difficult to treat [14]. In addition to having a detrimental effect on an individual's health and well-being, failure to take ARV medications as prescribed can have significant public health consequences, as individuals with suboptimal adherence have a greater risk of transmitting the virus during sexual contact [15].

In order to provide comprehensive HIV care and sustain effective ARV treatment, it is important to understand and address mental health and substance use in the HIV patient population. Given the burden of HIV infection and disparities in health outcomes in the South, it is crucial for these issues to be explored in this context. The purpose of this study was to examine clinical data from a large HIV clinic in North Carolina in order to describe the prevalence of mental health conditions and substance use among HIV-infected patients, to examine differences by demographic characteristics, and to examine the relation of substance use and depression with suboptimal adherence to HIV medications.

Methods

Participants and Procedures

This study was a secondary analysis of clinical data routinely collected at a large HIV clinic in North Carolina. This clinic predominantly serves patients without private insurance; the patient population is divided approximately evenly among the following 4 payer sources: private insurance, Medicare, Medicaid, and no payer. Five full-time social workers are employed in the clinic and are available to provide mental health counseling, substance use counseling, and referral services.

At each clinic visit, patients were given a 2-page health screening questionnaire to complete while in the waiting room. Patients took approximately 5–10 minutes to complete the questionnaire. Providers were given the questionnaire to review, and it was at their discretion as to whether they discussed it with their patients.

Data from the questionnaire were entered into an electronic research database that is separate from the patients' medical records. Data were extracted from this database for patients who completed the questionnaire between February 2011 and August 2012. For patients who attended multiple appointments during that time period, only their most recent data were included in this analysis. Data extraction resulted in a dataset of 1,398 unique patients, out of approximately 1,900 patients enrolled in the clinic during the study period. This study was approved by Duke University Medical Center's institutional review board.

Measures

Demographic characteristics. Patients indicated their sex (male or female) and their sexual orientation (heterosexual, gay or lesbian, or bisexual). Patients wrote in their age and race/ethnicity, which we coded into categories of African American/black, white, Latino, or other.

Depression. Patients completed the Patient Health Questionnaire-9 (PHQ-9) [16], a scale that assesses how often individuals were bothered by symptoms of depression over the past 2 weeks (eg, feeling down, depressed, or hopeless; little interest or pleasure in doing things; feeling tired or having little energy). Patients indicated how often they experienced each symptom on a 4-point scale: (0) not at all, (1) several days, (2) more than half the days, and (3) nearly every day. Responses from the 9 questions were totaled to create a summary depression score (0–27). Presence and severity of depression symptomology was determined based on standard cutoffs: mild (5–9), moderate (10–14), moderately severe (15–19), or severe (20–27) [17]. A score of 10 or greater was indicative of risk for major depressive disorder.

Mental health diagnoses. Patients were asked about lifetime mental health diagnoses. The question stated, "Have you ever been diagnosed with any of the following mental health problems?" Patients were instructed to check all that apply from the following choices: depression, bipolar/manic depression, schizophrenia or psychotic disorder, anxiety (eg, obsessive compulsive disorder, panic disorder), other (specify), or none.

Psychiatric medications. Patients reported whether they were currently taking any psychiatric medication for depression, anxiety, or other mental health conditions.

Alcohol use. Patients completed questions from the Substance Abuse and Mental Illness Symptoms Screener (SAMISS) [18]. Three multiple-choice questions assessed typical alcohol use; these questions asked about frequency of drinking, number of drinks on a typical day, and how often respondents have 4 or more drinks on 1 occasion. Responses were scaled on a 4-point or 5-point Likert scale, with higher numbers indicative of more problematic drinking. Responses to the questions were totaled (range, 0–13), and patients were considered to have problematic drinking if their total score was 5 or greater [18].

Drug use. Patients reported which of the following drugs they had used to get high in the past year: marijuana, cocaine, crack, heroin, methamphetamine, painkillers (eg, oxycodone, Percocet), or other. They also indicated how often they used illicit drugs to get high or change the way they felt. According to SAMISS criteria, patients who reported using any drug at least weekly were considered to have problematic drug use [18].

Smoking. Patients reported whether or not they currently smoked cigarettes.

Adherence. Patients were asked a question from the Adult AIDS Clinical Trials Group Adherence Instrument to deter-

mine the last time they had missed taking their HIV ARV medication, if they were prescribed ARV therapy [19]. They were given 6 response choices: never skipped ARV medication, more than 3 months ago, 1–3 months ago, 2–4 weeks ago, within past 2 weeks, or within past 2 days. Patients were considered to have suboptimal adherence if they reported missing any pills in the previous month. A recent meta-analysis concluded that a single-item assessment of recent missed pills is a valid means of measuring adherence [20].

Analysis

Descriptive statistics were used to characterize the demographic characteristics of the sample. To examine sex and racial/ethnic differences in mental health and substance use outcomes, chi-square (χ^2) tests were conducted. For the purpose of the analysis, we combined the response categories of Latino, other, and African American/black to create a racial minority category.

To examine factors associated with suboptimal adherence to ARV medication, univariate logistic regression analyses were performed with 3 independent variables (problematic drinking, problematic drug use, and current depression symptomology) and demographic variables. Independent variables that were significantly associated with suboptimal adherence ($P<.10$) and all demographic characteristics (age, sex, sexual orientation, and race/ethnicity) were then included in a multivariable logistic regression model predicting suboptimal adherence. Odds ratios (ORs) and 95% confidence intervals are reported.

Results

Description of the Sample

Data were extracted from the responses of 1,398 patients (879 men, 353 women, 166 sex not reported) who completed the clinic's health behavior questionnaire between February 2011 and August 2012 (See Table 1). The sample was predominantly male (71.3%), with a mean age of 46 years. The majority of the sample identified as African American or black (56.3%), followed by white (38.2%).

Among female patients, 76.4% identified as African American or black, whereas 47.8% of male patients identified as African American or black ($\chi^2 = 76.6$; $P<.001$). Of the men who reported their sexual orientation, 73.3% reported being gay or bisexual; white men were more likely to report being gay or bisexual, compared with men in the minority race group (86.9% versus 41.6%; $P<.001$).

Mental Health

One-third (32.3%) of patients endorsed symptoms indicative of depression, with 12.2% endorsing symptomology indicative of moderate or severe levels of depression (See Table 2). Women were significantly more likely than men to report moderate or severe levels of depressive symptoms ($\chi^2 = 6.67$; $P<.05$). Over one-fifth of the sample indicated that they were currently taking psychiatric medication for depression, anxiety, or other mental health conditions. White patients ($\chi^2 = 32.88$; $P<.05$) and women ($\chi^2 = 3.94$; $P<.05$) were more likely to report taking psychiatric medications.

Overall, 38.6% of patients reported receiving a lifetime psychiatric diagnosis. White patients were more likely than minority patients to report a diagnosis of depression ($\chi^2 = 9.91$; $P<.01$) or anxiety ($\chi^2 = 22.50$; $P<.001$), while minority patients were more likely to report a diagnosis of schizophrenia or psychotic disorder ($\chi^2 = 9.52$; $P<.01$). Compared to men, women were more likely to report a diagnosis of depression ($\chi^2 = 3.93$; $P<.01$), bipolar disorder ($\chi^2 = 18.30$; $P<.001$), or schizophrenia or psychotic disorder ($\chi^2 = 21.88$; $P<.001$).

Substance Use

The majority (63.6%) of patients reported any current alcohol use, and one-third of those had indications of problematic drinking (19.1% of the entire sample; See Table 2). White patients ($\chi^2 = 6.09$; $P<.05$) and men ($\chi^2 = 13.53$; $P<.001$) were more likely to have indications of problematic drinking.

About one-fifth (19.1%) of patients reported illicit drug use in the past year, and 42.6% of those had indications of problematic drug use (8.2% of the entire sample). The most commonly used drug in the past year was marijuana (18.0%), followed by crack/cocaine (3.8%), painkillers (2.4%), methamphetamine (0.8%), and heroin (0.5%). There were no differences in overall problematic drug use by race/ethnicity or sex. However, when marijuana use was excluded, minority patients were more likely than white patients to report other drug use (ie, cocaine, crack, heroin, methamphetamine, or painkillers) in the past year (8.7% versus 3.2%; $\chi^2 = 13.47$; $P<.001$). Approximately one-third (31.0%) of the sample reported currently smoking

TABLE 1.
Description of the Patient Sample (N = 1,398)

	% (No.)
Sex	
Male	71.3% (879/1,232)
Female	28.7% (353/1,232)
Age	
17–34 years	15.8% (215/1,358)
35–49 years	45.4% (616/1,358)
50 years and older	38.8% (527/1,358)
Ethnicity	
African American/black	56.3% (720/1,279)
White	38.2% (488/1,279)
Other	3.0% (38/1,279)
Latino/Latina	2.6% (33/1,279)
Sexual orientation	
Gay/bisexual men	53.6% (450/839)
Heterosexual women	25.4% (213/839)
Heterosexual men	19.5% (164/839)
Lesbian/bisexual women	1.4% (12/839)

TABLE 2.
Descriptions of Mental Health and Substance Use and Differences by Race/Ethnicity and Sex (N = 1,398)

	% (No.)	Comparisons by race/ethnicity % (No.)			Comparisons by sex % (No.)		
	Total (N = 1,398)	White (n = 488)	Racial minority (n = 791)	*P*-value	Male (n = 879)	Female (n = 353)	*P*-value
Current mental health							
Any depression (score >5)	32.3% (415/1,286)	33.2% (155/467)	32.4% (234/722)	.414	30.5% (250/820)	38.4% (122/318)	.007*
Moderate or severe depression (score >10)	12.2% (157/1,189)	10.7% (50/467)	12.9% (93/722)	.150	10.5% (86/820)	16.0% (51/318)	.008*
Psychiatric medications	21.9% (302/1,380)	30.9% (133/778)	17.1% (150/485)	<.001**	21.2% (185/874)	26.5% (91/344)	.029*
Lifetime mental health diagnoses							
Any diagnosis	38.6% (497/1,288)	46.5% (214/460)	34.6% (251/726)	<.001**	36.8% (301/817)	45.2% (147/325)	.005**
Depression	30.7% (396/1,288)	36.7% (169/461)	28.0% (203/726)	.001**	29.5% (241/817)	37.5% (122/325)	.005**
Anxiety	13.8% (178/1,288)	20.0% (92/460)	10.2% (74/726)	<.001**	13.0% (106/817)	16.3% (53/325)	.086†
Bipolar/manic depression	5.6% (72/1,288)	4.5% (21/460)	6.2% (45/736)	.143	3.9% (32/817)	10.5% (34/325)	<.001**
Schizophrenia or psychotic disorder	2.3% (30/1,288)	0.7% (3/460)	3.4% (25/726)	.001	1.1% (9/818)	5.8% (19/325)	<.001**
Substance use							
Problematic drinking	19.1% (247/1,290)	23.1% (106/458)	17.3% (126/728)	.009*	21.8% (178/817)	12.3% (40/325)	<.001**
Problematic drug use	8.2% (104/1,263)	8.2% (37/450)	8.6% (61/709)	.455	9.1% (73/798)	6.6% (21/317)	.104
Smoke cigarettes	31.0% (396/1,276)	25.8% (118/457)	34.6% (248/717)	.001**	29.6% (238/804)	30.2% (98/324)	.442

†*P*<.10
**P*<.05
***P*<.01

cigarettes, with minority patients being more likely to report smoking ($\chi^2 = 10.00$; *P*<.01).

Predictors of Suboptimal Adherence to HIV Medications

Most of the sample (89.8%) reported currently taking ARV medications. Among those taking ARV medications, nearly one-quarter (22.1%) reported that they missed taking any of their ARV medication within the past month. Results of the bivariate and multivariable regression models are summarized in Table 3. Factors significantly associated with suboptimal adherence to ARV medications in univariate analyses were racial/ethnic minority, female sex, younger age, indications of moderate or severe depression, and problematic drug use. In the multivariable model, significant predictors of missed ARV medications included racial/ethnic minority (OR = 1.62; *P*<.05), age less than 35 years (OR = 1.72; *P*<.05), and having indications of moderate or severe depression (OR = 2.21; *P*<.01).

Discussion

This study examined mental health and substance use and their association with ARV medication adherence among patients in a large HIV clinic. Rates of mental health distress and substance use were high in this sample of HIV-infected patients. Compared to a national study that administered the same depression screening instrument, indications of depression were over 1.5 times higher in our sample than among the general population (12.2% versus 7.2%) [21]. A previous study conducted a decade earlier in this setting found rates of mental illness to be 60%, but that study had a much broader definition of mental illness and did not provide information about specific types of symptoms [22]. In our sample, there were no racial differences in current rates of depression. However, white patients in our sample reported much higher rates of ever having been diagnosed with depression and of ever having been prescribed psychiatric medications. These findings are consistent with the wider literature on depression. A large national prevalence study found higher lifetime rates of depression among non-Hispanic whites than among African Americans, but it found no racial differences in diagnoses of depression in the past year [23]. Differences between current depression symptomology and engagement with mental health treatment may reflect disparities in access to these services [24].

A majority of our sample reported current alcohol use, with nearly one-fifth (19%) having indications of problematic drinking; about 1 in 10 patients (8.2%) had indications of problematic drug use. A study conducted a decade ago in this setting reported that 32% of patients were abusing substances, but it is difficult to compare these results with

TABLE 3.
Univariate and Multivariate Predictors of Suboptimal Adherence to HIV Medication[a] (n = 1,117)

	Poor adherence[a]	Unadjusted OR (95% CI)	*P*-value	Adjusted OR (95% CI)	*P*-value
Demographic characteristics					
Sex					
Male	20.4%	1.00		1.00	
Female	26.8%	1.43 (1.03–1.98)	.032*	1.70 (0.95–3.07)	.075†
Age					
17–34 years	31.8%	1.72 (1.15–2.56)	.008**	1.72 (1.03–2.97)	.037*
35–49 years	21.4%	1.00		1.00	
50 years and older	19.5%	0.89 (0.65–1.23)	.474	1.04 (0.66–1.65)	.864
Ethnicity					
White	18.8%	1.00		1.00	
Minority	24.6%	1.40 (1.03–1.91)	.031*	1.62 (1.03–2.56)	.036*
Sexual orientation					
Heterosexual	24.2%	1.00		1.00	
Gay/lesbian/bisexual	22.8%	0.93 (0.66–1.31)	.665	1.38 (0.77–2.46)	.274
Mental health/substance use					
Depression					
None/mild	20.8%	1.00		1.00	
Moderate/severe	35.2%	2.07 (1.35–3.19)	.001**	2.21 (1.23–4.00)	.008**
Alcohol					
No problematic drinking	20.9%	1.00		1.00	
Problematic drinking	27.1%	1.40 (0.99–1.98)	.056†	1.17 (0.71–1.93)	.527
Drugs					
No problematic drug use	21.2%	1.00		1.00	
Problematic drug use	33.7%	1.89 (1.19–3.01)	.007**	1.02 (0.52–2.00)	.952

Note. CI, confidence interval; OR, odds ratio.
†*P*<.10
**P*<.05
***P*<.01
[a]Poor adherence to antiretroviral medication was defined as any missed pills in the previous month.

our findings because the previous study collapsed drug and alcohol abuse into a single category [22]. Drug use in our sample is slightly lower than national prevalence rates for patients with HIV, with one national study finding that 12% of HIV-infected adults screened positive for drug dependence within the past year [5]. In contrast, while national prevalence studies suggest that 8–11% of HIV-infected individuals are heavy or hazardous drinkers [6, 25], 19% of patients in our sample had indications of problematic drinking. This high level of alcohol use may be a reflection of contextual factors that contribute to the prevalence of HIV in this region, including high levels of HIV-related stigma [26, 27]. Substance use may be a means of coping with stress related to living with HIV [28, 29].

The rate of cigarette smoking was also much higher in our sample compared to the national rate (31% versus 19%) [30], although other studies of HIV-positive individuals have found smoking rates ranging between 50% and 70% [31]. Smoking rates were particularly elevated among women, who reported smoking at a rate nearly double national estimates (30% versus 17%). In our sample, minority individuals were significantly more likely to report smoking than whites. This difference is notable given that national data suggest that the smoking rate for minorities is comparable to or lower than the rate for whites (19% for non-Hispanic blacks, 13% for Hispanics, and 21% for whites)

The high prevalence of smoking in our sample is troubling because there is evidence that HIV-infected individuals are more vulnerable to the harmful effects of tobacco. Specifically, a large, multisite study of veterans found that smoking conferred a significantly higher risk of mortality among HIV-positive individuals compared to demographically matched HIV-negative individuals [32]. Although research is needed to understand the mechanisms by which smoking increases mortality in this population, there is some evidence that tobacco may reduce the effectiveness of highly active antiretroviral therapy (HAART) [33]. This underscores the importance of targeting smoking cessation efforts in this population.

About one-quarter of our sample reported suboptimal adherence to ARV medications. A meta-analysis of studies across a variety of settings has shown that nearly half of HIV patients have suboptimal adherence [34]. Higher adherence in our sample may be due to selection bias. Approximately 500 patients were enrolled in the clinic but did not fill out the questionnaire, either because they refused to participate or because they did not attend any clinical appointments over the 18-month period of data collection. Another 281 patients

completed portions of the questionnaire but skipped questions related to adherence. It is possible that the nearly 800 patients who did not disclose adherence habits were significantly less adherent, which would bias our findings.

Disclosure of suboptimal adherence behaviors may have been further compromised by the fact that data reported in this study were collected through a health behavior questionnaire administered as part of routine clinical care. Patients completed the questionnaire knowing that their responses would be reviewed by their health care provider. This may have introduced social desirability bias and created barriers to full disclosure of highly personal and potentially stigmatizing health behaviors. However, it is notable that a significant number of patients voluntarily reported sensitive information, suggesting a willingness of patients to engage in conversations with their health care providers regarding these behaviors. This lends strength to the recommendation that HIV care providers routinely assess mental health, substance use, and medication adherence as a part of clinical care [35-37]. Routine screening for these issues allows providers to address barriers to care, make appropriate referrals, and provide more comprehensive support to their patients.

In our sample, suboptimal adherence to ARV therapy was significantly correlated with depression symptoms. This finding, which is consistent with previous research documenting a robust relationship between depression and poor adherence to HIV medications [12, 13], provides strong evidence to suggest that addressing depression may improve both adherence to HIV treatment and subsequent HIV-related clinical outcomes. Moreover, treating depression may also reduce HIV risk transmission behaviors, including sexual risk taking and substance abuse, thus serving as an effective secondary HIV prevention strategy [38].

Younger patients and patients of minority race/ethnicity were also more likely to report suboptimal medication adherence. This may reflect less engagement with the health care system, which could be caused by a variety of factors. Younger patients may be unfamiliar with the health care system due to a shorter history of engagement, and/or they may lack the financial stability to attend appointments regularly [39]. Among minority patients, feelings of discrimination may lead to distrust and disengagement [40], and economic or social circumstances, including HIV stigma, may limit access to care and consistent use of medications [41, 42].

Suboptimal adherence among minority individuals may also be related to social and contextual factors such as poverty and lack of consistent access to care. Poverty can exacerbate the problem directly, though lack of insurance and affordable care, as well as indirectly, particularly for minorities, through its association with depression and discrimination [43]. Of individuals in this clinic, for example, only approximately one-fourth have private insurance. This is crucial to consider because the presence of unmet basic needs, such as food and shelter, is known to have the greatest effect on HIV disease progression, over and above medication adherence [44]. Given the high burden of HIV infection in minority communities in the South [1], there is an urgent need to better understand cultural and structural barriers to engagement with HIV care and to provide targeted outreach and services to appropriately engage these high-risk populations and retain them in care.

Findings from our study also suggest a need to increase access to behavioral health services. Standard pharmacological and psychotherapy interventions have been shown to be effective among HIV-infected populations [45-47], and thus greater integration of these services into HIV clinics has the potential to significantly improve the identification and management of mental illness. There is evidence to support the successful integration of depression or substance use treatment into nonpsychiatric clinical settings [48-50], suggesting that it would be feasible to co-locate these services in HIV clinics [51]. Additionally, given the low socioeconomic status of many patients in the clinic, it may also be important to consider environmental barriers that prevent engagement with care. Antidepressants and psychotherapy interventions have been shown to effectively reduce depression among minority, low-income populations when coupled with educational outreach, child care, and transportation [52].

This study has several limitations, in addition to the challenge noted above regarding possible social desirability bias. First, although the health behavior questionnaire was given to all patients, some opted not to fill out the form. Generalizability of our findings may be limited because we do not have information regarding patients who chose not to fill out the form. Non–English-speaking patients may not have been able to complete the form, which may be a reason for the low representation of Latino patients in our sample. Second, we did not have enough power to look at interactions between demographic groups. Future research would benefit from comparing demographic subgroups (eg, minority women versus minority men) to determine whether there are significant differences with regards to retention in care, as such information could be used to inform specialized outreach efforts. Third, use of each patient's most recently completed questionnaire may have biased our results, as it is possible that patients had respondent fatigue and may not have completed the form fully or accurately. Fourth, assessment of medication adherence is based on a single self-reported response, which may be compromised by social desirability bias or difficulty remembering the exact time that a dose of ARV medication was last missed. Future research would benefit from a more comprehensive assessment of treatment engagement, beyond medication adherence; criteria could include consistently staying in care for an extended period of time [53] or viral suppression. Fifth, the relationship between suboptimal adherence and minorities may be confounded by factors that were not measured

in the study, such as social support or HIV disclosure. Sixth, the clinic questionnaire was entered into a separate research database that is not linked to patients' medical records. As a result, we were not able to examine associations with clinical outcomes such as CD4 count or viral load. Finally, diagnoses of mental illnesses were measured by patient self-report; we did not have the resources to confirm past psychiatric diagnoses via medical record review or to conduct clinical assessments to confirm current diagnoses.

In summary, our findings suggest that addressing depression may be a key to improving ARV medication adherence among HIV patients in North Carolina. Providing comprehensive care that addresses mental health and substance use in the HIV clinic setting may lead to improved clinical outcomes. In addition, while access to comprehensive care is necessary, patients must also be motivated to participate in care. In the clinic setting, medical and other providers can boost patient motivation through routine screening; brief interventions with patients in the way they talk about alcohol and substance use; and referral to mental health and substance use services, which are ideally integrated into the HIV clinical care setting [54, 55]. In particular, minority patients, as well as younger patients, may be at higher risk for poor adherence, and thus would especially benefit from increased efforts to improve engagement and adherence. NCM

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