

The Contribution of Missed Clinic Visits to Disparities in HIV Viral Load Outcomes

Anne Zinski, PhD, Andrew O. Westfall, MS, Lytt I. Gardner, PhD, Thomas P. Giordano, MD, MPH, Tracey E. Wilson, PhD, Mari-Lynn Drainoni, PhD, Jeanne C. Keruly, MS, CRNP, Allan E. Rodriguez, MD, Faye Malitz, MS, D. Scott Batey, PhD, MSW, and Michael J. Mugavero, MD, MHSc

Disparities in HIV prevalence and health outcomes are well described for racial and ethnic minority populations and among persons with reported injection drug use (IDU) in the United States.¹⁻⁴ Among individuals diagnosed with HIV infection, these disparities are principally evident with respect to differential viral suppression (or virological failure), higher prevalence of AIDS, and increased mortality.^{1,5,6} Although recent literature indicates that 72% to 77% of all HIV-positive persons in the United States are linked to HIV primary care within 4 months of initial HIV diagnosis, only 35% of persons living with HIV are virally suppressed, attributable in part to challenges with longitudinal retention in care and inconsistent adherence to antiretroviral therapy (ART).^{3,7} Moreover, at a population level, surveillance data indicate that fewer Black persons have suppressed viral loads relative to both White and Hispanic/Latino populations.⁷ Similar disparities have been observed for patients who report IDU, with lower documented clinical service use, higher viral load burden, and increased mortality.^{4,8,9}

In recent years, considerable focus has been placed on the role of retention in HIV primary care as a critical determinant of HIV outcomes.^{10,11} Suboptimal retention in care is associated with lower ART receipt and worse biological outcomes, including higher viral load, which can contribute to increased infectivity and transmission.^{10,12,13} Disparate health care access and socioeconomic barriers may also have an impact on both prevalence and mortality rates in HIV.^{6,14-16} In addition, published literature has established that having a greater number of missed or “no-show” primary care HIV visits, as a measure of care retention, is associated with increased mortality among both new and established clinic patients in HIV primary care settings in the United States and abroad.¹⁵⁻¹⁷ Finally, among persons living with HIV/AIDS in the United States,

Objectives. We explored the contribution of missed primary HIV care visits (“no-show”) to observed disparities in virological failure (VF) among Black persons and persons with injection drug use (IDU) history.

Methods. We used patient-level data from 6 academic clinics, before the Centers for Disease Control and Prevention and Health Resources and Services Administration Retention in Care intervention. We employed staged multivariable logistic regression and multivariable models stratified by no-show visit frequency to evaluate the association of sociodemographic factors with VF. We used multiple imputations to assign missing viral load values.

Results. Among 10 053 patients (mean age = 46 years; 35% female; 64% Black; 15% with IDU history), 31% experienced VF. Although Black patients and patients with IDU history were significantly more likely to experience VF in initial analyses, race and IDU parameter estimates were attenuated after sequential addition of no-show frequency. In stratified models, race and IDU were not statistically significantly associated with VF at any no-show level.

Conclusions. Because missed clinic visits contributed to observed differences in viral load outcomes among Black and IDU patients, achieving an improved understanding of differential visit attendance is imperative to reducing disparities in HIV. (*Am J Public Health.* 2015;105:2068–2075. doi:10.2105/AJPH.2015.302695)

poor retention rates have been observed in Black persons and those who report IDU.^{4,9,17,18}

Although studies have identified suboptimal retention in care and inferior viral load responses among Black persons and persons who report IDU, few investigations have explicitly examined the role of poor retention patterns as they relate to observed disparities in HIV biological outcomes. In this study, we used a large cohort of established HIV primary care patients to examine the role of retention behavior, as measured by cumulative no-show visits, in contributing to disparities in HIV viral load outcomes among Black persons and persons who report IDU. We hypothesized that differential frequency of no-show clinic visits would contribute to the disparate occurrence of virological failure (nonsuppression) among race and risk transmission groups. As improving health outcomes and attenuating disparities are principal objectives of the US National HIV/AIDS Strategy,¹⁹ investigating the contribution

of retention in HIV care to observed disparities in outcomes may help establish a modifiable intermediary intervention target on the continuum of HIV care.

METHODS

The study sample included 10 053 patients at 6 clinical sites before the implementation of the Centers for Disease Control and Prevention and Health Resources and Services Administration–sponsored Retention in Care (RIC) Intervention Study (ClinicalTrials.gov: CDCHRSA9272007); details from the parent study have been described in detail previously.^{20,21} The 6 university-affiliated HIV Outpatient Primary Care Clinics were in mid-to large-size metropolitan areas in the United States: Baltimore, Maryland; Birmingham, Alabama; Boston, Massachusetts; Brooklyn, New York; Houston, Texas; and Miami, Florida. Data from each site were stripped of individual identifiers.

Inclusion Criteria

To ensure that the study population comprised established clinic patients, we employed 2 specific inclusion criteria for analyses. First, patients must have arrived for at least 1 scheduled HIV primary care visit at the participating clinic during the 12-month period before the study measurement period of May 1, 2008, through April 30, 2009 (the year preceding implementation of the RIC intervention).

Second, each of the patients who met the first criterion had to have a scheduled HIV primary care appointment during the first 6 months of the study measurement period. As this group had greater opportunities to receive ART and achieve viral suppression, we elected to use data from established clinic patients versus new clinic patients, who may have had insufficient time to achieve viral suppression, the primary outcome of interest.

Finally, we chose the 12-month period before the intervention implementation as the measurement period to avoid potential confounding by phase 1 of the subsequent RIC intervention, which began in May 2009.²⁰ Because we included all patients meeting the eligibility criteria, analyses are reflective of clinic-wide evaluation of established patients in 6 study sites.

Variables of Interest

We collected patient-level sociodemographic factors from records data. These included gender, race, ethnicity, age, site, and HIV risk factor. Risk factor categories were heterosexual, men who have sex with men (MSM), IDU, and other or unknown; we categorized records listing both MSM and IDU risk factors as IDU.

We defined baseline viral load and CD4 count as the measure nearest the observation period start date, May 1, 2008, within a plus-or-minus-120-day window. We defined the principal exposure of interest, retention in HIV primary care, as number of missed HIV primary care clinic visits, with consistent coding employed across all participating sites. We defined missed clinic visits as scheduled HIV primary care appointments that were not cancelled by the patient or by the clinic for which the patient did not arrive, also called “no-show” visits.²²

We conducted sensitivity analyses by using visit adherence (proportion of arrived HIV primary care visits) in place of missed visit count as the measure of retention in HIV primary care, with comparable findings observed (data not shown).

The primary outcome measure was non-suppressed plasma viral load, defined as a viral load greater than 400 copies per milliliter (c/mL), because of limits of viral load detection at this level with assays used by laboratories during the study period (2008–2009). Viral load measures were captured as part of routine care, with the measure closest to the end of the 12-month observation period (± 120 days) used for analytic purposes.

Statistical Analyses

We computed descriptive statistics including means, standard deviations, frequencies, and percentages for all study variables to assess distributions. To investigate the relationship among missed visits, the sociodemographic variables of Black race and IDU, and virological nonsuppression at 12 months (> 400 c/mL), we fit staged multivariable logistic regression models. First, we used multivariable models to evaluate relationships between sociodemographic variables (including race and IDU) and virological nonsuppression at the end of 12 months. Next, we added the count of no-show visits that occurred during the 12-month observation period, our designated measure of retention in care, to the model to assess the impact of missed visits on the parameter estimates and statistical significance of the race and HIV transmission risk categories. Consistent with previous studies,²³ we employed this staged modeling approach to evaluate the putative role of differential retention in care, operationalized as missed visit count, as a mediator on the causal pathway between Black race and IDU with virological failure.

Next, we employed separate multivariable models to assess associations between patient characteristics and virological nonsuppression among patients stratified by frequency of no-show visits. These models used patients' retention classified as zero, 1, 2, 3, or 4 or more no-show visits during the measurement period. We used these multivariable models stratified by missed visit

count to evaluate the presence of disparities in virological nonsuppression across socio-demographic groups exhibiting similar patterns of HIV care retention (i.e., according to the same number of no-show visits accrued over 12 months). Because we hypothesized that missed visits would be a mediator on the casual pathway between race and risk factor with laboratory indicators,^{10,24} we evaluated these stratified models to provide additional evidence, beyond the staged modeling approach, of the putative mediating role of missed visits in contributing to disparities in virological nonsuppression among Black and IDU patients.

For patients with missing 12-month viral load measures ($n = 1818$), we imputed values with SAS's multiple imputation procedure (version 9.3, SAS Institute Inc, Cary, NC), a fully conditional specification multiple imputation method. Multiple imputation is a Monte Carlo technique in which missing values are replaced by m simulated versions. According to recommendations,²⁵ we used $m = 10$ simulated versions for primary analyses, and also ran $m = 20$ simulated versions as sensitivity analyses, with highly consistent results observed (data not shown). Variables included in the imputation process were site, gender, race, ethnicity, HIV risk factor classification, age at baseline, baseline viral load, baseline CD4, 12-month viral load (continuous), and the number of no-show visits (continuous). The imputed missing values (1818×10 simulations) yielded 42% with viral loads less than or equal to 400 c/mL ($n = 7603$), and 58% at greater than 400 c/mL ($n = 10\,577$). We analyzed each of the simulated complete data sets by standard methods, and we combined the results by using SAS's MIANALYZE procedure to produce estimates and confidence intervals that incorporated missing-data uncertainty.

RESULTS

Among 10 053 study participants, the majority were male (65%), Black (64%), approximately 19% Hispanic ethnicity, and the mean age was 46 years (Table 1). Baseline viral load for the sample was 2.59 (± 1.17) \log_{10} c/mL, and baseline CD4 cell count was 456 c/mL (± 296 ; Table 1). Just over one quarter of the

TABLE 1—Sociodemographic Characteristics: Centers for Disease Control and Prevention and Health Resources and Services Administration Retention in Care Preintervention, 6 US Metropolitan Areas, May 2008–April 2009

Characteristic	Mean \pm SD or Frequency (%)
Site	
Boston University Medical Center	1053 (10.5)
Johns Hopkins University	1883 (18.7)
Baylor College of Medicine/Thomas Street Health Center	2904 (28.9)
University of Miami	1984 (19.7)
SUNY Downstate Medical Center	922 (9.2)
University of Alabama at Birmingham	1307 (13.0)
Age, y	45.95 \pm 10.0
Gender ^a	
Female	3465 (34.6)
Male	6549 (65.4)
Race	
Black	6435 (64.0)
White	3004 (29.9)
Other	614 (6.1)
Ethnicity ^a	
Hispanic	1880 (18.9)
Non-Hispanic	8066 (81.1)
HIV risk factor	
Heterosexual	4947 (49.2)
IDU	1548 (15.4)
MSM	2837 (28.2)
Other or unknown	721 (7.2)
Baseline CD4	456.3 \pm 295.7
Baseline plasma HIV RNA (\log_{10} c/mL)	2.59 \pm 1.17
Mean number of no-show visits	1.51 \pm 1.70
12-mo virological failure (> 400 c/mL) or missing ^a	3749 (37.3)

Note. IDU = intravenous drug use; MSM = men who have sex with men; SUNY = State University of New York. The metropolitan areas surveyed were in Baltimore, MD; Birmingham, AL; Boston, MA; Brooklyn, NY; Houston, TX; and Miami, FL. The sample size was $n = 10\ 053$.

^aMissing values: gender = 39; ethnicity = 107; viral load at 12 months = 1818.

sample had a transmission risk category of MSM (28.2%), with approximately half with heterosexual risk behavior (49.2%), and an additional 13.1% had a risk factor of IDU (Table 1). At 12-month follow up, more than one third of the total sample (37%) exhibited a nonsuppressed viral load (> 400 c/mL), or had a missing 12-month viral load value.

As shown in Table 1, the mean number of no-shows for HIV primary care visits for the overall sample was 1.51 during the 12-month observation period. A graphic comparison of the overall no-show count patterns for Black and White patients is available in Figures 1 and

2; the mean number of no-show visits differed by race group (1.69 Black vs 1.13 White), and by HIV transmission risk classification, specifically IDU (1.96 IDU vs 1.20 MSM; data not shown).

In the initial multivariable model (Table 2), older age (odds ratio [OR] = 0.83 per 10 years; 95% confidence interval [CI] = 0.78, 0.88) and Hispanic ethnicity (OR = 0.81; 95% CI = 0.67, 0.98) were associated with more favorable viral load outcomes (i.e., a decreased odds of a nonsuppressed viral load). Black race (OR = 1.19; 95% CI = 1.01, 1.40), IDU (OR = 1.23; 95% CI = 1.03, 1.47), baseline

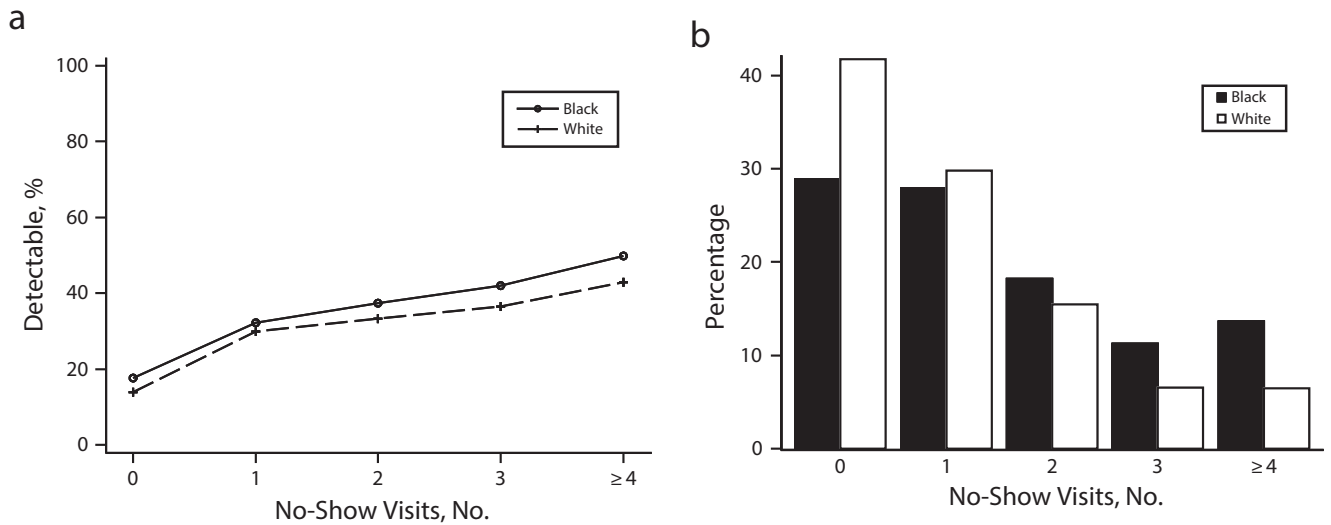
CD4 less than 200 c/mL (OR = 1.24; 95% CI = 1.04, 1.47), and higher baseline viral load (OR = 2.06; 95% CI = 1.96, 2.17) were associated with statistically significantly greater odds of having a nonsuppressed 12-month viral load.

After we added the no-show visit count variable to the initial multivariable model, the odds of having a nonsuppressed viral load remained unchanged with respect to age, ethnicity, and baseline viral load. However, we observed attenuated parameter estimates for patient characteristics that were significant predictors of virological nonsuppression in the initial model (Table 2). With respect to race, the original odds for virological failure for Black patients decreased from 1.19 in the initial model to 1.11 (95% CI = 0.94, 1.32), and the contribution of race was no longer statistically significant ($P = .039$ vs $.202$). Similarly, for IDU versus heterosexual risk group, odds of virological failure were attenuated from 1.23 in the initial model to 1.10 (95% CI = 0.97, 1.32), and was no longer statistically significant ($P = .025$ vs $.324$) with the inclusion of no-show frequency (Table 2). A 20% increased odds for virological nonsuppression at 12 months was observed for each additional missed visit accrued during this time period.

Next, we used separate multivariable models to assess associations between sociodemographic characteristics (including race and IDU) and virological failure stratified by frequency of no-show visits (Table 3). The contribution of race and IDU to odds of nonsuppressed viral load was not statistically significant in any models for any level of the no-show groups (Table 3). A visual representation of this relationship is presented in Figure 1a for race, where the proportion of nonsuppressed viral load for Black and White race subgroups is depicted according to number of no-show visits alongside Figure 1b, illustrating percentage of Black and White patients by number of missed visits; similar visual results are shown for IDU risk factor (Figure 2).

DISCUSSION

This study has important implications, particularly for illustrating the relationship between retention patterns, as measured by missed clinic visits, and viral load outcomes for



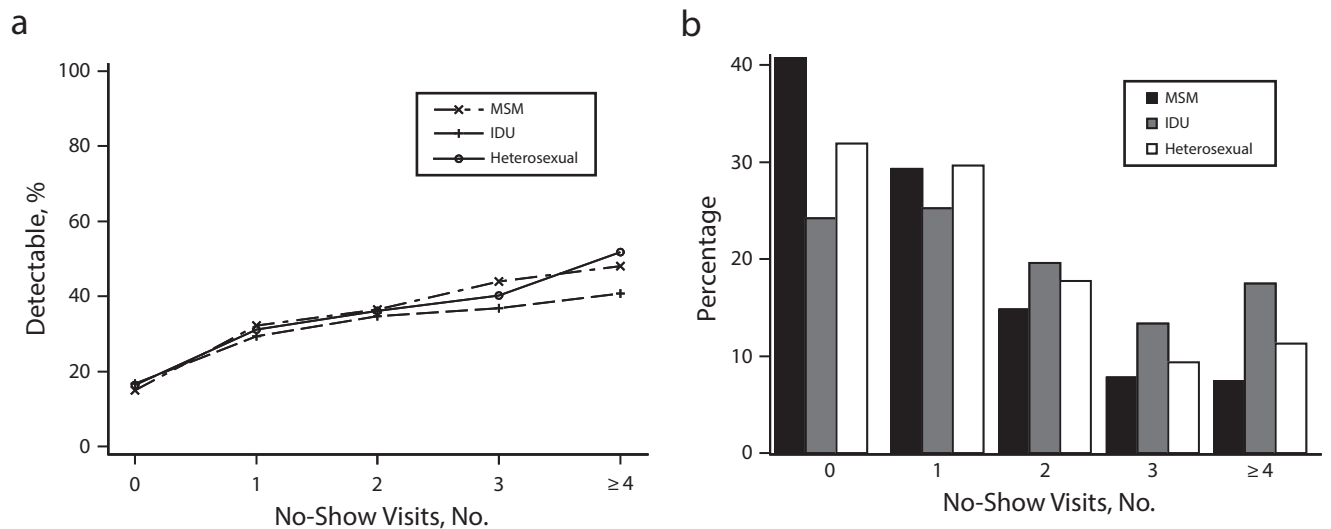
Note. The metropolitan areas surveyed were in Baltimore, MD; Birmingham, AL; Boston, MA; Brooklyn, NY; Houston, TX; and Miami, FL.

FIGURE 1—Percentage of (a) virological failure by race stratified by frequency of no-show visits and (b) no-show visits by race: Centers for Disease Control and Prevention and Health Resources and Services Administration Retention in Care preintervention, 6 US metropolitan areas, May 2008 to April 2009.

groups with traditionally disparate HIV outcomes. This is especially noteworthy with respect to racial subgroup disparities, as a primary objective of the US National HIV/AIDS

Strategy is to reduce HIV-related inequities specifically by increasing the proportion of HIV-diagnosed Black patients with undetectable viral load by at least 20%.¹⁹ Race alone

cannot be specifically targeted for change in interventions to improve viral suppression, and Black race could heretofore only be identified as a priority population for focused



Note. IDU = intravenous drug use; MSM = men who have sex with men. The metropolitan areas surveyed were in Baltimore, MD; Birmingham, AL; Boston, MA; Brooklyn, NY; Houston, TX; and Miami, FL.

FIGURE 2—Percentage of (a) virological failure by risk factor stratified by frequency of no-show visits and (b) no-show visits by risk factor: Centers for Disease Control and Prevention and Health Resources and Services Administration Retention in Care preintervention, 6 US metropolitan areas, May 2008 to April 2009.

TABLE 2—Odds of Virological Failure in Multivariable Analyses for Characteristics With Patient Variables and No-Show Visit Count: Centers for Disease Control and Prevention and Health Resources and Services Administration Retention in Care Preintervention, 6 US Metropolitan Areas, May 2008–April 2009

Characteristic	Odds of VF, Patient Variables Only		Odds of VF, With No-Show Count	
	OR (95% CI)	P	OR (95% CI)	P
Gender: male vs female	1.05 (0.91, 1.21)	.526	1.07 (0.92, 1.23)	.371
Ethnicity: Hispanic vs non-Hispanic	0.81 (0.67, 0.98)	.03	0.79 (0.65, 0.96)	.015
Race				
Black vs White	1.19 (1.01, 1.40)	.039	1.11 (0.94, 1.32)	.202
Other vs White	1.24 (0.89, 1.73)	.198	1.20 (0.85, 1.68)	.283
Risk factor				
IDU vs heterosexual	1.23 (1.03, 1.47)	.025	1.10 (0.91, 1.32)	.324
MSM vs heterosexual	0.91 (0.76, 1.08)	.263	0.91 (0.76, 1.08)	.266
Age, baseline (per 10 y)	0.83 (0.78, 0.88)	< .001	0.86 (0.81, 0.91)	< .001
Baseline CD4				
< 200 vs > 350	1.24 (1.04, 1.47)	.015	1.14 (0.96, 1.36)	.127
200–350 vs > 350	1.04 (0.90, 1.20)	.612	0.99 (0.85, 1.14)	.87
Baseline viral load (log ₁₀ c/mL)	2.06 (1.96, 2.17)	< .001	1.98 (1.88, 2.09)	< .001
No-show frequency (per no-show visit)			1.20 (1.16, 1.25)	< .001

Note. CI = confidence interval; IDU = intravenous drug use; MSM = men who have sex with men; OR = odds ratio; VF = virological failure. The metropolitan areas surveyed were in Baltimore, MD; Birmingham, AL; Boston, MA; Brooklyn, NY; Houston, TX; and Miami, FL. The sample size was n = 10 053.

interventions. However, our finding of a comparable frequency of virological nonsuppression across racial groups when stratified by missed visit frequency suggests that no-show events represent a specific target behavior for potential intervention. Although future investigations will determine whether interventions to equalize no-show visit frequencies between racial groups will attenuate and overcome disparities in HIV viral suppression, our findings provide empirical evidence supporting the potential of this approach.

Because the association between poor retention, particularly no-show behavior, and poorer biological outcomes evidenced by virological failure and mortality is established in the literature,^{10,11,15,26} we employed no-show frequency as a measure of overall retention in primary care. Study findings were consistent with our original hypothesis that no-show clinic visits contribute to the association between patient race and HIV risk transmission behavior and virological nonsuppression. Our results suggest that the frequency of no-show clinic events influences the relationship between disparities in race and risk subgroups and

virological nonsuppression for established HIV patients, which is consistent with the limited number of investigations of this type.²³ As analyses using a dichotomous measure of no-show visit events (yes or no) produced similar results (data not shown), it is essential to further evaluate missed clinic visits and no-show events as modifiable behavioral factors, and use them as intervention targets for HIV clinical and public health programming.

Reduced service use and no-show behaviors are prevalent for persons who report IDU,^{8,15,27} as replicated in this study. As observed for Black patients, the greater frequency of viral nonsuppression observed among persons with reported IDU was markedly attenuated when we controlled for missed visits. Moreover, we observed comparable frequencies of viral nonsuppression between IDU and heterosexual risk factor when stratified by missed visit count. This is not unexpected, as reduced ancillary service use and decreased uptake of clinical and laboratory services have also been shown for persons who inject drugs and for persons with drug abuse histories.⁴ Limits to availability and scope of HIV

education and services²⁸ have also been cited as barriers for those who report IDU that may contribute to the frequency of missed visits and likelihood of nonsuppressed viral load.

When one is considering potential intervention approaches, proactive clinical scheduling systems and sophisticated surveillance technologies may prove beneficial for both identifying and subsequently preventing no-show behavior. Success has been shown for automated and live text or voice appointment reminders alone or in combination with coordinated messages^{20,29} or missed visit notifications to improve attendance at health care visits. In addition, the evidence for employing telemedicine services for improving HIV outcomes in rural populations in the United States is limited, but poses promising evidence for reducing missed visits that are the result of transportation limitations.

Barriers to accessing care, including time, distance to clinic, and insurance or payment limitations, have been shown to influence retention negatively,^{18,30,31} and may be indicators of important social determinants fueling disparities and serving as intervention targets. Lack of insurance is described as a contributor to gaps in HIV care, poor retention, and staying out of care entirely for specific risk subgroups such as persons with drug or alcohol use.^{30,32,33} Level of social support and social capital^{10,34–37} can influence visit adherence and gaps in HIV primary care, particularly among persons who report IDU,³⁵ persons of younger age,³³ and racial/ethnic minority MSM.³⁸ Access barriers, particularly with respect to ART, have been shown to contribute to HIV prevalence and overall mortality in the United States.^{6,39,40} Recent literature posits an association between poverty and worse viral suppression and mortality in persons with HIV.^{18,41} It is important to note, however, that several recent investigations indicated that racial and sociodemographic disparities were reduced when access to HIV services was similar among heterogeneous cohorts of HIV-positive individuals.^{42,43}

Other intervention targets include psychological and attitudinal factors, which have also shown an association with no-show events, and with retention behavior patterns in general. Perceived and anticipated stigma are documented barriers to HIV service use^{10,44} and

TABLE 3—Odds of Virological Failure in Multivariable Analysis by No-Show Visit Frequency: Centers for Disease Control and Prevention and Health Resources and Services Administration Retention in Care Preintervention, 6 US Metropolitan Areas, May 2008–April 2009

Characteristic	Odds of VF No-Show Count = 0		Odds of VF No-Show Count = 1		Odds of VF No-Show Count = 2		Odds of VF No-Show Count = 3		Odds of VF No-Show Count ≥4	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Gender: male vs female	1.03 (0.76, 1.38)	.857	1.06 (0.83, 1.37)	.638	1.13 (0.79, 1.62)	.487	1.05 (0.71, 1.55)	.796	1.01 (0.74, 1.39)	.93
Ethnicity: Hispanic vs non-Hispanic	0.72 (0.46, 1.14)	.16	0.84 (0.60, 1.17)	.302	0.73 (0.47, 1.16)	.183	0.76 (0.39, 1.46)	.402	0.70 (0.39, 1.28)	.248
Race										
Black vs White	1.15 (0.82, 1.61)	.406	1.00 (0.74, 1.35)	.994	1.10 (0.78, 1.55)	.603	1.25 (0.72, 2.18)	.424	1.09 (0.67, 1.76)	.723
Other vs White	1.22 (0.68, 2.20)	.496	1.19 (0.67, 2.10)	.548	1.32 (0.67, 2.60)	.419	0.90 (0.37, 2.20)	.825	1.20 (0.53, 2.72)	.663
Risk factor										
IDU vs heterosexual	1.31 (0.84, 2.05)	.235	1.16 (0.86, 1.57)	.34	1.15 (0.77, 1.70)	.488	1.30 (0.79, 2.15)	.294	0.74 (0.50, 1.09)	.127
MSM vs heterosexual	0.92 (0.66, 1.30)	.642	0.97 (0.74, 1.28)	.84	0.87 (0.58, 1.31)	.509	1.09 (0.70, 1.70)	.707	0.73 (0.47, 1.15)	.177
Age, baseline (per 10 y increased age)	0.86 (0.76, 0.97)	.013	0.89 (0.80, 0.99)	.025	0.86 (0.74, 0.99)	.032	0.83 (0.69, 1.00)	.056	0.88 (0.76, 1.03)	.114
Baseline CD4										
< 200 vs > 350	0.89 (0.58, 1.36)	.578	1.11 (0.82, 1.48)	.498	1.40 (0.96, 2.06)	.081	0.95 (0.61, 1.48)	.807	1.55 (1.07, 2.24)	.02
200–350 vs > 350	0.95 (0.72, 1.26)	.718	1.02 (0.79, 1.33)	.854	0.97 (0.72, 1.30)	.824	0.90 (0.56, 1.44)	.658	1.08 (0.73, 1.61)	.699
Baseline viral load (log ₁₀ c/mL)	2.42 (2.14, 2.73)	<.001	1.93 (1.75, 2.12)	<.001	1.83 (1.62, 2.05)	<.001	1.88 (1.63, 2.16)	<.001	1.80 (1.59, 2.05)	<.001

Note. CI = confidence interval; IDU = intravenous drug use; MSM = men who have sex with men; OR = odds ratio; VF = virological failure. The metropolitan areas surveyed were in Baltimore, MD; Birmingham, AL; Boston, MA; Brooklyn, NY; Houston, TX; and Miami, FL. The sample size was n = 10 053.

present a distinct barrier to self-management behaviors in HIV-infected female populations.⁴⁵ HIV self-care behaviors, including medication adherence and visit attendance for infected subgroups, are also shown to be influenced by cultural factors, mistrust, and conspiracy beliefs.^{46–48} Emerging system- and individual-level literature that describes the influence of patient satisfaction, health care empowerment, patient–provider relationships, and clinical interactions on retention in care also shows promise for improving appointment attendance, and for implementation of retention interventions at multiple levels.^{10,49,50}

This study helps to reiterate the need to address suboptimal retention behavior across all HIV-positive subgroups to improve virological outcomes. The increased use of evidence-based intervention approaches to prevent or reduce no-show events, including peer support, education initiatives, structured strengths-based case management, addressing substance use, and frequent personal contact with clients from clinical facilities,^{15,20,51–53} may help to lessen known race and risk transmission group disparities in HIV, particularly with respect to retention and virological suppression.

Limitations

Limitations of this study included use of an observational cohort study design over a relatively short 12-month follow-up period. Second, exposure to ART, the major contributor to virological suppression, was not systematically captured and available for inclusion in these analyses. As a greater proportion of Black patients had 4 or more missed visits (Figure 1b), poor ART adherence or delayed ART initiation in this subgroup may have contributed to the observed association between low baseline CD4 count and viral nonsuppression. In addition, although mechanisms for recording patient-level insurance status and type were in place for billing purposes at participating clinical sites during the observation period, these were not reported uniformly or coded consistently across all sites for comparison in this analysis. Therefore, we did not systematically explore insurance status and type, though they are potential socioeconomic indicators of health care access or poverty.^{31,37}

We elected to focus on missed visit count as the primary measure of retention as missed visits are readily captured in real time and immediately actionable, although variability between patients in total scheduled visits has an impact on this measure. The robustness of

study findings in sensitivity analyses using visit adherence, which further accounts for total number of scheduled visits, is noteworthy. Finally, these findings may not be applicable for persons who are newly diagnosed or new to HIV outpatient primary care or for individuals who have been out of care for more than 12 months, as we focused exclusively on established clinic patients. Notably, studies of patients newly initiating outpatient HIV medical care or ART have demonstrated a lower average frequency of missed visits over a 12-month observation period (1.11 to 1.23) than seen in the sample of established patients (1.51) in the current study.^{54,55}

Conclusions

With a large multisite observational US cohort drawn from HIV outpatient clinics, our analyses showed differences consistent with described disparities in virological nonsuppression for a number of patient subgroups. By using a staged logistic regression approach and a series of multivariable models stratified by retention behavior, specifically no-show visit count, we made innovative observations regarding nonsuppressed viral load for Black race and IDU risk factor. Our findings indicate that the frequency of missed HIV primary care

visits meaningfully contribute to observed differences in viral load outcomes for Black persons and persons who report IDU, a novel and noteworthy finding within a cohort of this size. These results indicate a need for efforts that emphasize the development, investigation, and implementation of interventions to target factors that influence no-show behavior, in an effort to overcome observed disparities and to improve outcomes for all persons living with HIV. ■

About the Authors

Anne Zinski, Andrew O. Westfall, D. Scott Batey, and Michael J. Mugavero are with the Department of Medicine, Division of Infectious Diseases, University of Alabama at Birmingham. Lytt I. Gardner is with the Division of HIV/AIDS Prevention, Centers for Disease Control and Prevention, Atlanta, GA. Thomas P. Giordano is with the Department of Medicine, Section of Infectious Diseases, Baylor College of Medicine, Houston, TX. Tracey E. Wilson is with the Department of Community Health Sciences, State University of New York, Downstate Medical Center, Brooklyn, NY. Mari-Lynn Drainoni is with the Department of Health Policy and Management, Boston University School of Public Health, Boston, MA. Jeanne C. Keruly is with Johns Hopkins University, School of Medicine, Division of Infectious Diseases, Baltimore, MD. Allan E. Rodriguez is with the Division of Infectious Diseases, Miller School of Medicine, University of Miami, FL. Faye Malitz is with the HIV/AIDS Bureau, Health Resources and Services Administration, Rockville, MD.

Correspondence should be sent to Anne Zinski, University of Alabama at Birmingham, 845 19th St S, BBRB 206B, Birmingham, AL 35294-2170 (e-mail: azinski@uab.edu). Reprints can be ordered at <http://www.ajph.org> by clicking the "Reprints" link.

This article was accepted March 29, 2015.

Note. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Contributors

A. Zinski led the writing for this article, with statistical analyses by A. O. Westfall. All other authors have contributed to the concept, analysis, drafting, and revisions to the article, and each has approved the final version. Please note that this article reflects contributions from a principal investigator at each of 6 academic sites that participated in the study, as well as the original study design and sponsoring team, with additional conceptual, design, and analytical support from the corresponding author's home institution.

Acknowledgments

The Retention in Care (RIC) Intervention study was funded by the Centers for Disease Control and Prevention and Health Resources and Services Administration (ClinicalTrials.gov: CDCHRSA9272007).

Findings were presented in part at the 8th International Conference on HIV Treatment and Prevention Adherence; June 3, 2013; Miami, FL.

The authors wish to thank the entire RIC Study Group.

Human Participant Protection

All participating clinical sites received institutional review board approvals to use clinic-wide, patient-level data in this investigation.

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