

# HIV Transmission Risk Behaviors among HIV-Infected Persons Who Are Successfully Linked to Care

Lisa R. Metsch,<sup>1</sup> Margaret Pereyra,<sup>1</sup> Shari Messinger,<sup>1</sup> Carlos del Rio,<sup>2</sup> Steffanie A. Strathdee,<sup>4</sup> Pamela Anderson-Mahoney,<sup>5</sup> Ellen Rudy,<sup>6</sup> Gary Marks,<sup>3</sup> and Lytt Gardner,<sup>3</sup> for the Antiretroviral Treatment and Access Study (ARTAS) Study Group<sup>a</sup>

<sup>1</sup>Miller School of Medicine, University of Miami, Miami, Florida; <sup>2</sup>Emory University School of Medicine and <sup>3</sup>Centers for Disease Control and Prevention, Atlanta, Georgia; and <sup>4</sup>University of California San Diego School of Medicine, San Diego, and <sup>5</sup>Epidemiology Resources and <sup>6</sup>Los Angeles County Health Department STD Program, Los Angeles, California

**Objectives.** We examined the relationship between receipt of medical care for human immunodeficiency virus (HIV) infection and HIV transmission risk behavior among persons who had received a recent diagnosis of HIV infection.

**Methods.** We enrolled 316 participants from 4 US cities and prospectively followed up participants for 1 year. Generalized estimating equations were used to examine whether having at least 3 medical care visits in a 6-month period was associated with unprotected vaginal or anal intercourse with an HIV-negative partner or partner with unknown HIV status.

**Results.** A total of 27.5% of the participants (84 of 305) self-reported having unprotected sex with an HIV-negative or unknown status partner at enrollment, decreasing to 12% (31 of 258) and 14.2% (36 of 254) at 6-month and 12-month follow-ups, respectively. At follow-up, people who had received medical care for HIV infection at least 3 times had reduced odds of engaging in risk behavior, compared with those with fewer visits. Other factors associated with reduced risk behavior were being >30 years of age, male sex, not having depressive symptoms, and not using crack cocaine.

**Conclusions.** Being in HIV care is associated with a reduced prevalence of sexual risk behavior among persons living with HIV infection. Persons linked to care can benefit from prevention services available in primary care settings.

Linking persons who have received a diagnosis of HIV infection to primary care has become a national priority [1–3]. Regular HIV primary care ensures that persons living with HIV infection will have their disease monitored and gives such individuals the opportunity to receive antiretroviral medications that can prolong survival [4, 5]. From a prevention perspective, receiving antiretroviral treatment is important, because it can reduce an HIV-infected person's viral load and, there-

fore, reduce the risk of that individual transmitting the virus to others [6, 7]. In addition, HIV prevention counseling is now recognized as an important part of HIV care [8].

However, little research has examined, from a longitudinal perspective, whether entering HIV primary care is associated with reduced HIV transmission risk behavior. Latkin et al. [9] conducted a cross-sectional analysis of 244 HIV-positive injection drug users recruited from street settings in Baltimore, Maryland, and showed that the odds of unprotected sex were lower among those who received medical care for HIV infection [9]. Booth et al. [10] conducted a cross-sectional analysis involving 777 HIV-positive injection drug users and crack smokers from 5 US cities and showed that injection drug use and sexual risk behaviors were lower among those who received general health care services.

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<sup>a</sup> Members of the study group are listed at the end of the text.

Reprints or correspondence: Dr. Lisa R. Metsch, Dept. of Epidemiology and Public Health, 1120 NW 14th St., Ste. 916, Miami, Florida 33136 (lmetsch@med.miami.edu).

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**Table 1. Baseline characteristics of study sample and prevalence of unprotected vaginal or anal sex with HIV-negative partners or partners with unknown HIV infection status, Antiretroviral Treatment Access Study (ARTAS), 2001–2002.**

Variable	No. (%) of patients		<i>P</i> <sup>b</sup>
	All patients	Patients reporting unprotected sex <sup>a</sup>	
No. of patients	308 (100)	305 (100)	
Study site			
Atlanta, GA	79/308 (25.6)	22/77 (28.6)	.012
Baltimore, MD	61/308 (19.8)	14/61 (23.0)	
Los Angeles, CA	92/308 (29.9)	17/91 (18.7)	
Miami, FL	76/308 (24.7)	31/76 (40.8)	
ARTAS study group			
Control group	154/308 (50.0)	48/153 (31.4)	.133
Intervention group	154/308 (50.0)	36/152 (23.7)	
Age			
≤30 years	73/308 (23.7)	29/73 (39.7)	.008
>30 years	235/308 (76.3)	55/232 (23.7)	
Sex			
M	224/308 (72.7)	55/224 (24.6)	.052
F	84/308 (27.3)	29/81 (35.8)	
Married or lives with partner			
Yes	54/307 (17.6)	18/53 (34.0)	.231
No	253/307 (82.4)	65/251 (25.9)	
Race/ethnicity			
White/non-Hispanic	27/308 (8.8)	9/26 (34.6)	.642
Black/non-Hispanic	183/308 (59.4)	48/182 (26.4)	
Hispanic	81/308 (26.3)	21/81 (25.9)	
Other	17/308 (5.5)	6/16 (37.5)	
High school graduate			
Yes	148/307 (48.2)	40/147 (27.2)	.874
No	159/307 (51.8)	44/157 (28.0)	
Income			
\$0–\$5000	148/292 (50.7)	35/146 (24.0)	.548
\$5001–\$10,000	57/292 (19.5)	16/57 (28.1)	
\$10,001–\$20,000	55/292 (18.8)	20/54 (37.0)	
\$20,001–\$30,000	21/292 (7.2)	7/21 (33.3)	
\$30,001–\$50,000	8/292 (2.7)	3/8 (37.5)	
≥\$50,001	3/292 (1.0)	1/3 (33.3)	
Employment status			
Unemployed	174/306 (56.9)	41/172 (23.8)	.083
Employed	132/306 (43.1)	43/131 (32.8)	
Stable housing			
Yes	237/306 (77.4)	67/236 (28.4)	.626
No	69/306 (22.6)	17/67 (25.4)	
Children living with respondent			
Yes	56/283 (19.8)	22/56 (39.3)	.018
No	227/283 (80.2)	53/224 (23.7)	
Perceived health status			
Poor	26/308 (8.4)	5/25 (20.0)	.321
Fair	63/308 (20.5)	17/63 (27.0)	
Good	90/308 (29.2)	23/90 (25.6)	
Very good	75/308 (24.4)	18/73 (24.7)	
Excellent	54/308 (17.5)	21/54 (38.9)	

(continued)

**Table 1. (Continued.)**

Variable	No. (%) of patients		<i>P</i> <sup>b</sup>
	All patients	Patients reporting unprotected sex <sup>a</sup>	
Depression symptoms <sup>c</sup>			
CES-D score ≥16	174/295 (59.0)	48/172 (27.9)	.581
CES-D score <16	121/295 (41.0)	30/120 (25.0)	
Crack cocaine use within previous 30 days			
Yes	52/306 (17.0)	18/50 (36.0)	.152
No	254/306 (83.0)	66/253 (26.1)	
Injection drug use within previous 30 days			
Yes	83/308 (26.9)	19/81 (23.5)	.337
No	225/308 (73.1)	65/224 (29.0)	
Drug treatment history			
Never	201/307 (65.5)	57/199 (28.6)	.850
Some	50/307 (16.3)	13/49 (26.5)	
Current	56/307 (18.2)	14/56 (25.0)	
Time since HIV diagnosis			
<1 month	137/308 (44.5)	41/136 (30.1)	.473
1 to <12 months	113/308 (36.7)	26/111 (23.4)	
≥12 months	58/308 (18.8)	17/58 (29.3)	
Response to the statement "I want to be active in making decisions about my HIV care"			
Strongly disagree	15/307 (4.9)	2/15 (13.3)	.589
Somewhat disagree	3/307 (1.0)	1/3 (33.3)	
Somewhat agree	21/307 (6.8)	7/21 (33.3)	
Strongly agree	268/307 (87.3)	73/265 (27.5)	

<sup>a</sup> Sample sizes differ because of missing data for some variables.

<sup>b</sup>  $\chi^2$  test of independence; *P* value for differences in unprotected sex among categories for each respondent characteristic.

<sup>c</sup> As determined by the Center for Epidemiologic Studies Depression (CES-D) scale [17]. A score ≥16 suggests a clinically significant level of psychological distress; it does not necessarily mean that the participant has a clinical diagnosis of depression.

(ARTAS) provided a unique opportunity to examine the potential impact of entering HIV primary care on HIV transmission behaviors, because this study recruited individuals who had recently received a diagnosis of HIV infection and who were not previously linked to HIV primary care [2]. ARTAS, therefore, provided a study sample in which the relationship between attendance at HIV clinics and its association with subsequent sexual behavior could be observed. Focus on this research issue has important clinical and public health significance: if being in HIV care is shown to be associated with decreased HIV transmission risk behaviors, this study would give additional support to HIV care clinics as an important setting for the prevention of HIV infection.

## PATIENTS AND METHODS

Three hundred and sixteen persons who had recently received a diagnosis of HIV infection were recruited from Atlanta, Georgia; Baltimore, Maryland; Los Angeles, California; and Miami,

Florida, to participate in the ARTAS randomized, controlled trial [2]. The primary goal of the ARTAS trial was to evaluate the efficacy of a brief case management intervention in linking HIV-infected persons to HIV primary care. Reducing HIV transmission risk behaviors was not a planned intervention outcome. Eligibility criteria for the ARTAS randomized trial included not having seen an HIV primary care provider more than once and being treatment naïve (i.e., never having received antiretroviral therapy for HIV infection), being able to give informed consent, and being ≥18 years of age. Participants were recruited from a variety of institutions in which HIV infection was diagnosed, including health department testing centers, sexually transmitted disease clinics, hospitals, and community-based organizations. Participants were enrolled from March 2001 through May 2002 and completed an audio computer-assisted self-interview instrument at baseline and at 6 and 12 months after baseline.

Participants were randomly assigned to either a brief case

**Table 2. Prevalence of sexual risk behavior and use of medical care for HIV infection across time, Antiretroviral Treatment Access Study, 2001–2002.**

Variable	Proportion (%) of patients
Unprotected vaginal or anal intercourse with HIV-negative or unknown status partner within the previous month	
Baseline	84/305 (27.5)
6-Month follow-up	31/258 (12.0)
12-Month follow-up	36/254 (14.2)
Receipt of medical care for HIV infection at least 3 times within 6-month period	
Period between baseline and 6-month follow-up	139/258 (53.9)
Period between 6-month and 12-month follow-up	116/254 (45.7)

management linkage intervention or to passive referral to a care provider. The intervention provided brief assistance (a maximum of 5 encounters and 90 days) to link participants to an HIV care provider. There was a mean of 2.6 contacts with the case manager per participant, and contact with the case manager ceased by 90 days after randomization. Participants were prospectively followed up by research staff for 1 year to determine whether they entered HIV primary care. The ARTAS intervention was shown to be effective in linking individuals with a recent diagnosis to HIV primary care [2]. Specifically, findings showed that a higher proportion of the case-managed participants than of the passive referral participants visited an HIV clinician at least once within a 6-month period (78% vs. 60%; adjusted relative risk, 1.36;  $P < .001$ ) and at least twice within a 12-month period (64% vs. 49%; adjusted relative risk, 1.41;  $P < .001$ ).

The present study represents a secondary analysis to examine whether being successfully linked to care is related to reduced HIV transmission behaviors over a 1-year period. Care-seeking behavior was obtained through the audio computer-assisted self-interview instrument self-report and medical record abstractions; information regarding HIV risk behavior was obtained through the audio computer-assisted self-interview. The dichotomous outcome variable for the present analysis was the presence or absence of any self-reported unprotected vaginal or anal intercourse with a partner reported to be of HIV-negative or unknown status in the month preceding the interview.

The ARTAS study provides an optimal database to examine this question, because at least one-half of the study participants were successfully linked to care at both the 6-month and 12-month follow-up periods. The purpose of the present analysis was to examine whether receipt of medical care for HIV infection was related to reduced HIV transmission behavior. The primary predictor variable, being in care at least 3 times in the previous 6 months, was selected because the mean number of outpatient visits for HIV-infected persons in the United States has been reported to be ~6 visits per year [11]. This time period was also selected to ensure that there was sufficient time to

establish a patient-provider relationship; in many HIV clinics, the initial visits focus on an overall evaluation of the patient, including laboratory work and other activities associated with initiating the use of antiretroviral therapy. Therefore, this analysis examined whether having at least 3 visits in the 6-month period preceding an interview was associated with the level of sexual risk behavior reported at the interview.

Other predictor variables were obtained from the baseline interview; these variables have been shown to be associated with sexual risk behaviors among persons living with HIV infection in previous studies [12–16]. They included trial randomization arm, study site, age at enrollment, sex, race/ethnicity, education level (whether the individual had graduated high school), income, employment status, whether the individual had stable housing, whether the individual had children living with them, perceived health status, depressive symptoms (as measured by the 20-item Center for Epidemiologic Studies Depression scale [17]), recent crack cocaine use (within the previous 30 days), recent injection drug use (within the previous 30 days), drug treatment history, time since diagnosis of HIV infection (<1 month, 1–12 months, or >12 months), and an attitudinal variable that assessed an individual's desire to be involved in decision-making regarding their HIV care. This last item asked, on a 4-point scale, whether participants strongly agreed, somewhat agreed, somewhat disagreed, or strongly disagreed with the statement, "I want to be active in making decisions about my HIV care."

Bivariate tests of association with risk behavior were conducted using  $\chi^2$  tests for categorical predictors and Student's *t* tests for continuous predictors. Multiple logistic regression modeling was conducted as outlined by Hosmer and Lemeshow [18]. Predictor variables with *P* values  $\leq .25$  in bivariate associations were more formally evaluated for their adjusted relationship with sexual risk behavior through the use of multiple logistic regression appropriate for longitudinal data. Generalized estimating equations were incorporated to estimate test variances, to account for the correlation among observations obtained from the same participant at both baseline and sub-

**Table 3. Adjusted OR of unprotected sex from generalized estimating equations logistic regression analysis, Antiretroviral Treatment Access Study, 2001–2002.**

Variable	Adjusted OR (95% CI)	P
Time points after baseline (vs. baseline)	0.54 (0.35–0.85)	.007
Intervention group (vs. control group)	0.96 (0.62–1.50)	.865
Receipt of medical care for HIV infection at least 3 times within previous 6 months <sup>a</sup>	0.53 (0.30–0.94)	.029
Miami (vs. other sites)	1.68 (1.03–2.74)	.036
Age ≤30 years (vs. age >30 years)	2.65 (1.62–4.33)	<.001
Female sex	1.65 (1.04–2.63)	.035
Depressive symptoms (CES-D score ≥16 vs. <16) <sup>b</sup>	1.65 (1.08–2.52)	.021
Crack cocaine use within the previous 30 days	2.27 (1.40–3.66)	.001

**NOTE.** ORs were adjusted for all other variables in the table. Unprotected sex was defined as unprotected vaginal or anal intercourse within the previous 30 days with partners reported to be HIV negative or of unknown serostatus. CES-D, Center for Epidemiologic Studies Depression.

<sup>a</sup> Applicable only at 6-month and 12-month follow-up points.

<sup>b</sup> As determined by the CES-D scale [17]. A score ≥16 suggests a clinically significant level of psychological distress; it does not necessarily mean that the participant has a clinical diagnosis of depression.

sequent time points. In building the model, we initially entered those factors associated with sexual risk behavior (all with  $P < .25$ ) and then manually employed stepwise elimination, until a final model was reached in which all remaining factors were statistically significant with  $P < .05$ . It is important to note that respondents' random assignment to the intervention was not significant in the bivariate analysis or in the multiple logistic regression analysis; however, this variable was retained in the multiple regression model as a design variable. From this modeling framework, we are able to make inferences about changes in sexual risk behavior over time by comparing baseline data with data from time points after baseline, as well as assess associations with the risk factors under consideration.

## RESULTS

A total of 316 HIV-positive persons participated in ARTAS; we achieved an 80% follow-up rate at each of the 6-month and 12-month follow-up assessments (258 and 254 participants, respectively), and almost all participants (308 [97%] of 316) completed at least 1 follow-up visit and were included in the analysis. Of the 308 participants, the majority were >30 years of age, 73% (224) were male, 59% (183) were black/non-Hispanic, 26% (81) were Hispanic, 9% (27) were white, and 6% (17) were of another ethnicity (table 1). Less than one-half of the participants had graduated from high school, 57% (174 of 307) reported being unemployed at the time of the interview, and 71% (205 of 292) had an annual income of <\$10,000. Most respondents (71%; 219 of 308) reported their general health as good to excellent. Overall, 64% (189 of 294) of the participants self-identified as heterosexual (90% of women [70 of 78] and 55% of men [119 of 216]). Over one-half of the participants reported symptoms of depression, and 17% (52 of 306) reported crack cocaine use within the previous 30 days.

Over one-fourth (27%; 83 of 308) of the participants reported injection drug use within the previous 30 days, 8% (25 of 307) reported use of heroin within the previous 30 days, 8% (23 of 308) reported use of cocaine (other than crack cocaine) within the previous 30 days, and 1% (3 of 308) reported use of amphetamines within the previous 30 days. Over 80% of respondents (250 of 308) had received a diagnosis of HIV infection <1 year before the time of the baseline interview.

Table 1 also highlights baseline subgroups that had a higher prevalence of unprotected vaginal or anal sex with an HIV-negative or unknown status partner in the month preceding the interview. Higher rates of unprotected sex were associated with living in Miami, female sex, being <30 years of age, and living with children. At baseline, 27% of participants (84 of 305) self-reported having unprotected vaginal or anal sex with an HIV-negative or unknown status partner within the previous month. This proportion decreased to 12% (31 of 258) at 6-month follow-up and was 14% (36 of 254) at 12-month follow-up (table 2). Approximately one-half of the participants had received medical care for HIV infection at least 3 times at the 6-month and 12-month follow-up points (139 [54%] of 258 and 116 [46%] of 254, respectively) (table 2).

Results of the multiple logistic regression model, shown in table 3, indicate that the prevalence of sexual risk behavior at time points after baseline was significantly reduced from baseline; the odds of sexual risk at time points after baseline was one-half that at baseline (OR, 0.54;  $P = .007$ ). At the 6-month and 12-month follow-up points, people who had received medical care for HIV infection at least 3 times during the 6 months preceding the interview had reduced odds of engaging in risk behavior in the previous month, compared with those with <3 visits (OR, 0.53;  $P = .03$ ). Higher depression scores, female sex, crack cocaine use, younger age, and residence in Miami

were also independently associated with an increase in the odds of high-risk sexual behavior at time points after baseline.

## DISCUSSION

This study presents longitudinal data that demonstrate a positive association between receiving regular HIV care and reduced HIV sexual risk behavior among persons living with HIV infection. Specifically, HIV-positive persons who were seen by an HIV care provider at least 3 times in the previous 6 months were twice as likely to have abstained from having unprotected sex with an HIV-negative or unknown status partner in the preceding month. The relationship between receipt of recent HIV care and reduced HIV risk behavior has been suggested in previous cross-sectional studies [9, 10], but our study extends these earlier findings in a prospective analysis across 4 US cities.

These findings have important implications for prevention strategies for persons living with HIV infection. HAART has already been shown to reduce the potential for HIV transmission by reducing viral load in HIV-positive individuals and, thus, making such individuals less infectious [6, 7]. However, it has been suggested recently by McCormick et al. [19] that the potential reduction in transmission associated with receipt of antiretroviral therapy may be offset among long-term survivors by the long duration of infectiousness (and the possible eventual failure of antiretroviral therapy). These authors conclude that antiretroviral therapy must be accompanied by effective HIV-related risk-reduction interventions for the duration of HIV infection.

Fortunately, there has been a recent public health emphasis on increasing the delivery of risk-reduction counseling in the context of medical care for HIV infection [1, 20, 21]. Studies have demonstrated that provider-based interventions carried out in the context of HIV primary care are effective in reducing HIV transmission behaviors among HIV-positive clinic patients [22, 23]. The current study confirms that receiving HIV primary care is associated with significant reductions in HIV transmission behavior. Together, these findings suggest that efforts to link individuals to and retain persons in HIV primary care should be among our highest prevention priorities.

The ARTAS case management intervention did not have a significant effect on reducing sexual HIV transmission behavior. This is not surprising, because the ARTAS intervention had the sole focus of linking persons with a recent diagnosis of HIV infection to HIV primary care. It was brief (typically lasting <60 days and with a mean of 2.6 encounters per individual) and consisted of case management strategies that were designed to increase knowledge, motivation, and skills, as a way to reduce barriers to and facilitate the use of primary medical care by socioeconomically disadvantaged, HIV-positive individuals with a recent diagnosis. The primary outcome was for persons to have seen a provider  $\geq 2$  times over a 12-month period.

Reducing risk behaviors was not a planned outcome of the trial.

Other findings are also noteworthy. Demographic characteristics, including female sex and younger age, were associated with continuing sexual risk behaviors. Both of these factors have been shown to be associated with increased risk behaviors in other studies involving persons living with HIV infection [9, 24–27]. Regarding the increased sexual risk behaviors of women, compared with men, prior studies have highlighted the challenges faced by HIV-positive women in convincing their male partners to use condoms. These challenges include not feeling confident about discussing condom use with their partners and not feeling confident about being able to disclose their HIV infection status to their partner [28–30]. Having depressive symptoms was also a significant factor for engaging in high-risk sexual behavior. Other studies involving persons living with HIV infection have shown that depression has been associated with nonadherence to HIV medications, missed medical appointments, and rapid progression to AIDS [31–34]. Crack cocaine use was associated with continued sexual risk, and this, too, is consistent with the findings of other studies [16]. The highly addictive nature of crack cocaine and the short duration of the “high” (which is followed by intense cravings for more drugs) may lead to a tendency to put the acquisition of more drugs ahead of other needs. This has been shown in previous studies, in which women who use crack cocaine have engaged in “survival sex,” such as trading sex for money or drugs to support their families and/or their illegal drug use [35–37]. Given the findings related to depression and crack cocaine use, mental health and substance use evaluations conducted by the clinicians providing primary care may also be considered. It is not clear why participants in Miami would have increased sexual risk behaviors, and this warrants further investigation.

Very little has been previously published about the impact of increased numbers of care visits on patient survival, morbidity measures, or transmission-related behaviors. Attendance at HIV care on a quarterly basis, compared with less frequent attendance, was shown to be associated with increased survival [38]. Patients who missed  $\geq 25\%$  of their appointments in the Johns Hopkins AIDS Service database were one-half as likely to have suppressed viral loads of <400 copies/mL, compared with those individuals who missed fewer appointments (R. Moore, personal communication). The analyses presented here represent, to our knowledge, the first in which the finding that  $\geq 3$  clinic visits is associated with reduced sexual risk behaviors is reported. It is important to recognize that the participants in this study had, for the most part, recently received a diagnosis of HIV infection and were new to HIV care. Thus, it might be expected that the patients would have an increased number of care visits, because they would be starting antiretroviral therapy

and receiving additional screening and blood work for other comorbidities associated with HIV infection.

Our study was not without limitations. First, these data were obtained from a convenience sample of HIV-positive patients recruited from venues in which people receive a diagnosis of HIV infection, including health department testing centers, sexually transmitted disease clinics, hospitals, and community-based organizations in 4 large urban cities. Thus, results may not be applicable to other HIV-positive individuals in rural areas or other countries. However, using a multisite sample with different types of HIV testing centers strengthens the potential generalizability of our findings. Second, the data were based on self-reports, although the use of care data was corroborated by medical record abstractions [2]. There is always the possibility that high-risk sexual behaviors may have been underreported. To diminish this concern, we used computer-assisted self-interview data collection methods that have been shown to enhance reporting of sensitive risk behaviors [39]. Third, we used a 1-month time frame to examine risk behavior and to minimize recall problems. However, we therefore did not capture risk behaviors over the full 6-month period between study assessments. Finally, we do not know the types of prevention services currently or previously received by the patients in the study. Some patients may have received counseling concerning injection drug risk reduction, and we did not evaluate changes in the risk of transmission via injection. Additional research studies that are aimed at behavioral variables will help us to understand what features of care are most associated with reductions in HIV transmission behaviors.

In summary, our data highlight the importance of linking HIV-positive persons who have received a recent diagnosis to care so that they can benefit, not only from medical treatment, but also from prevention services that are increasingly available in HIV primary care settings. It has been estimated that, in the United States, 1 of every 3 people living with HIV infection are not in HIV care [40]. Studies have shown that the personal effects of not receiving HIV treatment include lower life expectancy and decreased quality of life. Our data highlight the public health consequences of not being in care and indicate that the receipt of sufficient care is an important HIV transmission prevention strategy.

## THE ARTAS STUDY GROUP

The ARTAS study group consists of the authors and Dr. Lytt I. Gardner, Dr. Scott D. Holmberg, Dr. Alan Greenberg, and Christopher S. Krawczyk (the Centers for Disease Control and Prevention; Atlanta, GA); Dr. Carlos del Rio, Sonya Green, Maribel Barragan, Dr. Wayne Duffus, Dr. Michael Leonard, Christine O'Daniels, Catherine Abrams, Felicia Berry, Valerie Hunter, and Howard Pope (Emory University School of Medicine, Division of Infectious Diseases; Atlanta, GA); Dr. Steffanie

Strathdee, Dr. Anita Loughlin, Steven Huettner, Matt Woolf, Ovedia Burt, and Janet Reaves (Johns Hopkins Bloomberg School of Public Health; Baltimore, MD); Dr. Pamela Anderson-Mahoney, Dr. Peter Kerndt, Bobby Gatson, Brandon Schmidt, Norma Perez, Amy Chan, Lawrence Fernandez, Jr., Jenny Kotlerman, Dr. Ellen Rudy, and Stella Gutierrez (Health Research Association; Los Angeles, CA); Dr. Lisa Metsch, Dr. Clyde McCoy, Dr. Gordon Dickinson, Dr. Toye Brewer, Eduardo Valverde, Brad Wohler-Torres, Lauren Gooden, Dr. Wei Zhao, Faye Yeomans, and Yolanda Davis Camacho (University of Miami School of Medicine; Miami, FL); and Dr. Harvey A. Siegel, Richard C. Rapp, Teri L. Rust, and Dr. Jichuan Wang (Wright State University School of Medicine; Dayton, OH).

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