

# Having a Consistent HIV Health Care Provider and HIV-Related Clinical Outcomes

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**T**he HIV/AIDS epidemic has been a constant public health challenge in the United States. As of 2012, there were approximately 1.2 million people 13 years and older living with HIV/AIDS (PLWHA) in the United States.<sup>1</sup> The number of HIV infections has steadily increased by around 50,000 cases per year.<sup>1</sup> In 2014, Illinois reported 1737 new diagnoses of HIV infection and ranked sixth in new diagnoses among all 50 states.<sup>1,2</sup> Further, more than 58% of individuals with new diagnoses and more than 62% of PLWHA resided in Chicago.<sup>2</sup> Following the introduction of highly active antiretroviral therapy (ART), HIV morbidity and mortality improved, and AIDS-related mortality has thus decreased dramatically.<sup>3,4</sup> ART is a customized combination of medications prescribed based on patients' HIV progression. To maximize the effectiveness of ART and to achieve desirable clinical outcomes, an HIV-infected individual needs to be retained in HIV care and to maintain high CD4 T lymphocyte (CD4 cell) counts and suppressed HIV viral load.<sup>5-7</sup>

Seeking consistent HIV health care is the key to achieving desirable clinical outcomes.<sup>8</sup> In the United States, more than 55% of PLWHA are not retained in routine HIV health care and 22% of patients who had been prescribed ART have not achieved viral suppression.<sup>9</sup> In Illinois, even though 84% of new HIV cases were linked to health care within 3 months of diagnosis in 2012, only 55% were retained in HIV health care by the end of 2013. Of all PLWHA in Illinois, only 42% achieved viral suppression in 2013.<sup>2</sup> Although factors that affect the HIV care continuum (a plan including detailed steps for PLWHA from their initial diagnosis to HIV treatment) and ART adherence among PLWHA have been studied, previous studies focused primarily on provider-patient relationships to improve ART adherence and concluded with mixed results.<sup>10-12</sup> Along with the assertion that an interactive provider-patient relationship could improve medical adherence in patients with HIV, some studies found that a better provider-patient relationship improves ART adherence.<sup>13,14</sup> Increased medical adherence leads to positive health care outcomes, including delaying HIV disease progression. Additionally, with the development of ART, HIV can be treated as a chronic disease.<sup>15</sup> Health care providers play an essential role in managing, treating, and helping patients with this chronic disease.<sup>16</sup> Previous studies

## ABSTRACT

**OBJECTIVES:** Seeking consistent HIV health care is essential for achieving expected clinical outcomes, as antiretroviral therapy prevents HIV from reproduction and decreases opportunistic infections. However, whether having a consistent HIV health care provider is associated with desirable clinical outcomes remained unclear. This study examined the association of having a consistent HIV health care provider and HIV-related clinical outcomes.

**STUDY DESIGN:** This was a multiyear cross-sectional observational study using secondary data.

**METHODS:** A total of 1584 people living with HIV/AIDS (PLWHA) and receiving HIV health care who participated in the Illinois Medical Monitoring Project from 2009 to 2014 were included. Two logistic regressions were conducted to examine the associations of having a consistent HIV health care provider and 2 clinical HIV outcomes, viral suppression and high CD4 cell count. The inverse probability weighting method was applied to address the potential issue of missing data about whether a patient had a consistent HIV health care provider.

**RESULTS:** Patients who had a consistent HIV health care provider, compared with those who did not, had higher odds of achieving HIV viral suppression (ie, viral load < 200 cells/mm<sup>3</sup>) and of having high counts of CD4 cells (ie, CD4 ≥ 200 cells/mm<sup>3</sup>) (odds ratios, 4.10 and 4.18, respectively; both  $P < .05$ ).

**CONCLUSIONS:** Having a consistent HIV health care provider was associated with a higher likelihood of achieving desirable HIV clinical outcomes among PLWHA. To optimize these outcomes, policy and educational interventions are needed for PLWHA to have consistent HIV health care providers and to establish long-term, consistent physician-patient relationships.

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mainly focused on how providers' behaviors, attitudes, and decisions improved patients' ART adherence, but few studies have focused on whether seeing a consistent HIV health care provider influences clinical outcomes (eg, HIV viral load, CD4 cell count) among PLWHA. Additionally, previous studies focused on using proxies to evaluate the clinical outcomes, but few studies used laboratory tests to confirm their conclusions regarding the association of having a consistent HIV health care provider with health outcomes. Therefore, there is a need to investigate the impact of having a consistent HIV health care provider on clinical outcomes through laboratory testing results.

In this study, we examined the association of having a consistent HIV health care provider with clinical outcomes. This study fills in existing literature gaps by analyzing data from the Illinois Medical Monitoring Project (MMP) during 2009-2014 on whether patients reported having a consistent HIV health care provider and on patients' clinical outcomes. We used inverse probability weighting (IPW) along with logistic regressions to address missing data for patients who did not report whether they have a consistent HIV health care provider. We hypothesized that for PLWHA, having a consistent HIV health care provider was associated with positive health outcomes such as HIV viral suppression and high CD4 cell counts.

## METHODS

### Data and Study Sample

This study used data from the MMP, a supplemental surveillance system sponsored by the CDC and designed to provide estimates on behaviors and clinical outcomes of PLWHA by combining face-to-face or telephone interviews and medical record abstractions.<sup>2,17</sup> During 2009-2014, the MMP applied a multistage probability sampling method. The detailed MMP sampling method has been described elsewhere.<sup>10</sup>

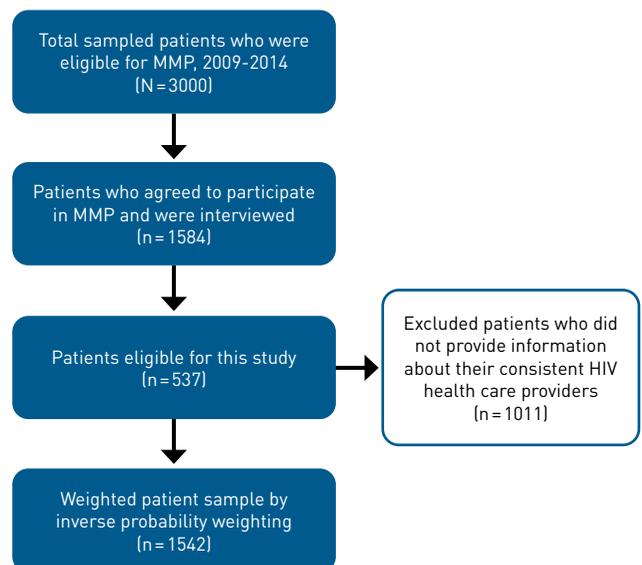
Both Illinois (excluding Chicago) and Chicago were selected as 2 separate sites of the MMP project. This study used the MMP data collected from Illinois and Chicago during 2009-2014. Selected patients must receive HIV-related health care at eligible facilities from January to April of the data collection cycle. During 2009-2014, 500 patients were sampled yearly from Illinois (n = 100) and Chicago (n = 400). Following the interviews, participants' medical records (including CD4 cell counts and HIV viral load test results) were obtained from the health care facilities where the participants received HIV-related health care services. The MMP is deemed to conform to standard public health practice as a routine surveillance activity and was granted exemption from human subjects research from the Institutional Review Board at the Illinois Department of Public Health.

The **Figure** illustrates the sample of participants who were included in this study. During 2009-2014, 3000 patients with HIV

## TAKEAWAY POINTS

- ▶ Patients with HIV who had a consistent HIV health care provider were more likely to achieve desired clinical outcomes, including HIV viral suppression and maintaining high CD4 cell counts, than those without a consistent HIV health care provider.
- ▶ To achieve positive HIV clinical outcomes, social services (eg, case management, housing, antiretroviral therapy adherence coaching programs) may support patients to seek HIV treatments, continue with HIV health care, and complement the treatment.
- ▶ To improve HIV-related clinical outcomes, policy and educational interventions are needed for patients with HIV to have a consistent HIV health care provider and establish a long-term physician-patient relationship.

**FIGURE.** Study Sample Selection From the Illinois MMP, 2009-2014



MMP, Medical Monitoring Project.

were selected and contacted by MMP staff. Among them, 1584 agreed to participate in MMP and were interviewed. Notably, among the original 1584 MMP participants, only 537 patients (33.9%) answered questions that measure whether the respondent identified a consistent HIV health care provider. To avoid internal validity issues caused by these missing data of the main predictor, we used the IPW method to deal with the missing response issue (described later in the statistical analysis section). Finally, the weighted sample representing 1542 observations was used for analysis after IPW.

### Conceptual Framework

This study applied the Andersen model of health care utilization to guide variable selection. Andersen's model consists of 3 major components—predisposing factors (eg, age, race/ethnicity), enabling factors (eg, health insurance, education, geography), and need factors (eg, self-perceived need for health services, actual physical and mental health status)—that, together, influence health care

utilization. These 3 groups of variables were included in this study when examining the associations of having a consistent HIV health care provider with HIV clinical outcomes.

### Variables and Measurement

**Outcome variables.** Two HIV-related clinical health outcomes were examined in this study: (1) whether a patient achieved viral suppression (ie, “undetectable” status) and (2) whether a patient’s CD4 count was maintained at a high level; these are 2 main prognostic indicators of HIV disease. For this study, viral suppression is defined as having viral load less than 200 cells/mm<sup>3</sup>.<sup>18</sup> We used a patient’s most recent viral load test from the MMP data set. In addition, CD4 count measures the ability of the human body to protect itself from infections. When the CD4 count of PLWHA falls below 200 cells/mm<sup>3</sup>, the risk of opportunistic infections increases.<sup>19,20</sup> Being conservative, we used a patient’s lowest CD4 count in the past 12 months. Both outcome variables are binary (yes/no).

**Primary predictor.** The primary predictor examined is whether a patient has a consistent HIV health care provider. In the MMP interview, patients are asked, “During the past 12 months, was there 1 usual place, like a doctor’s office or clinic, where you went for most of your HIV medical care?” and “Do you have a person you think of as your HIV doctor, nurse, or other health care provider?” Respondents who answered “yes” to both questions are considered as having a consistent HIV health care provider. This variable was coded as binary (yes/no).

**Covariates.** Based on the Andersen model, the covariates were categorized into 3 groups: predisposing, enabling, and need factors. The predisposing factors included sex (male, female, or other), age (18-24, 25-34, 35-44, 45-54, or ≥55 years), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or other), sexual orientation (homosexual, heterosexual, bisexual, or other), binge drinking status (yes/no), smoking status (yes/no), and injection drug use status (yes/no). Enabling factors included health insurance (no insurance, Ryan White [RW] only [including AIDS Drug Assistance Program (ADAP)], other insurance, or both RW and other insurance), education (less than college education, or college education or above), region (Chicago or downstate [ie, regions outside Chicago]), in poverty (yes/no), homeless (yes/no), and employment status (yes/no). Need factors included depression status in past 12 months (yes/no), emergency department visit during past 12 months to seek HIV health care (yes/no), unmet social service needs (yes/no), mental facility admission (yes/no), and ART adherence (ie, whether adhered to doses, instructions, and schedules in past 3 days [yes/no]) because ART adherence is essential to achieving expected outcomes of HIV treatment and delaying HIV/AIDS progression.

### Statistical Approach

Descriptive statistics including frequencies and percentages of all variables were computed. Chi-square tests were conducted to examine group differences by viral suppression and high CD4 count status on each covariate. We conducted 2 logistic regressions to

examine the associations of having a consistent HIV health care provider with the 2 clinical outcomes, controlling for all covariates. As mentioned, among the original 1584 MMP participants, only 537 (33.1%) answered 1 or both of the questions that measure whether they had an individual considered their HIV health care provider. It may be concerning that the patients who answered the question(s) for their consistent HIV health care provider status were systematically different from those who did not; for example, patients with a consistent HIV health care provider may be more willing to answer the question(s) than those who did not. To address this concern, we used the IPW method along with an additional logistic regression to identify variables that are systematically associated with whether a patient answered the 2 questions on their consistent HIV health care provider status. All covariates, guided by the Andersen model, were included in the additional logistic regression to estimate the probability of not answering the questions. Then we used the inverse of the predicted probability of whether a patient answered the 2 questions from the logistic regression as the frequency weight to weight all analyses including descriptive statistics and logistic regression models. The IPW method has been widely used in previous studies to deal with possible systematic differences between 2 groups to be compared.<sup>21,22</sup> All analyses were conducted using Stata 14 (StataCorp).

## RESULTS

**Table 1** demonstrates the descriptive statistics of the study sample. Of the 1584 patients (unweighted) with HIV medical treatment, 79.3% (n = 1256) achieved viral suppression and 85.1% (n = 1348) had high enough CD4 counts (≥200 cells/mm<sup>3</sup>). The majority of the study sample patients were male (75.2%), aged 45 to 54 years (35.9%), non-Hispanic black (55.6%), and heterosexual (37.3%). As for enabling factors, 65.6% patients had health insurance other than RW (including ADAP), 82.8% lived in Chicago, 47.9% were in poverty, 6.9% were homeless, and 16.4% were employed. Among the study participants, 18.8% suffered from depression, 8.8% visited emergency departments to seek HIV health care, 43.9% had unmet social service needs, 3.3% were admitted to mental health facilities, and only 35.4% fully adhered to ART.

**Table 2** shows the results of the 2 weighted logistic regressions examining the associations of having a consistent HIV health care provider and the 2 desirable patient HIV clinical outcomes, controlling for all covariates and using the IPW that dealt with the missing response issue. The first logistic regression model examined the association of having a consistent HIV health care provider and viral suppression. We found that patients with a consistent HIV health care provider were more likely to achieve viral suppression (ie, the most recent viral load < 200 cells/mm<sup>3</sup>) compared with those without a consistent HIV health care provider (odds ratio [OR], 4.10; 95% CI, 1.28-13.11). Being male, younger, non-Hispanic black (vs non-Hispanic white), heterosexual (vs homosexual), and a smoker, as well as having no health insurance coverage, living

**TABLE 1.** Unweighted Descriptive Statistics of the Variables of the Illinois 2009-2014 MMP Used in the Statistical Models by Study Samples<sup>a</sup>

	Overall N = 1584	Viral load < 200 cells/mm <sup>3</sup> n = 1256 [79.3%]	Viral load ≥ 200 cells/mm <sup>3</sup> n = 328 [20.7%]	P	CD4 count < 200 cells/mm <sup>3</sup> n = 236 [14.9%]	CD4 count ≥ 200 cells/mm <sup>3</sup> n = 1348 [85.1%]	P
Answered the questions on having a consistent HIV health care provider	537	429 (78.3%)	108 (19.7%)	.67	77 (14.3%)	460 (85.7%)	.18
<b>Predisposing factors</b>							
Sex							
Male	1191	957 (80.4%)	234 (19.6%)	.18	178 (15.0%)	1013 (85.0%)	.21
Female	373	283 (75.9%)	90 (24.1%)		57 (15.3%)	316 (84.7%)	
Other	20	16 (80.0%)	4 (20.0%)		1 (5.0%)	19 (95.0%)	
Age in years							
18-24	61	35 (57.4%)	26 (42.6%)	<.01**	5 (8.2%)	56 (91.8%)	.02*
25-34	229	165 (72.1%)	64 (27.9%)		39 (17.0%)	190 (83.0%)	
35-44	369	288 (78.1%)	81 (21.9%)		62 (16.8%)	307 (83.2%)	
45-54	568	461 (81.2%)	107 (18.8%)		86 (15.1%)	482 (84.9%)	
≥ 55	357	307 (86.0%)	50 (14.0%)		44 (12.3%)	313 (87.7%)	
Race/ethnicity							
Non-Hispanic white	421	366 (86.9%)	55 (13.1%)	<.01**	46 (10.9%)	375 (89.1%)	<.01**
Non-Hispanic black	881	653 (74.1%)	228 (25.9%)		153 (17.4%)	728 (82.6%)	
Hispanic	233	200 (85.8%)	33 (14.2%)		31 (13.3%)	202 (86.7%)	
Other	49	37 (75.5%)	12 (24.5%)		6 (12.2%)	43 (87.8%)	
Sexual orientation							
Homosexual	569	483 (84.9%)	86 (15.1%)	<.01**	57 (10.0%)	512 (90.0%)	<.01**
Heterosexual	591	443 (75.0%)	148 (25.0%)		118 (20.0%)	473 (80.0%)	
Bisexual	133	98 (73.7%)	35 (26.3%)		19 (14.3%)	114 (85.7%)	
Other	8	7 (87.5%)	1 (12.5%)		0 (0%)	8 (100.0%)	
Binge drinking	316	243 (76.9%)	73 (23.1%)	.22	48 (15.2%)	268 (84.8%)	.87
Smoking	559	444 (74.1%)	155 (25.9%)	<.01**	110 (19.7%)	489 (80.3%)	<.01**
Injection drug use	24	17 (70.8%)	7 (29.2%)	.30	1 (4.2%)	23 (95.8%)	.134
<b>Enabling factors</b>							
Health insurance							
No insurance	376	296 (78.7%)	80 (21.3%)	.32	35 (9.3%)	341 (90.7%)	<.01**
RW only (including ADAP)	43	39 (90.7%)	4 (9.3%)		5 (11.6%)	38 (88.4%)	
Other insurance only	1039	823 (79.2%)	216 (20.8%)		175 (16.8%)	864 (83.2%)	
Both RW and other insurance	116	92 (79.3%)	24 (20.7%)		18 (15.5%)	98 (84.5%)	
Education							
Less than college degree	1253	963 (76.9%)	290 (23.1%)	<.01**	210 (16.8%)	1043 (83.2%)	<.01**
College degree or above	331	293 (92.3%)	38 (7.7%)		26 (8.9%)	205 (91.1%)	
Region							
Chicago	1311	1052 (80.2%)	259 (19.8%)	.04*	186 (14.2%)	1125 (85.8%)	.08
Downstate	273	204 (74.7%)	69 (25.3%)		50 (18.3%)	223 (81.7%)	
Poverty	758	571 (75.3%)	187 (24.7%)	<.01**	126 (16.6%)	632 (83.4%)	.04*
Homeless	109	65 (59.6%)	44 (40.4%)	<.01**	25 (22.9%)	84 (77.1%)	.01**
Employed	260	211 (80.2%)	49 (18.8%)	.42	33 (12.7%)	227 (87.3%)	.27
<b>Need factors</b>							
Depression	297	217 (73.1%)	80 (26.9%)	<.01**	51 (17.2%)	246 (82.8%)	.22
Emergency department visit	140	85 (60.7%)	55 (39.3%)	<.01**	38 (27.1%)	102 (72.9%)	<.01**
Unmet needs	695	526 (75.7%)	169 (24.3%)	<.01**	131 (18.8%)	564 (81.2%)	<.01**
Mental health facility admission	53	31 (58.5%)	22 (41.5%)	<.01**	7 (13.2%)	46 (86.8%)	.72
ART adherence	560	479 (85.5%)	81 (14.5%)	<.01**	83 (14.8%)	477 (85.2%)	.95

ADAP, AIDS Drug Assistance Program; ART, antiretroviral therapy; MMP, Medical Monitoring Project; RW, Ryan White HIV/AIDS Program.

\*P < .05; \*\*P < .01.

<sup>a</sup>Data source: the Illinois 2009-2014 MMP. Group differences were tested through  $\chi^2$  tests.

## CLINICAL

**TABLE 2.** Multinomial Logistic Regression Models Examining the Associations Between Having a Consistent HIV Health Care Provider and Clinical Outcomes (N = 1542)<sup>a</sup>

Variables	Viral load < 200 cells/mm <sup>3</sup>	CD4 ≥ 200 cells/mm <sup>3</sup>
	OR (95% CI)	OR (95% CI)
Having a consistent HIV health care provider	4.10* (1.28-13.11)	4.18* (1.28-13.64)
<b>Predisposing factors</b>		
Sex		
Male	Ref	Ref
Female	7.64** (4.65-12.55)	10.01** (5.54-18.11)
Other	0.25 (0.06-1.01)	0.48 (0.11-2.17)
Age in years		
18-24	0.03** (0.01-0.06)	0.37 (0.10-1.37)
25-34	0.16** (0.08-0.29)	0.14** (0.07-0.29)
35-44	0.25** (0.14-0.45)	0.34* (0.17-0.66)
45-54	0.27** (0.16-0.45)	0.29* (0.16-0.50)
≥55	Ref	Ref
Race/ethnicity		
Non-Hispanic white	Ref	Ref
Non-Hispanic black	0.35** (0.22-0.59)	0.39** (0.22-0.69)
Hispanic	2.25* (1.10-4.61)	1.02 (0.51-2.05)
Other	0.18** (0.07-0.43)	3.14 (0.58-16.89)
Sexual orientation		
Homosexual	Ref	Ref
Heterosexual	0.11** (0.07-0.19)	0.11** (0.06-0.19)
Bisexual	1.04 (0.51-2.14)	4.62* (1.45-14.70)
Other	0.34** (0.20-0.59)	0.31** (0.17-0.56)
Binge drinking	0.83 (0.55-1.24)	0.37** (0.24-0.57)
Smoking	0.53** (0.37-0.74)	0.97 (0.65-1.45)
Injection drug use	3.78 (0.66-21.58)	5.53 (0.65-46.42)
<b>Enabling factors</b>		
Health insurance		
No insurance	Ref	Ref
RW only (including ADAP)	3.88** (2.46-6.13)	8.12 (4.39-15.04)
Other insurance only	9.43** (2.29-38.89)	2.43** (0.71-8.29)
Both RW and other insurance	2.72** (1.43-5.20)	2.39* (1.17-4.87)
Education		
Less than college degree	Ref	Ref
College degree or above	0.82 (0.51-1.31)	0.64 (0.38-1.08)
Region		
Chicago	Ref	Ref
Downstate	0.47** (0.32-0.69)	0.38** (0.25-0.59)
Poverty	0.93 (0.62-1.41)	1.32 (0.84-2.10)
Homeless	0.94 (0.53-1.70)	2.21 (0.99-4.94)
Employed	1.03 (0.63-1.72)	1.61 (0.91-2.86)
<b>Need factors</b>		
Depression	1.07 (0.71-1.62)	0.81 (0.61-1.30)
Emergency department visit	0.64 (0.38-1.07)	0.73 (0.41-1.32)
Unmet needs	0.52** (0.36-0.77)	0.59* (0.38-0.90)
Mental facility admission	0.24** (0.10-0.60)	1.69 (0.43-6.62)
ART adherence	2.97** (4.67-65.79)	1.21 (0.80-1.83)

ADAP, AIDS Drug Assistance Program; ART, antiretroviral therapy; OR, odds ratio; ref, reference; RW, Ryan White HIV/AIDS Program.

\**P* < .05; \*\**P* < .01.

<sup>a</sup>Data source: the Illinois 2009-2014 Medical Monitoring Project.

outside Chicago, and having unmet HIV-related public services needs, was associated with lower likelihood of viral suppression.

The second logistic regression model examined the association between having a consistent HIV health care provider and having high enough CD4 counts (ie, ≥200 cells/mm<sup>3</sup>). We found that patients having a consistent HIV health care provider were more likely to have high enough CD4 counts compared with those without a consistent HIV health care provider (OR, 4.18; 95% CI, 1.28-13.64). Being male, aged 25 to 44 years (vs ≥55 years), non-Hispanic black (vs non-Hispanic white), and heterosexual (vs homosexual), as well as living outside Chicago and having unmet HIV-related public services needs, was associated with lower odds of achieving CD4 counts of 200 cells/mm<sup>3</sup> or higher. Meanwhile, we also found that binge drinking was associated with lower likelihood of having CD4 counts of 200 cells/mm<sup>3</sup> or higher.

## DISCUSSION

This study analyzed data from the Illinois 2009-2014 MMP to examine the associations of having a consistent HIV health care provider and HIV-related clinical outcomes among PLWHA. After adjusting for predisposing, enabling, and need factors, our study findings indicated that patients with HIV with a consistent HIV health care provider were more likely to achieve desirable clinical outcomes—HIV viral suppression and maintaining a high level of CD4 cells—than those without a consistent HIV health care provider. These results indicated that if a patient has a consistent HIV health care provider, they will be more likely to achieve the expected positive clinical outcomes of HIV treatment and may in turn decrease the chance of opportunistic infections and slow the progression to AIDS. Our study filled in the gaps of the literature on health care-seeking behavior among patients with HIV in that we concluded the positive associations of having a consistent HIV health care provider and positive clinical outcomes. In sum, our findings concluded that positive associations exist between having a consistent HIV health care provider and promising HIV clinical outcomes among PLWHA, which is consistent

with previous findings.<sup>23,24</sup> Further, this study extended the association to a representative sample in Illinois and supported the association by using laboratory testing results. As such, policy makers in Illinois shall be aware of such associations when implementing prevention and intervention programs.

We also found that ART adherence was associated with achieving lower levels of HIV viral load. However, although results of previous studies have shown that ART is effective in controlling HIV if medical treatment is correctly taken, adherence to ART was not associated with high CD4 count status in this study,<sup>25</sup> which could be explained by 2 reasons. First, the level of CD4 cells used in this study was the lowest level of CD4 cells in the past 12 months. In fact, the level of CD4 cells may fluctuate depending on other factors such as diet, nutrition support, and lifestyle.<sup>26,27</sup> Yet, this study only investigated the lowest CD4 count in the past 12 months when the interview was conducted, and therefore the study could only capture the CD4 levels at 1 time point. Future studies should investigate strategies that could potentially increase CD4 counts in patients with HIV over a longer term.

The findings also indicated that having unmet social service needs was associated with worse HIV clinical outcomes, which confirmed findings from previous studies.<sup>28-30</sup> To achieve positive HIV clinical outcomes, social services (eg, case management, housing, ART adherence coaching programs) may support patients to seek HIV treatments, continue with HIV health care, and complement the treatment. For example, case management services help patients coordinate other health care services such as dental appointments, assistance with enrolling in health care assistance programs, access to legal services, public benefits, and housing.

Patient characteristics including sex, age, race/ethnicity, sexual orientation, health insurance coverage, and residing region were also associated with patients' clinical outcomes. For example, our findings indicated that female patients who received HIV health care were more likely to achieve desirable HIV clinical outcomes compared with male patients. Additionally, compared with non-Hispanic white patients with HIV, non-Hispanic black patients were less likely to achieve positive HIV clinical outcomes. Our findings also indicated that patients residing in Chicago were more likely to achieve viral suppression and higher CD4 count levels, possibly because of better access to health care providers and social services, better public transportation, and more public housing options compared with patients residing outside Chicago. This may imply that accessibility of health care sites is an important predictor of outcomes of HIV treatment.<sup>31</sup> This finding also indicated that the concentration of health care services in Chicago also played an important role compared with the sparse health care services in other Illinois areas. Our results also showed that heterosexual patients were less likely to achieve desirable clinical HIV outcomes compared with their homosexual counterparts, which is possibly due to nonproportional resources allocated to HIV prevention and health care programs for the homosexual population (in particular, men who have sex with men). This finding implies

that HIV prevention and treatment programs targeting high-risk heterosexual individuals are warranted.

Our study findings could inform policies in improving clinical outcomes of HIV health care. First, PLWHA were more likely to have positive clinical outcomes if they indicated that they have a consistent HIV health care provider. This finding supported the claim from previous research that a better health care provider-patient relationship is associated with positive clinical outcomes.<sup>13,32</sup> Moreover, we found that having a consistent HIV health care provider was associated with having a high level of CD4 cells. By having a consistent HIV health care provider, patients can have a stable patient-physician relationship and learn better access to health care consistently; this implies that having a consistent HIV health care provider will not only likely benefit patients' HIV outcomes but may also have a positive impact on their general health. Therefore, better linkage of patients with HIV to health care programs is crucial in HIV management efforts. Policy efforts from public health agencies should encourage and facilitate patients with HIV to have a consistent HIV health care provider.

### Limitations

This study had limitations. First, the MMP included only patients who received HIV health care at the time of the interview, and therefore we were unable to study patients with HIV who did not receive health care services, which limited the generalizability to all patients with HIV. Second, a large proportion of patients interviewed by the MMP did not respond to the interview questions about having a consistent HIV health care provider. To address this limitation, we applied the IPW to deal with the nonresponse issue. Third, despite the rich data included in the MMP study, we used only the Illinois subset, which may have limited generalizability to apply the conclusions to other parts of the United States.

## CONCLUSIONS

This study examined the associations of having a consistent HIV health care provider and patient clinical outcomes among PLWHA in Illinois. To our knowledge, this was the first study that confirmed the positive association that patients who received HIV health care with a consistent HIV health care provider were more likely to achieve positive clinical outcomes. To improve HIV-related clinical outcomes, policy and educational interventions are needed for PLWHA to have a consistent HIV health care provider and establish a long-term physician-patient relationship. Specific interventions and policies should be implemented to encourage patients to have a consistent HIV health care provider. ■

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## REFERENCES

- Hall HI, An Q, Tang T, et al. CDC. Prevalence of diagnosed and undiagnosed HIV infection—United States, 2008–2012. *MMWR Morb Mortal Wkly Rep*. 2015;64(24):657–662.
- HIV surveillance update reports. Illinois Department of Public Health. Accessed October 20, 2016. <https://www.dph.illinois.gov/topics-services/diseases-and-conditions/hiv-aids/hiv-surveillance/update-reports>
- Kaplan JE, Hanson D, Dworkin MS, et al. Epidemiology of human immunodeficiency virus–associated opportunistic infections in the United States in the era of highly active antiretroviral therapy. *Clin Infect Dis*. 2000;30(suppl 1):S5–S14. doi:10.1086/313843
- Lesko CR, Cole SR, Hall HI, et al. CNICS Investigators. The effect of antiretroviral therapy on all-cause mortality, generalized to persons diagnosed with HIV in the USA, 2009–11. *Int J Epidemiol*. 2016;45(1):140–150. doi:10.1093/ije/dyv352
- Cheever LW. Engaging HIV-infected patients in care: their lives depend on it. *Clin Infect Dis*. 2007;44(11):1500–1502. doi:10.1086/517534
- Kay ES, Batey DS, Mugavero MJ. The HIV treatment cascade and care continuum: updates, goals, and recommendations for the future. *AIDS Res Ther*. 2016;13:35. doi:10.1186/s12981-016-0120-0
- Hoehn N, Gill MJ, Krentz HB. Understanding the delay in starting antiretroviral therapy despite recent guidelines for HIV patients retained in care. *AIDS Care*. 2017;29(5):564–569. doi:10.1080/09540121.2016.1234678
- Rebeiro P, Althoff KN, Buchacz K, et al. North American AIDS Cohort Collaboration on Research and Design. Retention among North American HIV-infected persons in clinical care, 2000–2008. *J Acquir Immune Defic Syndr*. 2013;62(3):356–362. doi:10.1097/QAI.0b013e31827f578a
- Beer L, Skarbinski J. Adherence to antiretroviral therapy among HIV-infected adults in the United States. *AIDS Educ Prev*. 2014;26(6):521–527. doi:10.1521/aeap.2014.26.6.521
- Kane RL, Maciejewski M, Finch M. The relationship of patient satisfaction with care and clinical outcomes. *Med Care*. 1997;35(7):714–730. doi:10.1097/00005650-199707000-00005
- Royal SW, Kidder DP, Patrabansh S, et al. Factors associated with adherence to highly active antiretroviral therapy in homeless or unstably housed adults living with HIV. *AIDS Care*. 2009;21(4):448–455. doi:10.1080/09540120802270250
- Kelly JD, Hartman C, Graham J, Kallen MA, Giordano TP. Social support as a predictor of early diagnosis, linkage, retention, and adherence to HIV care: results from the Steps Study. *J Assoc Nurses AIDS Care*. 2014;25(5):405–413. doi:10.1016/j.jana.2013.12.002
- Schneider J, Kaplan SH, Greenfield S, Li W, Wilson IB. Better physician-patient relationships are associated with higher reported adherence to antiretroviral therapy in patients with HIV infection. *J Gen Intern Med*. 2004;19(11):1096–1103. doi:10.1111/j.1525-1497.2004.30418.x
- Mills EJ, Nachega JB, Buchan I, et al. Adherence to antiretroviral therapy in sub-Saharan Africa and North America: a meta-analysis. *JAMA*. 2006;296(6):679–690. doi:10.1001/jama.296.6.679
- Deeks SG, Lewin SR, Havlir DV. The end of AIDS: HIV infection as a chronic disease. *Lancet*. 2013;382(9903):1525–1533. doi:10.1016/S0140-6736(13)61809-7
- Sneeuw KC, Sprangers MA, Aaronson NK. The role of health care providers and significant others in evaluating the quality of life of patients with chronic disease. *J Clin Epidemiol*. 2002;55(11):1130–1143. doi:10.1016/s0895-4356(02)00479-1
- Frankel M, McNaghten A, Shapiro M, et al. A probability sample for monitoring the HIV-infected population in care in the U.S. and in selected states. *Open AIDS J*. 2012;6:67–76. doi:10.2174/1874613601206010067
- Calmy A, Ford N, Hirschel B, et al. HIV viral load monitoring in resource-limited regions: optional or necessary? *Clin Infect Dis*. 2007;44(1):128–134. doi:10.1086/510073
- Masur H, Ognibene FP, Yarchoan R, et al. CD4 counts as predictors of opportunistic pneumonias in human immunodeficiency virus (HIV) infection. *Ann Intern Med*. 1989;111(3):223–231. doi:10.7326/0003-4819-111-3-223
- Krentz HB, Auld MC, Gill MJ. The high cost of medical care for patients who present late [CD4 <200 cells/microL] with HIV infection. *HIV Med*. 2004;5(2):93–98. doi:10.1111/j.1468-1293.2004.00193.x
- DiNardo J, Fortin NM, Lemieux T. Labor market institutions and the distribution of wages, 1973–1992: a semiparametric approach. National Bureau of Economic Research working paper 5093. April 1995. Accessed November 20, 2016. <https://www.nber.org/papers/w5093>
- Hirano K, Imbens GW, Ridder G. Efficient estimation of average treatment effects using the estimated propensity score. *Econometrica*. 2003;71(4):1161–1189. doi:10.1111/1468-0262.00442
- Aida AA, Wilson MG, Shubert V, et al. Housing status, medical care, and health outcomes among people living with HIV/AIDS: a systematic review. *Am J Public Health*. 2016;106(1):e1–e23. doi:10.2105/AJPH.2015.302905
- Higa DH, Marks G, Crepez N, Liou A, Lyles CM. Interventions to improve retention in HIV primary care: a systematic review of U.S. studies. *Curr HIV/AIDS Rep*. 2012;9(4):313–325. doi:10.1007/s11904-012-0136-6
- Bradley H, Mattson CL, Beer L, Huang P, Shouse RL, Medical Monitoring Project. Increased antiretroviral therapy prescription and HIV viral suppression among persons receiving clinical care for HIV infection. *AIDS*. 2016;30(13):2117–2124. doi:10.1097/QAD.0000000000001164
- Ironson G, O'Leirigh C, Fletcher MA, et al. Psychosocial factors predict CD4 and viral load change in men and women with human immunodeficiency virus in the era of highly active antiretroviral treatment. *Psychosom Med*. 2005;47(6):1013–1021. doi:10.1097/01.psy.0000188569.58998.c8
- Smith CJ, Sabin CA, Youle MS, et al. Factors influencing increases in CD4 cell counts of HIV-positive persons receiving long-term highly active antiretroviral therapy. *J Infect Dis*. 2004;190(10):1860–1868. doi:10.1086/425075
- Katz MH, Cunningham WE, Fleishman JA, et al. Effect of case management on unmet needs and utilization of medical care and medications among HIV-infected persons. *Ann Intern Med*. 2001;135(8, pt 1):557–565. doi:10.7326/0003-4819-135-8\_part\_1-200110160-00006
- Piette JD, Fleishman JA, Stein MD, Mor V, Mayer K. Perceived needs and unmet needs for formal services among people with HIV disease. *J Community Health*. 1993;18(1):11–23. doi:10.1007/BF01321517
- Hestlin KC, Cunningham WE, Marcus M, et al. A comparison of unmet needs for dental and medical care among persons with HIV infection receiving care in the United States. *J Public Health Dent*. 2001;61(1):14–21. doi:10.1111/j.1752-7325.2001.tb03350.x
- Bradley H, Viall AH, Wortley PM, Dempsey A, Hauck H, Skarbinski J. Ryan White HIV/AIDS Program assistance and HIV treatment outcomes. *Clin Infect Dis*. 2016;62(1):90–98. doi:10.1093/cid/civ708
- Roberts KJ. Physician-patient relationships, patient satisfaction, and antiretroviral medication adherence among HIV-infected adults attending a public health clinic. *AIDS Patient Care STDS*. 2002;16(1):43–50. doi:10.1089/108729102753429398

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