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## Location of HIV Diagnosis Impacts Linkage to Medical Care

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### Abstract

We evaluated 1,359 adults newly diagnosed with HIV in Philadelphia in 2010-2011 to determine if diagnosis site (medical clinic, inpatient setting, counseling and testing center (CTC), correctional facility) impacted time to linkage to care (difference between date of diagnosis and first CD4/viral load). 1,093 patients (80%) linked to care: 86% diagnosed in medical clinics, 75% in inpatient settings, 62% in CTCs, and 44% in correctional facilities. Adjusting for other factors, diagnosis in inpatient settings, CTCs, and correctional facilities resulted in a 33% (adjusted hazard ratio=0.77, 95% confidence interval=0.64-0.92), 46% (0.56, 0.42-0.72), and 75% (0.25, 0.18-0.35) decrease in the probability of linkage compared to medical clinics, respectively.

### Keywords

HIV; Testing; Linkage to Care; Diagnosis

### Introduction

Linkage to care is critical to achieving HIV viral suppression, and is a key component of the test-and-treat approach to HIV prevention.<sup>1</sup> Accordingly, the United States (U.S.) *National HIV/AIDS Strategy* (NHAS) calls for immediate linkage to care after HIV diagnosis, and has set a goal of increasing the proportion of persons linked to care within 3 months of diagnosis

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from 65% to 85%.<sup>2</sup> To meet this goal, a better understanding of factors impacting linkage to care is needed.

Prior research have focused on patient factors associated with linkage to care, noting that uninsured individuals, injection drugs users, and persons with lower household incomes had delayed linkage compared to their counterparts.<sup>3-11</sup> Few studies have examined how site of HIV diagnosis impacts linkage to care. Among 1,928 New York City residents newly diagnosed with HIV in 2003, individuals diagnosed at community testing sites, correctional facilities, and department of health sexually transmitted diseases clinics were less likely to link to care (define using laboratory data – CD4 cell count and HIV viral load) than those diagnosed at primary medical care clinics.<sup>8</sup> However, this study was limited in that it was unable to differentiate between laboratory tests conducted at medical care sites versus other locations and did not evaluate linkage rates for individuals diagnosed in inpatient facilities.

The current analysis extends prior research by (1) using more recent data from a different geographic region, (2) employing an improved definition of linkage to care, and (3) examining linkage to care for persons diagnosed in inpatient facilities. In this way, we provide new information on how the site of HIV diagnosis influences linkage to care.

## Methods

### Data Source and Study Population

Data were extracted from the City of Philadelphia's Enhanced HIV/AIDS Reporting System (eHARS), a database containing demographic, laboratory, and health service utilization information on all HIV cases reported to the Philadelphia Department of Public Health. Philadelphia requires name-based case reporting of all new HIV infections in the City. In addition, local mandates require reporting of all CD4 cell counts  $<350$  cell/mm<sup>3</sup> and all HIV-1 RNA results. In 2012, the City started collecting information on all CD4 cell counts (not only those  $<350$  cell/mm<sup>3</sup>) and retrospectively obtained data for 2009-2012.

All laboratory results, including reactive HIV Western blots, CD4 cell counts, and HIV-1 RNA levels, are assigned a unique identifier indicating the facility associated with the requesting provider. Death data from the Pennsylvania Bureau of Vital Statistics, Social Security Death Master Index, and the National Death Index are routinely matched with eHARS data to identify deceased persons. The eHARS data are routinely monitored to identify duplicate cases, and undergo quality control and verification to ensure that abstracted data are correctly assigned to unique case records.

This analysis included all adults ( $\geq 18$  years old) with a new HIV diagnosis (positive Western blot) in Philadelphia between 2010 and 2011. Cases were followed through 2012.

### Predictor and Outcome Variables

For each person, we defined age, sex at birth, race/ethnicity, and HIV transmission risk at the time of HIV diagnosis. Age was divided into 4 groups: 18-29, 30-39, 40-49, and  $\geq 50$  years old. Race/ethnicity was categorized as non-Hispanic white, non-Hispanic black, Hispanic, and other/unknown. HIV transmission risk was grouped into heterosexual, men

who have sex with men (MSM), injection drug use (IDU), and other/unknown. Patients who had IDU in combination with another risk factor (e.g. MSM, heterosexual transmission) were classified as IDU. Site of HIV diagnosis was categorized as medical care clinic; inpatient facility, including the emergency department (ED); counseling and testing center (CTC), sites offering HIV counseling and testing, but not outpatient medical care services; and correctional system.

We calculated the difference between date of HIV diagnosis (date of first positive Western blot) and date of entry into care (date of first CD4 cell count or HIV-1 RNA at a medical care clinic). CD4 cell count and HIV-1 RNA tests collected in inpatient and correctional facilities were excluded, as they did not represent linkage to outpatient primary HIV care. In exploratory analyses, we defined linkage as HIV laboratory testing at a medical care clinic or correctional facility. Timely linkage was classified as entering care within 3 months of diagnosis. For those linked to care, we calculated the median CD4 count at the time of entry into care.

### Statistical Analyses

Comparisons of demographic characteristics of the sample across HIV diagnosis sites were made using the  $X^2$  test of independence. The proportion of cases linked to care (within 3 months, after 3 months, and not linked) was assessed for each demographic characteristic and diagnosis site. A time-to-event analysis was conducted using days between HIV diagnosis and entry into care as the dependent variable. Patients contributed observation time from the date of diagnosis to the date of entry into care, or were censored at death or end of the study period (December 31, 2012). The Kaplan-Meier product-limit method was used to estimate the cumulative proportion entering care after HIV diagnosis, stratified by diagnosis site. In primary analyses, multivariate Cox proportional hazards regression was used to identify factors (age, sex, race/ethnicity, HIV transmission risk, year of diagnosis, site of HIV diagnosis) associated with time to entry into care and to calculate their adjusted hazard ratios (AHRs). In secondary analyses, multivariable logistic regression was used to examine the association between HIV diagnosis site and timely linkage to care (within 3 months of diagnosis), adjusting for patient characteristics. Two-sided testing was used, with a P-value of  $<0.05$  considered significant. Analyses were conducted using STATA 12.1 (College Station, TX).

### Results

Between 2010 and 2011, 1,359 individuals were newly diagnosed with HIV; 74% were male, 68% were black, and 60% were 18-39 years old. The majority of patients had HET (46%) or MSM (41%) as their HIV risk behavior. Seventy-three percent of the sample was diagnosed in a medical care clinic, 15% in an inpatient setting, 7% in a CTC, and 6% in a correctional facility. (**Table 1**)

Young adults (18-29 years) and those with MSM risk were more likely to be diagnosed at a medical care clinic or CTC than older individuals and those with HET or IDU risk ( $p<0.05$ ). Males, 30-49 years old, and those with HET or IDU risk were diagnosed at higher proportions in correctional facilities than their counterparts ( $p<0.05$ ). While, older adults,

females, and those with HET or IDU risk were more likely to be diagnosed in an inpatient setting compared to younger individuals, males, and persons with MSM risk, respectively ( $p < 0.05$ ). (**Table 1**)

By the end of the study period, 1,093 (80%) newly diagnosed individuals linked to care: 821 (60%) within 3 months and 272 (20%) after 3 months of diagnosis; 266 (20%) did not link to care. (**Table 2**) Median CD4 count at the time of entry into care was 351 cell/mm<sup>3</sup> for those who linked within 3 months and 382 cell/mm<sup>3</sup> for those who linked after 3 months. Kaplan-Meier results demonstrate that persons diagnosed in medical care clinics had the highest proportion linked to care (86%), followed by those diagnosed in inpatient settings (75%) and CTCs (62%); persons diagnosed in correctional facilities had the lowest proportion linked to care (44%). (**Appendix Figure**) In analyses defining linkage as completion of HIV laboratory tests in medical care clinics or correctional facilities, 87% of persons diagnosed in medical care clinics were linked to care, 77% from inpatient settings, 66% from CTCs, and 82% from correctional facilities; 67%, 54%, 53%, and 63% were linked to care within 3 months, respectively. (**Appendix Table 1**)

In multivariate analyses, diagnosis in inpatient settings, counseling and testing centers, and correctional facilities resulted in a 23% (AHR 0.77, 95% confidence interval 0.64-0.92), 46% (0.56, 0.42-0.72), and 75% (0.25, 0.18-0.35) decrease in the **hazard** of linkage to care compared to diagnosis in medical care clinics, respectively. Additionally, the **hazard** of not linking to care was greater for black patients (vs. white), persons with IDU as their HIV risk factor (vs. heterosexual), and those diagnosed in 2010 (vs. 2011). (**Table 2**) Secondary analyses examining factors associated with timely linkage to care, within 3 month of HIV diagnosis, yielded similar results. (**Appendix Table 2**)

## Discussion

These data, from a large geographic sample of people newly diagnosed with HIV, demonstrate that diagnosis at sites without co-located outpatient care, black race/ethnicity, and IDU risk behavior are strongly associated with delayed linkage to care. Our findings support those of earlier studies, noting higher linkage to care rates when HIV testing programs are co-located at medical care clinics.<sup>8,12</sup> Moreover, they highlight the need to develop and evaluate effective interventions to facilitate linkage to care for HIV-infected individuals newly diagnosed in correctional facilities, counseling and testing centers, and inpatient/ED settings.

Rates of HIV testing among inmates have been reported between 73%-90%, in part due to the Centers for Disease Control and Prevention (CDC) recommendation to screen for HIV infection upon entry into prison and state policies mandating HIV testing during incarceration.<sup>13-15</sup> However, linkage to care for ex-offenders is often challenging, reflecting both significant obligations individuals face after release from prison (e.g. addressing basic needs, finding employment, obtaining/renewing healthcare coverage) and limited support provided during this transition.<sup>15-20</sup> In addition, untreated mental illness and drug addiction, which are conditions commonly associated with incarceration, may continue after release compounding the challenges of linking to care.<sup>21</sup> Despite these obstacles, programs such as

Project Bridge, a federally funded demonstration project that provided intensive case management for HIV-infected ex-offenders being released from prison to the community, have been shown to improve linkage to medical care for ex-offenders.<sup>21,22</sup> In order to improve linkage rates among prisoners, Philadelphia has implemented a prison to community linkage program using case management services. Similar multifaceted approaches to addressing barriers to care and improving care coordination need to be implemented and evaluated.

From a measurement standpoint, additional studies are needed to evaluate the appropriate definition of linkage to care for persons diagnosed in correctional facilities. Our results demonstrated a near doubling of the proportion linked to care when linkage was defined as completion of HIV laboratory testing at a correctional facility or medical care clinic compared to medical care clinic alone (82% vs. 44%). While the proportion linked to care varies between the two methodologies, the central issue of ensuring a safe and effective transition from prison to the community for persons newly diagnosed during incarceration remains.<sup>18</sup>

Analogous to individuals newly diagnosed with HIV in prison, those diagnosed in hospital wards and EDs face multiple challenges to timely linkage to care. Prior data indicates that only half to two-thirds of patients fully understand their post-discharge treatment plan, and this lack of understanding impacts their ability to comply with discharge instructions, including follow-up appointments.<sup>23-26</sup> While these issues are not unique to HIV-infected patients, persons with HIV may be less likely to link to care given the high prevalence of poverty, mental illness, and substance abuse in this population and the fear of stigma associated with HIV infection.<sup>27,28</sup> Case management and patient navigation may be effective tools to improve the transition from inpatient to outpatient care.<sup>29</sup>

In contrast to inpatient and correctional facilities, persons diagnosed in medical care clinics had higher linkage rates. Integration of HIV testing and medical services may facilitate linkage to care, particularly for younger adults and MSMs, by decreasing appointment wait times, leveraging patients' familiarity with the clinic environment and staff, and providing ancillary support services (e.g. case management, social work).<sup>8,30,31</sup> Persons diagnosed at medical care clinics may also have fewer health care barriers, as demonstrated by their ability to navigate the healthcare system and access medical services.

Consistent with earlier studies, individuals with IDU transmission risk were less likely to link to care, both overall and within 3 months of diagnosis, than their counterparts.<sup>3,8,11</sup> Care coordination, case management, and co-location of medical and mental health/substance abuse treatment programs have been identified as effective strategies for improving linkage to care, and may be particularly helpful in this population.<sup>28,32</sup> We did not observe any differences in linkage to care between men and women. However, prior studies note mixed findings, with some noting that women are more likely to link to care than men and other demonstrating the opposite.<sup>6,8</sup> Additional research is warranted to determine the impact of gender on linkage to care.

Prior studies indicate that lower household income and lack of health insurance coverage are associated with lower rates of linkage to care, which may reflect prioritization of basic needs (e.g. food, housing) over healthcare and challenges in navigating the healthcare system.<sup>3,4,9</sup> The Affordable Care Act, which expanded Medicaid coverage in some states to include all people with incomes up to 138% of the federal poverty level, may provide an opportunity to address some of these barriers and improve access to care.<sup>33</sup> Persons with MSM risk (vs. heterosexual) had similar linkage rates overall, but were less likely to link to care within 3 months of diagnosis. Paz-Bailey and colleagues evaluated linkage to care among 8,153 MSMs in 21 U.S. cities, noting that lower income and testing positive at their first HIV test were associated with delayed linkage (>3 months after diagnosis) and age 18-29 years and not having insurance were associated with not linking to care at all.<sup>4</sup> These findings demonstrate that differing factors impact timely linkage and non-linkage to care. Additional studies are needed to identify these differences and develop interventions to improve linkage to care, particularly among adolescents and the uninsured who represent a significant and growing portion of new HIV infections in the U.S.

Our study has several limitations. First, we relied on the use of laboratory data to define linkage to care. This may underestimate timely linkage (within 3 months of diagnosis) if laboratory tests were not ordered at or were drawn after the first HIV care visit. Second, we narrowly defined linkage to care as having evidence of laboratory testing at a medical care facility. Exclusion of laboratory tests collected outside these sites may explain why our linkage rates (particularly for those diagnosed in prison) were lower than reported elsewhere.<sup>15,17</sup> Third, we were unable to distinguish laboratory tests conducted in the ED from those conducted on hospital wards. Given the high patient volume and turnover in EDs,<sup>34</sup> additional studies evaluating the HIV testing and linkage processes in these settings are necessary. Fourth, information on the date of release from a correctional facility was not available, making inference on timely linkage to outpatient HIV care in the community difficult. Improving data sharing between correctional and surveillance systems may provide opportunities for future investigations in this area. Fifth, data from the CDC Routine Interstate Duplicate Review file indicates that 82 individuals relocated from Philadelphia during the study period (exact dates were not available and thus could not be included in Cox regression models). However, only 14 persons moving out of the City before linking to care; this small number is unlikely to significantly alter our results. Sixth, surveillance data does not capture certain patient and structure factors that may impact linkage to care (e.g. **household income, insurance status**, fear of stigma and discrimination, social supports, and comorbid conditions). Future studies should evaluate how these and other factors affect linkage to care. Lastly, generalizability was limited as we only studied HIV-infected individuals in one U.S. city, with high proportions of racial/ethnic minorities and low income individuals.<sup>35</sup>

Only 60% of our sample linked to care within 3 months of HIV diagnosis. Improving linkage to HIV care, particularly for individuals diagnosed at sites without co-located medical care, will be critical to realizing the treatment and prevention benefits of antiretroviral therapy, and for achieving the targets set in the NHAS.<sup>2</sup>

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1**  
 Characteristics of Persons Newly Diagnosed with HIV in Philadelphia (2010-2011), Overall and by Site of HIV Diagnosis.

Characteristics	No. of Cases	Medical Care Clinic	Inpatient Setting	Counseling & Testing Center	Correctional Facility	P
<b>Total</b> <sup>†***</sup>	<b>1,359 (100%)</b>	<b>986 (73%)</b>	<b>201 (15%)</b>	<b>90 (7%)</b>	<b>82 (6%)</b>	<b>&lt;0.01</b>
<b>Age (years)</b> <sup>†***</sup>						
18-29	495 (36%)	396 (40%)	30 (15%)	45 (50%)	24 (29%)	
30-39	324 (24%)	222 (23%)	52 (26%)	22 (24%)	28 (34%)	<0.01
40-49	313 (23%)	210 (21%)	67 (33%)	14 (16%)	22 (27%)	
50	227 (17%)	158 (16%)	52 (26%)	9 (10%)	8 (10%)	
<b>Sex</b> <sup>†**</sup>						
Male	1,010 (74%)	730 (74%)	139 (69%)	76 (84%)	65 (79%)	0.033
Female	349 (26%)	256 (26%)	62 (31%)	14 (16%)	17 (21%)	
<b>Race/Ethnicity</b> <sup>†</sup>						
White	202 (15%)	157 (16%)	23 (11%)	11 (12%)	11 (13%)	0.219
Black	921 (68%)	668 (68%)	142 (71%)	56 (62%)	55 (67%)	
Hispanic	208 (15%)	138 (14%)	33 (16%)	21 (23%)	16 (20%)	
Other/Unknown	28 (2%)	23 (2%)	3 (1%)	2 (2%)	0 (0%)	
<b>HIV Risk Factor</b> <sup>†***</sup>						
HET	622 (46%)	435 (44%)	113 (56%)	17 (19%)	57 (70%)	<0.01
MSM	563 (41%)	449 (46%)	53 (26%)	53 (59%)	8 (10%)	
IDU	142 (10%)	82 (8%)	26 (13%)	20 (22%)	14 (17%)	
Other/Unknown	32 (2%)	20 (2%)	9 (4%)	0 (0%)	3 (4%)	

**Abbreviations:** HET, heterosexual transmission; HIV, human immunodeficiency virus; IDU, injection drug use; MSM, men who have sex with men.

<sup>†</sup> Data are given as number (row percent) of the total number of cases.

<sup>†</sup> Data are given as number (column percent) of the total number of cases in each column.

\* P-value <0.05

P-value < 0.01  
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**Table 2**

Factors Associated with Linkage to Care in Persons Newly Diagnosed with HIV in Philadelphia (2010-2011).

Characteristics	* Linked to Care		Not Linked**	AHR 95% CI**
	Within 90 Days of Diagnosis	After 90 Days of Diagnosis		
<b>Total (n=1,359)</b>	<b>821 (60%)</b>	<b>272 (20%)</b>	<b>266 (20%)</b>	--
<b>Site of HIV Diagnosis</b>				
Medical Care Clinic	656 (67%)	195 (20%)	135 (14%)	1 [Reference]
Inpatient Setting	108 (54%)	42 (21%)	51 (25%)	<b>0.77 (0.64-0.92)</b>
Counseling and Testing Center	47 (52%)	9 (10%)	34 (38%)	<b>0.56 (0.42-0.74)</b>
Correctional Facility	10 (12%)	26 (32%)	46 (56%)	<b>0.25 (0.18-0.35)</b>
<b>Age (years)</b>				
18-29	285 (58%)	120 (24%)	90 (18%)	1 [Reference]
30-39	199 (61%)	50 (15%)	75 (23%)	1.02 (0.86-1.21)
40-49	188 (60%)	67 (21%)	58 (19%)	1.09 (0.92-1.29)
50	149 (66%)	35 (15%)	43 (19%)	1.14 (0.94-1.37)
<b>Sex</b>				
Male	596 (60%)	209 (21%)	205 (20%)	1 [Reference]
Female	225 (64%)	63 (18%)	61 (17%)	1.04 (0.88-1.22)
<b>Race/Ethnicity</b>				
White	138 (61%)	40 (20%)	24 (12%)	1 [Reference]
Black	538 (58%)	192 (21%)	191 (21%)	<b>0.76 (0.64-0.91)</b>
Hispanic	129 (62%)	36 (17%)	43 (21%)	0.89 (0.72-1.11)
Other/Unknown	16 (57%)	4 (14%)	8 (29%)	0.67 (0.42-1.06)
<b>HIV Risk Factor</b>				
HET	403 (65%)	101 (16%)	118 (19%)	1 [Reference]
MSM	341 (61%)	128 (23%)	94 (17%)	0.89 (0.76-1.05)
IDU	62 (44%)	33 (23%)	47 (33%)	<b>0.65 (0.52-0.81)</b>
Other/Unknown	15 (47%)	10 (31%)	7 (22%)	0.75 (0.50-1.13)

Characteristics	Linked to Care *		Not Linked *	AHR 95% CI **
	Within 90 Days of Diagnosis	After 90 Days of Diagnosis		
<b>Year of Diagnosis</b>				
2010	402 (57%)	163 (23%)	138 (20%)	1 [Reference]
2011	419 (64%)	109 (17%)	128 (20%)	<b>1.32 (1.17-1.50)</b>

**Abbreviations:** AHR, adjusted hazard ratio; CI, confidence interval; HET, heterosexual transmission; HIV, human immunodeficiency virus; IDU, injection drug use; MSM, men who have sex with men.

\* Data are given as number (row percent) of the total number of cases in each row.

\*\* Results are from multivariate Cox proportional hazards regression model.