



Effect of Patient Navigation on Transitions of HIV Care After Release from Prison: A Retrospective Cohort Study

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Abstract

Antiretroviral therapy is successfully administered to people living with HIV while they are incarcerated in most US prison systems, but interruptions in treatment are common after people are released. We undertook an observational cohort study designed to examine the clinical and psychosocial factors that influence linkage to HIV care and viral suppression after release from a single state prison system. In this report we describe baseline characteristics and 6-month post-incarceration HIV care outcomes for 170 individuals in Wisconsin. Overall, 114 (67%) individuals were linked to outpatient HIV care within 180 days of release from prison, and of these, 90 (79%) were observed to have HIV viral suppression when evaluated in the community. The strongest predictor of linkage to care in this study was participation in a patient navigation program: Those who received patient navigation were linked to care 84% of the time, compared to 60% of the individuals who received only standard release planning (adjusted OR 3.69, 95% CI 1.24, 10.96; $P < 0.01$). Findings from this study demonstrate that building and maintaining intensive patient navigation programs that support individuals releasing from prison is beneficial for improving transitions in HIV care.

Keywords Human immunodeficiency virus · Linkage to care · Viral suppression · Incarceration · Reentry

Introduction

Human immunodeficiency virus (HIV) is a chronic viral infection requiring sustained access and adherence to antiretroviral therapy (ART) in order to prevent viral transmission and progression to acquired immunodeficiency syndrome (AIDS). Globally, incarcerated persons represent a key priority population for HIV control efforts because of their high prevalence of HIV and comorbidities such as viral hepatitis and tuberculosis [1]. There is also a high concentration of transmission risk behaviors in criminal justice settings,

creating environments which can fuel the HIV epidemic and thwart population-level interventions to reduce HIV transmission [2].

In the United States, criminal justice-involved adults have a substantially higher prevalence of HIV infection than the general population [3]. ART is widely available for infected individuals incarcerated in state and federal prisons in the United States, although access to ART is less well documented and may be sporadic in many local jails and other short-term detention facilities. Prior studies have shown that patients treated for HIV while in prison tend to have comparable treatment outcomes to people treated in community-based clinics [4, 5]. Other studies have documented, however, that continuity of HIV care is extremely poor for people who are released from prison and must transition from prison-based care to a community-based provider. In this context, patients often miss HIV-related clinical appointments [6], experience frequent lapses in treatment adherence [7, 8] and develop virologic failure [6, 9].

Improving care for people living with HIV (PLWH) following incarceration is important for the health of these individuals and the communities to which they return.

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Antiretroviral treatment interruptions can lead to higher community rates of HIV transmission and can increase the prevalence of antiretroviral drug resistance [10]. Optimizing the HIV care continuum by ensuring efficient linkage to care for PLWH, providing universal access to ART and promoting uninterrupted medication adherence, is viewed as the foundation of global programs striving to end the HIV epidemic [11]. Addressing continued management of HIV infections within formerly incarcerated people upon community re-entry has been identified as a critically important component of these efforts [12, 13].

The process of community re-entry poses significant challenges to managing HIV, including risk of substance use relapse, poor access to mental health care, and lack of employment, housing, transportation, and education [14, 15]. The purpose of this study is to describe the HIV care experiences and outcomes of a cohort of criminal justice-involved adults living with HIV as they transition to community life during the first 6 months after release from prison. By enhancing our understanding of the specific challenges encountered during this critically important period, this study aims to inform the development of future interventions and policy changes that can improve retention in HIV care. In this report, we describe baseline characteristics and post-release HIV outcomes for participants in this cohort.

Methods

Study Setting

Wisconsin is a medium-sized state in the Great Lakes region of the United States, with a low-to-moderate HIV prevalence. In 2017, there were 7123 people living with diagnosed HIV in Wisconsin [16], corresponding to a prevalence rate of 121 per 100,000 persons. Despite an overall low HIV prevalence, Wisconsin has substantial racial and geographic disparities. Milwaukee County, the state's main urban center, accounts for 17% of the state's population but 51% of all new HIV diagnoses [16, 17]. The HIV diagnosis rate among Black men in Wisconsin is 13-fold greater than that of White men, and the diagnosis rate among Black women in Wisconsin is 22-fold greater than White women [16]. Wisconsin also has the United States' widest racial disparity in the rate of incarceration [18], making it a valuable context in which to study social factors influencing the HIV care continuum.

The Wisconsin Department of Corrections (WI DOC) houses an adult prison population of approximately 22,600 individuals, with an estimated HIV prevalence of 7 per 1000 incarcerated persons [19]. PLWH in WI DOC prisons receive clinical care at the University of Wisconsin HIV/AIDS Comprehensive Care Clinic (UWCCC), which also served as the venue for recruiting participants for this study.

The standard of care at WI DOC is for individuals to be dispensed a 30 day supply of all chronically-prescribed medications at the time of release, and this practice remained constant throughout the study period.

Study Participants

In this retrospective cohort study, individuals were included if they were released from a Wisconsin state prison between January 1, 2011 and December 31, 2015 and met the following inclusion criteria: (1) were 18 years of age or older, (2) could speak and understand English, (3) were incarcerated for at least 30 days, and (4) received ART for HIV infection while incarcerated.

Data Collection

Using a standardized data collection form, researchers collected past medical history from the UWCCC electronic health record (EHR) system, including dates of HIV/AIDS-related diagnoses, receipt of antiretroviral medications, and prior diagnoses of co-morbid chronic medical conditions, mental health problems and substance use disorders. To create a comprehensive record of prior HIV care for each participant, data were extracted from clinic encounters occurring during the period of incarceration, during prior instances of incarceration outside the study period, and during health care encounters at UWCCC occurring at times when the participant was not incarcerated.

After executing a data use agreement with the Wisconsin Department of Health Services (DHS) and establishing a mechanism for secure, encrypted and HIPAA-compliant data transfer, we obtained participant-level data contained in the enhanced HIV/AIDS Reporting System (eHARS) database. eHARS data were used to describe demographic characteristics, risk behaviors obtained at the time of initial diagnosis, and all subsequent laboratory data (i.e. quantitative HIV RNA levels) reported through mandated laboratory-based reporting. DHS also queried vital records and provided dates of death for deceased study participants.

Data describing periods of incarceration were obtained through a data sharing agreement with WI DOC. Again using an encrypted file transfer protocol, WI DOC staff provided dates of admission and release from all Wisconsin prisons for all study participants. This allowed us to define the period(s) of time that each participant was incarcerated, and ultimately to determine whether individuals were engaging in HIV care and adhering to ART after periods of incarceration. For cases where participants were incarcerated multiple times during the study period, we evaluate in this paper the outcomes related to the most recent eligible incarceration period.

The study protocol was approved by the Health Sciences Institutional Review Board at the University of Wisconsin–Madison, and the Wisconsin Department of Corrections Research Committee. A Certificate of Confidentiality was obtained through the National Institute on Drug Abuse.

Study Outcomes

We used eHARS surveillance data to define two main study outcomes. The first, linkage to care, was defined as having the results of a quantitative HIV RNA test obtained at any community-based provider reported to eHARS within 180 days of release from prison. The second outcome, viral suppression, was measured as a validated indicator of medication adherence [20]. Viral suppression was ascertained only for participants who achieved linkage to care, and was defined as having an HIV RNA level less than 200 copies/mL for *all* quantitative HIV RNA tests reported within 180 days of release from prison (with a minimum of one test reported). For participants who were re-incarcerated within 180 days of release, linkage to care and viral suppression were assessed only during the period in which they resided in the community. That is, HIV RNA test results reported to eHARS that corresponded to a date on which a participant was residing in a WI DOC facility did not constitute evidence of linkage to care.

Covariates considered as potential predictors of post-release engagement in care included the clinical and behavioral variables obtained through UWCCC chart reviews, demographic and pre-release viral suppression obtained using eHARS, and prison release year obtained from the WI DOC database. Individuals were considered virally suppressed prior to release from prison if the last HIV RNA laboratory result reported prior to their release occurred during their incarcerated period and was less than 200 copies/mL. In addition to these, we considered whether participants enrolled in an intensive case management program designed to improve retention in care for vulnerable patients, named the WI Linkage to Care Program [17]. Beginning in June 2013, incarcerated PLWH being released to one of the two largest cities in Wisconsin, Madison and Milwaukee, were invited to enroll in this time-limited, high-contact, patient navigation model that provided support for medical appointment access and management, treatment adherence, housing, social services, emotional wellbeing, and health education, as described in detail previously [21]. This initiative, along with similar efforts in five other states, were supported by the Health Resources and Services Administration's Special Projects of National Significance Program's Systems Linkages and Access to Care for Populations at High Risk of HIV Infection Initiative. Lastly, between October 2013 and December 2015, a subset of participants participated in a prospective, mixed-methods study aiming to investigate in-depth the transitional care experiences of PLWH after release

from prison. Participation in this study involved receipt of a mobile phone and monthly telephone interviews for 6 months following release from prison. The methods and qualitative findings of this sub-study have been reported previously [22, 23]. Acknowledging that the WI Linkage to Care Program and this prospective research study likely influence linkage to care and viral suppression, we included participation in these programs as independent variables in our analysis.

Data Analysis

Descriptive statistics of baseline characteristics and main study outcomes were calculated using SAS 9.4 (SAS Institute Inc., Cary, NC). Bivariate analyses were conducted to assess whether any individual characteristics were independently associated with the two main study outcomes, linkage to care and viral suppression, using Pearson Chi square (when all expected cell sizes are > 5) or Fisher Exact tests (when one or more expected cell sizes are ≤ 5) for categorical variables, and the two-sample unpaired *t* test (when normally distributed) or the nonparametric Wilcoxon rank sum test (when non-normally distributed) for continuous variables. For individuals who experienced more than one incarceration during the study timeframe, we used eHARS viral load data corresponding to the last incarceration period that lasted at least 30 days during the study timeframe (January 1, 2011–December 31, 2015). Variables that were at least suggestive to be independent predictors of linkage to care and viral suppression ($P \leq 0.2$) were considered candidates for analysis using multiple logistic regression. To evaluate whether any characteristics influence *how promptly* individuals were linked to care after release from prison, we created survival plots using Kaplan–Meier estimation to compare the time elapsed between the date of release and the first evidence of HIV care engagement across subgroups of participants defined by characteristics determined to be statistically significantly associated with linkage to care ($P \leq 0.05$). Re-incarcerated individuals with no HIV RNA tests reported prior to re-incarceration were censored. All other individuals were assumed to be living in the community and eligible for linkage to care for 180 days, unless the vital records data showed a date of death during this time period. Individuals who did not die or receive a HIV RNA test 180 days after release from prison (i.e. did not achieve HIV linkage to care) were administratively censored.

Results

Demographic Characteristics

Between January 1, 2011 and December 31, 2015, there were 170 unique individuals who were released one or

more times from a WI DOC prison after being incarcerated for at least 30 days. The median length of stay in prison, not including prior or future incarcerations, was 541 days (1.5 years), ranging from 32 to 6951 days (19.0 years). Eleven individuals were re-incarcerated within 180 days of release from prison. Re-incarceration among these 11 individuals occurred from 16 to 169 days after release (mean: 76 days). No deaths occurred among this population within 180 days of release from prison.

Baseline descriptive characteristics of the study population are displayed in Table 1. The sample was 91% male and 58% Black/African-American. The mean age was 41, ranging from 20 to 68. The primary mode of HIV transmission reported was heterosexual contact (42%), followed by male-to-male sexual contact (31%) and injection drug use (17%). Of the 170 individuals included in this analysis, 146 (86%) had a viral load laboratory result in eHARS prior to their release from prison, of which 126 (86%) were virally suppressed at this time. The majority of the sample had never been diagnosed with AIDS (72%) and were receiving ART (57%) prior to incarceration. The most commonly identified co-morbid chronic diseases were hypertension (22%) and hepatitis C infection (19%). Depression (37%) and anxiety (20%) were the most commonly listed mental health problems.

Main Study Outcomes

Of 170 individuals released from prison during the study, 114 (67%) were linked to care within 180 days of release from prison. Of the 11 individuals who were re-incarcerated within 180 days, six were linked to care prior to re-incarceration. Associations between baseline characteristics and linkage to care are displayed in Table 2. Bivariate analyses revealed that individuals who ever enrolled in the WI Linkage to Care Program ($n=51$) were significantly more likely to be linked to care compared to those who never enrolled (84% vs. 60%, $P=0.002$). Similarly, individuals who participated in the prospective research study were significantly more likely to be linked to care compared to those who did not (78% vs. 63%, $P=0.050$). Individuals who were virally suppressed before release from prison were significantly more likely to be linked to care in the community than those with elevated HIV RNA prior to release (76% vs. 55%, $P=0.047$). Of the 11 individuals who were not virally suppressed prior to release and who linked to care in the community within 180 days, six remained unsuppressed at the time of the linkage and five had achieved viral suppression. Although not statistically significant, we observed a trend toward improved linkage to care among individuals released from prison in later years of the study ($P=0.077$).

In an analysis limited to the 114 individuals linked to care within 180 days, 90 (79%) participants were determined to

Table 1 Description of cohort ($N=170$)

Characteristic	N (%)
Gender	
Male	155 (91.2)
Cisgender female	11 (6.5)
Transgender female	4 (2.4)
Age at release from prison	
20–29	19 (11.2)
30–39	52 (30.6)
40–49	71 (41.8)
50–59	21 (12.4)
60–68	7 (4.1)
Release year	
2011	25 (14.7)
2012	36 (21.2)
2013	35 (20.6)
2014	37 (21.8)
2015	37 (21.8)
Race	
Black/African-American	98 (57.6)
White/Caucasian	57 (33.5)
Native American	7 (4.1)
Asian/Pacific Islander	2 (1.2)
Other	6 (3.5)
Ethnicity	
Not Hispanic/Latino	158 (92.9)
Hispanic/Latino	12 (7.1)
IDU	
No	139 (81.8)
Yes	31 (18.2)
MSM	
No	114 (67.1)
Yes	56 (32.9)
Chronic disease diagnoses	
COPD	5 (2.9)
Cirrhosis	0 (0.0)
Cancer	6 (3.5)
Diabetes	8 (4.7)
Heart disease	5 (2.9)
Hepatitis B	7 (4.1)
Hepatitis C	33 (19.4)
Hypertension	38 (22.4)
Kidney disease	6 (3.5)
Mental health diagnoses	
Anxiety or panic disorder	34 (20.0)
Bipolar disorder	21 (12.4)
Depression	62 (36.5)
Psychotic disorder	2 (1.2)
Schizophrenia	7 (4.1)
Alcohol use disorder	17 (10.0)
Opioid use disorder	18 (10.6)
Cocaine use disorder	28 (16.5)

Table 1 (continued)

Characteristic	N (%)
Methamphetamine use disorder	3 (1.8)
Number of diagnoses	
At least 1 chronic disease diagnosis	73 (42.9)
At least 1 mental health diagnosis	97 (57.1)
3 or more total diagnoses	47 (27.6)
Virally suppressed prior to release from prison ^a	
No	20 (13.7)
Yes	126 (86.3)
Ever had AIDS-defining condition ^a	
No	121 (71.6)
Yes	48 (28.4)
Received HIV care prior to incarceration ^a	
No	68 (40.5)
Yes	100 (59.5)
Participated in prospective research study	
No	120 (70.6)
Yes	50 (29.4)
Enrolled in WI Linkage to Care Program	
No	119 (70.0)
Yes	51 (30.0)

^aMissing pre-release viral load data for 24 individuals, AIDS data for one individual and prior HIV care data for two individuals

have achieved HIV viral suppression, indicating sustained adherence to ART during the transition period. As shown in Table 3, the only variable significantly predictive of viral suppression after release from prison is viral suppression prior to release (94% vs. 75%, $P=0.007$). We also observed a trend toward increased viral suppression among participants within several subgroups: Participants who were Black/African-American (84% vs. 71%, $P=0.097$), those who had never received an AIDS diagnosis (83% vs. 69%, $P=0.102$), and those who received HIV care for the first time while in prison (86% vs. 74%, $P=0.115$), all appeared more likely to have viral suppression after they were released.

Multiple Logistic Regression

Variables that appeared to be associated with either linkage to care or viral suppression at a significance level of 0.2 were included in the final model and include Black/African American race, prison release year (treated as a continuous variable), 3 or more comorbidities diagnosed, having an AIDS diagnosis, receiving HIV care prior to incarceration, being virally suppressed prior to release, enrollment in the WI Linkage to Care Program, and participation in the prospective research study. After adjusting for these variables (Table 4), enrollment in the WI Linkage to Care Program remained the strongest predictor of linkage to care

Table 2 Associations between individual characteristics and linkage to care (N = 170)

Characteristic	Linked to care, N (%) ^a	Not linked to care, N (%) ^a	P value
Total	114 (67.1)	56 (32.9)	
Prison release year			
2011 (N=25)	12 (48.0)	13 (52.0)	0.077
2012 (N=36)	24 (66.7)	12 (33.3)	
2013 (N=35)	25 (71.4)	10 (28.6)	
2014 (N=37)	26 (70.3)	11 (29.7)	
2015 (N=37)	27 (73.0)	10 (27.0)	
Male			
No (N=15)	9 (60.0)	6 (40.0)	0.572
Yes (N=155)	105 (67.7)	50 (32.3)	
Age			
Mean (SD)	42 (9.8)	41 (9.2)	0.468
Black/African-American			
No (N=72)	45 (62.5)	27 (37.5)	0.278
Yes (N=98)	69 (70.4)	29 (29.6)	
Duration of incarceration			
≤365 days (N=56)	35 (62.5)	21 (37.5)	0.375
>365 days (N=114)	79 (69.3)	35 (30.7)	
IDU			
No (N=139)	91 (65.5)	48 (34.5)	0.350
Yes (N=31)	23 (74.2)	8 (25.8)	
MSM			
No (N=114)	77 (67.5)	37 (32.5)	0.848
Yes (N=56)	37 (66.1)	19 (33.9)	
At least 1 chronic disease diagnosis			
No (N=97)	66 (68.0)	31 (32.0)	0.753
Yes (N=73)	48 (65.8)	25 (34.2)	
At least 1 mental health diagnosis			
No (N=73)	49 (67.1)	24 (32.9)	0.988
Yes (N=97)	65 (67.0)	32 (33.0)	
At least 3 comorbid conditions			
No (N=123)	86 (69.9)	37 (30.1)	0.199
Yes (N=47)	28 (59.6)	19 (40.4)	
Virally suppressed prior to release from prison ^b			
No (N=20)	11 (55.0)	9 (45.0)	0.047
Yes (N=126)	96 (76.2)	30 (23.8)	
Diagnosed with AIDS ^b			
No (N=121)	81 (66.9)	40 (33.1)	0.973
Yes (N=48)	32 (66.7)	16 (33.3)	
Received HIV care prior to incarceration ^b			
No (N=68)	44 (64.7)	24 (35.3)	0.560
Yes (N=100)	69 (69.0)	31 (31.0)	
Participated in a prospective research study			
No (N=120)	75 (62.5)	45 (37.5)	0.050
Yes (N=50)	39 (78.0)	11 (22.0)	
Enrolled in Wisconsin Linkage to Care Program			
No (N=119)	71 (59.7)	48 (40.3)	0.002
Yes (N=51)	43 (84.3)	8 (15.7)	

^aPercentages present the proportion linked to care/not linked to care with that characteristic

^bMissing pre-release viral load data for 24 individuals, AIDS data for one individual and prior HIV care data for two individuals

Table 3 Associations between individual characteristics and viral suppression among those linked to care (N = 114)

Characteristic	Virally suppressed, N (%) ^a	Not virally suppressed, N (%) ^a	P value
Total	90 (78.9)	24 (21.1)	
Prison release year			
2011 (N = 12)	11 (91.7)	1 (8.3)	0.619
2012 (N = 24)	19 (79.2)	5 (20.8)	
2013 (N = 25)	18 (72.0)	7 (28.0)	
2014 (N = 26)	21 (80.8)	5 (19.2)	
2015 (N = 27)	21 (77.8)	6 (22.2)	
Male			
No (N = 9)	8 (88.9)	1 (11.1)	0.682
Yes (N = 105)	82 (78.1)	23 (21.9)	
Age			
Mean (SD)	42 (10.1)	43 (8.7)	0.691
Black/African-American			
No (N = 45)	32 (71.1)	13 (28.9)	0.097
Yes (N = 69)	58 (84.1)	11 (15.9)	
Duration of incarceration			
≤ 180 days (N = 35)	27 (77.1)	8 (22.9)	0.753
> 180 days (N = 79)	63 (79.8)	16 (20.3)	
IDU			
No (N = 91)	72 (79.1)	19 (20.9)	1.000
Yes (N = 23)	18 (78.3)	5 (20.8)	
MSM			
No (N = 77)	62 (80.5)	15 (19.5)	0.553
Yes (N = 37)	28 (75.7)	9 (24.3)	
At least 1 chronic disease diagnosis			
No (N = 66)	51 (77.3)	15 (22.7)	0.607
Yes (N = 48)	39 (81.3)	9 (18.8)	
At least 1 mental health diagnosis			
No (N = 49)	41 (83.7)	8 (16.3)	0.283
Yes (N = 65)	49 (75.4)	16 (24.6)	
At least 3 comorbid conditions			
No (N = 86)	68 (79.1)	18 (20.9)	0.955
Yes (N = 28)	22 (78.6)	6 (21.4)	
Virally suppressed prior to release from prison ^b			
No (N = 11)	5 (45.5)	6 (54.6)	0.007
Yes (N = 96)	78 (81.3)	18 (18.8)	
Diagnosed with AIDS ^b			
No (N = 81)	67 (82.7)	14 (17.3)	0.102
Yes (N = 32)	22 (68.8)	10 (31.3)	
Received HIV care prior to incarceration ^b			
No (N = 44)	38 (86.4)	6 (13.6)	0.115
Yes (N = 69)	51 (73.9)	18 (26.1)	
Participated in prospective research study			
No (N = 75)	58 (77.3)	17 (22.7)	0.558
Yes (N = 39)	32 (82.1)	7 (18.0)	
Enrolled in Wisconsin Linkage to Care Program			
No (N = 71)	55 (77.5)	16 (22.5)	0.618
Yes (N = 43)	35 (81.4)	8 (18.6)	

^aPercentages present the proportion virally suppressed/not virally suppressed with that characteristic

^bMissing pre-release viral load data for 7 individuals, AIDS data for one individual and prior HIV care data for one individual

after release from prison. Individuals who enrolled in the WI Linkage to Care Program, on average, had 3.7 times greater odds of linkage to care than non-participants when all other variables are held constant (aOR 3.7; 95% CI 1.2–11.0). Although not statistically significant, individuals who were virally suppressed prior to release from prison were 2.7 times more likely to achieve linkage to care (aOR 2.7; 95% CI 0.9–7.6).

Time to Linkage to Care

Sixty-one (36%) individuals had been linked to care by 30 days post-release, 89 (52%) individuals were linked to care by 90 days, 99 (58%) individuals were linked to care by 120 days, and 114 (67%) individuals were linked to care by 180 days. Among the 114 individuals who were linked to care within 180 days, the median time to linkage was 28 days (IQR 7–77 days). As shown in Fig. 1, individuals who participated in the WI Linkage to Care Program established HIV care significantly earlier than those who did not participate in the program ($P = 0.0003$; logrank test). The median time to linkage among the 43 individuals who were linked to care and in the WI Linkage to Care Program was 22 days (IQR 7–67 days), compared to a median of 30 days (IQR 7–96 days) among the 71 individuals who were linked to care but did not participate in the program.

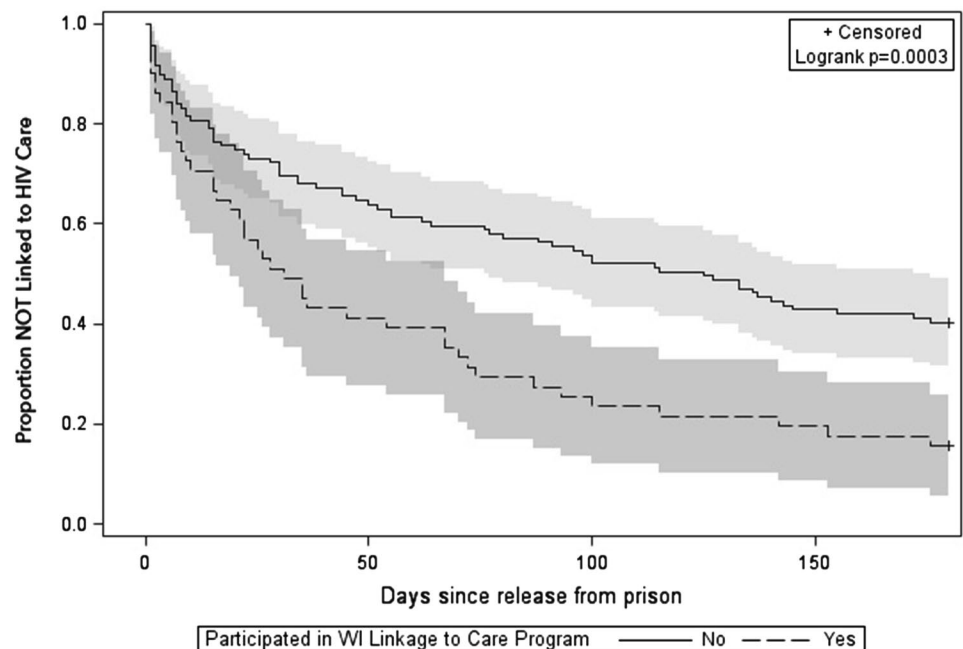
Discussion

The goal of this study was to build a better understanding of the HIV care experiences and outcomes among a cohort of criminal justice-involved adults living with HIV as they transition from prison to community life. We found that out of the 170 individuals with HIV who released from prison, 114 (67%) were linked to care within 180 of release and 90 (53%) were virally suppressed. Estimated rates of engagement in HIV care after release from incarceration have varied substantially in the literature. A systematic review [24] identifying 12 studies that reported on engagement in HIV care after release from incarceration found that the proportion linked to care in 3 months (90 days) ranged from 28 to 60% and the proportion linked to care in 6 months (180 days) ranged from 58 to 85%. Our estimates of 52% and 67% at 90 and 180 days, respectively, fall within these ranges. The low proportion (36%) of individuals in this study linked to care within 30 days of release demonstrates the need for interventions that improve the timeliness of linkage and prevent lapses in medication adherence. To better understand lapses in HIV treatment following release from prison, future studies are needed that measure the number of doses individuals leave prison with, and how promptly prescriptions are refilled.

Table 4 Adjusted odds ratios of being linked to care after release from prison

	Adjusted OR ^a	95% Wald confidence limits		P value
Black/African American vs non-Black/African American	1.186	0.520	2.705	0.685
At least 3 disease diagnoses vs less than 3	0.674	0.263	1.723	0.410
Diagnosed with AIDS vs no AIDS diagnosis	0.657	0.279	1.548	0.337
Engaged in pre-incarceration HIV care vs not	0.904	0.398	2.049	0.808
Enrolled in WI Linkage to Care Program vs not	3.689	1.241	10.959	0.019
Prison release year (continuous, 2011–2015)	1.063	0.747	1.512	0.735
Virally suppressed prior to release from prison vs not	2.677	0.940	7.627	0.065
Participated in prospective research study vs not	0.762	0.240	2.421	0.645

^aAdjusted for Black/African American race, 3 or more comorbidities diagnosed, having an AIDS diagnosis, receiving HIV care prior to incarceration, prison release year, pre-release viral suppression, enrollment in the WI Linkage to Care Program, and participation in the prospective research study

Fig. 1 Time to linkage to HIV care, by participation in the WI Linkage to Care Program, with 95% confidence intervals

Linkage to care upon release from prison was significantly greater for individuals who participated in the WI Linkage to Care Program. Involvement in this program was observed to also positively influence how quickly HIV-positive individuals linked to care after release. Because individuals were not randomized to the WI Linkage to Care Program, the outcome (linkage to care) may reflect predisposing interest in being linked to care versus disinterest in immediately addressing one's personal health following release. However, during the first 3 years the WI Linkage to Care Program was offered, only two individuals who released from prison and were offered the program refused to participate (data provided by UWCCC Inmate Social Worker). This suggests willingness to accept such services even among those who may not choose to prioritize their health during the reentry period. Thus, while this study was not designed to formally

evaluate the effectiveness of the Linkage to Care Program, the findings support the potential benefits of individualized, patient-centered care coordination strategies in the context of HIV care during re-entry.

While not statistically significant, our findings also suggest that individuals with co-morbid medical and mental health conditions may have poorer continuity of HIV care after release from prison. Participants with at three or more comorbid diagnoses appeared to be less likely to be engaged in HIV care compared with those with fewer than three diagnoses. Individuals with at least one mental health diagnosis also appeared less likely to achieve viral suppression compared to individuals without any mental health conditions. Inferior HIV outcomes among individuals with comorbid conditions have been reported in previous studies [25–27] and suggest more aggressive and comprehensive clinical

management is needed for persons suffering from HIV and other psychiatric and chronic comorbidities.

Research has shown that incarcerated populations are more likely to experience periods of homelessness [28], and those who are homeless or living in marginal conditions are more likely to be infected with HIV and less likely to access HIV medical care and treatment [29–31]. We were unable to ascertain the housing status of our study population through the data sources used in this study. Controlling for homelessness in the multivariable analysis could have either mitigated or exacerbated some of the effect that enrollment in the WI Linkage to Care Program had on linkage to care after release from prison. Future studies should examine the role housing status plays in these causal relationships.

This study is subject to additional limitations. Although researchers frequently use HIV viral load surveillance data to assess medical care engagement [32, 33], receipt of a viral load test is an imperfect construct for linkage to HIV care. This operationalization assumes that a viral load test was conducted at each HIV-related care appointment and that each viral load test conducted was during an outpatient appointment with an HIV or primary care provider. This method may not reflect HIV care visits among former WI DOC individuals who move out of state upon community re-entry. Likewise, viral suppression is an imperfect way to measure medication adherence, as individuals respond at different rates when lapses in medication occur. When ART is stopped completely, however, HIV RNA rebounds within days [34]. Lastly, this study has a relatively small sample size, precluding meaningful subgroup analyses and limiting our ability to test hypothesized relationships among variables with precision. The generalizability of the study's findings to other geographic areas may be further limited because of the heterogeneous nature of correctional health care systems and the complex social determinants influencing HIV treatment outcomes.

Strengths of this study design include the incorporation of multiple data sources and the high proportion of eligible individuals contributing data through chart-reviews and administrative data analysis. Furthermore, since all PLWH in WI DOC prisons receive care in a single health system prior to release, the cohort followed in this study reflects the post-incarceration HIV care experience of all patients in the state.

This study supports the need for care coordination strategies that account for numerous types of barriers and challenges faced by PLWH during the post-incarceration period. Findings from this study add to the existing literature describing complex challenges to retention in HIV care after release from prison, and support further development of patient-centered interventions aimed at reducing barriers to care.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments.

Informed Consent Participant data was collected for this study under a waiver of informed consent.

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