

# Systematic Assessment of Linkage to Care for Persons with HIV Released from Corrections Facilities Using Existing Datasets

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## Abstract

Populations in corrections continue to have high prevalence of HIV. Expanded testing and treatment programs allow persons to be identified and stabilized on treatment while incarcerated. However, these gains are frequently lost on reentry. Systemic frameworks are needed to monitor linkage to care to guide programs supporting linkage to care. To assess the adequacy of linkage to care on reentry, incarceration data from the National Corrections Reporting Program and data from the Ryan White Services Report from 2010 to 2012 were linked using an encrypted client identification (eUCI). Time from release to the first visit and presence of detectable HIV RNA at linkage were assessed. Multivariate survival analyses were performed to identify associations between patient characteristics and time to linkage. Among those linking, only 43% in Rhode Island and 49% in North Carolina linked within 90 days, and 33% in both states had detectable viremia at the first visit. Those not previously in care and with shorter incarceration experiences longer linkage times. Persons identified as black, had median times greater than 1 year. Using existing datasets, significant gaps in linkage to care for persons with HIV on release from corrections were demonstrated in Rhode Island and North Carolina. Systemically implementing this monitoring to evaluate changes over time would provide important information to support interventions to improve linkage in high-risk populations. Using national datasets for both corrections and clinical data, this framework equally could be used to evaluate experiences of persons with HIV linking to care on release from corrections facilities nationwide.

## Introduction

**I**NCARCERATED POPULATIONS REMAIN A PRIORITY area for HIV control efforts. Since the beginning of the epidemic, higher prevalences of HIV have been observed in prisons and jails compared to the general population.<sup>1-3</sup> Though testing is common in correctional facilities, policies governing testing and consent vary by facility.<sup>4</sup> Among those with HIV in corrections, co-morbid mental health, and substance abuse disorders are common.<sup>5-7</sup> Periods of incarceration represent both opportunities and challenges for persons living with HIV. For many, they provide important stability and access to care. This allows them to receive antiretroviral therapy and achieve virologic suppression.<sup>8</sup> Upon release, however, many of these gains are lost due to delays in uptake to care,

unstable social circumstances, and relapse to substance abuse and other transmission risk behaviors.<sup>9-12</sup>

Loss to follow-up on reentry and delays in linkage to care on release from corrections have been previously identified.<sup>13,14</sup> Much of the published literature is based on analyses of data from individual programs or cohorts with small population sizes. In 2009, Baillargeon et al.<sup>12</sup> used Ryan White HIV/AIDS Program (RWHAP) AIDS Drug Assistance Program data in Texas to identify that only 5.8% of 2115 persons released from prison linked to care in time to avoid lapses in treatment. In a subsequent study of 1750 persons with HIV released from prison in Texas, Baillargeon et al. found that those who do ultimately link to care do so after substantial delays, with only 28% linking to care within 90 days.<sup>11</sup> In a multisite study of 867 persons with HIV linking

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to care following detention in jails, only 19% had a visit in the first quarter after release, and 34% were lost follow-up.<sup>15</sup> Studies examining the clinical status of persons with HIV reincarcerated following release similarly showed that at the time of reincarceration those individuals had recurrent HIV viremia and reductions in CD4 count.<sup>9,16</sup>

Resources available to support linkage to care vary by jurisdiction. Intensive case management interventions have been established, often in the context of innovation grants, to improve outcomes in model centers.<sup>17–22</sup> Project Bridge in Rhode Island was established under a Special Projects of National Significance (SPNS) grant from the Health Resources and Services Administration (HRSA). Among enrolling clients in Project Bridge, 95% ultimately linked to care during the 18-month follow-up interval.<sup>18</sup> Wohl et al.<sup>19</sup> in North Carolina compared intensive case management with comprehensive discharge planning for persons with HIV being released to the community. No statistically significant differences were observed between the study arms. Sixty-five percent of those in the case management arm and 54% of those in the discharge-planning-only arm linked to care within 4 weeks, and 88% and 78%, respectively, linked to care within 12 weeks.

To be effective, programs supporting linkage to care on release from correctional facilities need systems for ongoing monitoring of linkage on reentry. In 2011, we proposed a framework for systematically assessing the adequacy of linkage to care using corrections release data and clinical service data from RWHAP-funded service providers linked by the HRSA HIV/AIDS Bureau (HAB) encrypted Unique Client Identifier (eUCI).<sup>23</sup> The strength of utilizing the eUCI is that it circumvents the need to use patient identifiers (e.g., name and date of birth) for linkage, and instead utilizes a unique surrogate identifier for linkage of correctional and community clinical service data. Additionally, our framework utilizes a Bayesian modeling approach to reduce false positive matches of eUCIs across datasets.<sup>24</sup> The validation of this method in RI showed that the eUCI performed comparably to the probabilistic matching techniques commonly used for merging data sets by patient identifiers.<sup>24</sup> With this methodology, we examined data from Rhode Island and North Carolina over the years 2010–2013 to assess time to linkage and clinical status for HIV-positive persons released from prison and engaging in care with RWHAP-funded service providers.

## Methods

This study was a retrospective analysis of corrections release data and client level clinical data obtained from existing data sources, the National Corrections Reporting Program and the Ryan White Service Report. The study was reviewed and approved by the Institutional Review Boards at the Miriam Hospital, Abt Associates, the University of North Carolina, as well as the Rhode Island and North Carolina prison systems and the Office for Human Research Protections.

### *National Corrections Reporting Program*

Since 1983, the National Corrections Reporting Program (NCRP) has collected administrative data annually on prison admissions and releases in participating state jurisdictions.<sup>25</sup>

The data include demographics, incarceration, and release dates from individual prisoner records. Data analyzed for Rhode Island and North Carolina included records for all sentenced persons released from prison between January 1, 2010 and December 31, 2013. In addition, for North Carolina, a separate NCRP dataset was obtained with records filtered to only include those individuals identified in the correctional system as HIV positive. For Rhode Island, state law restricts transmission of data that identifies an individual's HIV status. Accordingly the HIV status of individuals within the Rhode Island corrections data was not known.

### *Ryan White Service Report (RSR)*

HRSA HAB mandates that all providers submit client level data for persons receiving RWHAP-funded services in the form of the Ryan White Service Report (RSR).<sup>26</sup> Data elements in the RSR include demographics, dates and results of viral load and CD4 monitoring, and dates of outpatient ambulatory care visits. For this study, the RSR files were received from participating sites for clients served between January 1, 2010 and December 31, 2013. In Rhode Island, the file was obtained from a single program that serves greater than 90% nearly all persons with HIV released from the correctional facility.<sup>24</sup> In North Carolina, files were obtained from 15 of the 19 RWHAP-funded grantees, including data from all of the providers with which they subcontract. Data files were not available from the RWHAP providers within Charlotte-Mecklenburg County Transitional Grant Area (TGA). The 10,849 cases received for North Carolina represent approximately 75% of the 14,570 individuals in North Carolina receiving RWHAP-funded services.

### *RSR/NCRP merged data set*

To create the analytic sample, the NCRP and the RSR data files were merged using the eUCI, the primary identifier used in the RSR. The eUCI is formed from the first and third characters of the first and last names, the full birth date, and coded gender. The assembled string is encrypted using a HASH algorithm in a manner that prevents recovery of the source data.<sup>27,28</sup> eUCIs were generated for all NCRP release records with separate eUCIs generated for each alias, and personal identifier were removed from the data. NCRP and RSR records were then matched and linked using the eUCI. A match between any eUCI (primary name or alias) from the NCRP data to an eUCI from the RSR was considered to be a match for that individual. The eUCIs were replaced with arbitrary identifiers to further protect confidentiality. All matched records were included in the analysis set.

**Outcomes.** The primary outcome assessed was time to linkage defined as the time from release to the first ambulatory care visit in the community. The secondary outcome was viral load at the first community HIV ambulatory care visit, which was categorized as 200 or greater (classified as not suppressed) and less than 200 (classified as suppressed).

**Study populations.** For Rhode Island, the cohort for time to linkage assessments included all persons identified as HIV-positive based on an eUCI-match between the NCRP and RSR records. For North Carolina, the person included both persons with known HIV positivity, documented in the

corrections records, and persons for whom there was an eUCI match between the NCRP and RSR data files. Incarceration events were excluded if an individual was re-incarcerated within 30 days of release from their previous incarceration event. Repeat incarcerations for a matched individual were analyzed as independent release events.

### *Statistical analyses*

Descriptive statistics of patient characteristics and outcomes. The distributions of key demographic and clinical variables were assessed by state including: race, ethnicity, gender, prior Ryan White program enrollment, HIV risk factor, prescription for HAART following linkage, housing status, insurance status, AIDS diagnosis, and categorized time incarcerated (less than 180 days vs. greater than or equal to 180 days). The 180-day threshold was selected based on the community standard of care that patients be seen at least every 6 months. The median time to linkage and percent linking within 90 days were assessed. Among those who linked, the proportion with a suppressed viral load was estimated by time to linkage: less than 30 days, 30–60 days, 60–90 days, and greater than 90 days.

Factors associated with time to linkage to care. Univariate mixed effects survival models, which assumed a lognormal distribution of linkage time, were generated to estimate the time to linkage, by clinical and demographic groups. The lognormal distribution was assumed to account for the skewed distribution of time to care. Random effects were included to account for multiple prison releases for the same individual. The time origin for survival analyses was the individual's release date and time to linkage was counted, in days, until the individual either linked to a medical visit, was re-incarcerated, or reached the end of the observation period. Individuals were censored if no medical visits occurred before the end of the observation period or if the individuals were re-incarcerated. The maximum number of days an individual could be in the data set without linking to medical care was 1278 days.

Factors identified as significant in univariate tests of association with time to linkage were included in multivariate mixed effects survival models to generate adjusted estimates of effect size.

Estimated median time to linkage by group. Post-estimation linear combinations were used to ascertain median days to care for key subgroups based on demographic and risk variables after each regression model. In contrast to the descriptive statistics, the estimates reflect the linkage experience of all persons including those not observed to link within the follow-up interval. Linkage beyond 180 days was considered highly relevant given the current recommendations that even patients stable on antiretroviral therapy be seen by an HIV provider at least every 6 months.

Adjustment for matching error associated with the eUCI. To adjust for the possible impact of false positive matches, we used a multiply imputed latent variable that identified each pair as a true positive match or a false positive match.<sup>24</sup> This resulted in 30 complete data sets, such that in each data set we can identify the true matches, and estimate the

parameters of interest. These estimates were combined to derive point and interval estimates using Rubin's Rule for multiple imputation.<sup>29</sup>

The imputed classification value for each pair is based on the probability that an individual was correctly matched between the NCRP and the Ryan White data set, accounting for possible errors. Pairs that have a higher probability of being a false match are classified as so at a higher rate in each of the complete data sets, and are thus having lower overall impact on the estimates.<sup>24</sup> This method to correct for false positive matches was used to generate all estimates. STATA/SE 12.1 was used for all statistical analyses.<sup>30</sup>

## **Results**

### *Patient samples and characteristics*

There were 171 individuals matched between the corrections release and clinical data sets in Rhode Island between 2010 and 2013 (Table 1). Of those, 133 resulted in the inmates linking to medical care. The remainder had services prior to the period of incarceration but no services following release. During the same time frame, there were 761 prison releases among individuals known to be HIV+ in North Carolina and 533 were matched to records in the clinical data set. African Americans were more prevalent in NC at 79% as compared to 42% in RI. Eighty-five percent in RI and 80% in NC were male. Injection drug use (IDU) and male sexual contact (MSM) were more commonly reported as risk factors for HIV in RI and heterosexual contact was more commonly reported in NC. Eighty-two percent in RI had a prior documented relationship with a Ryan White care provider as compared to only 55% in NC.

### *Time to linkage and viral suppression at linkage*

Among those who linked to care, median time to first service in RI was 57 days (range 1–1260) and 43% linked within 90 days (Table 2). In North Carolina the median time linkage was 35 days (range 1–1185) and 49% linked within 90 days. Of the individuals who linked to care, 35% and 33% had detectable viremia at first assessment in the community in RI and NC, respectively. A higher proportion of individuals linking to care within 0–30 or 30–60 days had suppressed viremia at their first assessment as compared to those with first service 60–90 or greater than 90 days. Of note, 56% of individuals in RI and 52% of individuals in NC with first service documented greater than 90 days from the time of release had no significant viremia at first assessment.

### *Factors associated with time to linkage to care*

In univariate associations with time to linkage to care, race, prior Ryan White enrollment, documented prior diagnosis of AIDS, housing status and time incarcerated greater than 180 days were identified as potentially important factors (Table 3). In Rhode Island, persons who had received RWHAP funded care prior to incarceration and those who were clinically diagnosed with having AIDS had shorter times to linkage to care. Those released in North Carolina had shorter times to linkage if they were white or if they had longer prison sentences.

In the multivariable mixed-effect survival analysis model for Rhode Island, having received RWHAP funded care prior

TABLE 1. DISTRIBUTION OF INDIVIDUALS BY KEY SOCIAL, DEMOGRAPHIC, AND CLINICAL FACTORS

	Rhode Island n (%)	North Carolina n (%)
Correctional release data		
All releases	19,361	97,989
HIV+ releases	n/a	1,488
Unique individuals in analysis set	11,854	1,341
Ryan White client level data		
Unique individuals receiving ambulatory services	1,634	10,849
Individuals matched	171	761
Matched individuals with services post release	133	533
Race		
White	60 (45)	93 (17)
Black	56 (42)	422 (79)
Other	17 (13)	18 (3)
Ethnicity		
Non-Hispanic/non-Latino	106 (80)	526 (99)
Hispanic/Latino	27 (20)	6 (<1)
Unknown	-	1 (<1)
Sex		
Male	113 (85)	424 (80)
Female	20 (15)	109 (20)
Prior Ryan White enrollment		
Yes, in care prior	109 (82)	293 (55)
No, new to care	24 (18)	240 (45)
HIV risk		
MSM	60 (45)	95 (18)
IDU	45 (34)	53 (10)
Heterosexual contact	23 (17)	366 (69)
Other risk	5 (4)	19 (3)
No, not on HAART	34 (26)	107 (20)
Housing status		
Permanent/stable	64 (48)	388 (73)
Temporary/unstable	67 (50)	136 (26)
Unknown	2 (2)	9 (1)
HIV/AIDS status		
HIV+	79 (59)	308 (58)
CDC defined AIDS	54 (41)	209 (39)
Unknown status	-	16 (3)
Time incarcerated		
Less than 180 Days	69 (52)	203 (38)
More than 180 Days	64 (48)	330 (62)

to incarceration and having longer prison stays were significantly associated with linking to care sooner. In North Carolina, having a longer prison stay was significantly associated with linking to care sooner. Persons in North Carolina identifying as being of other race had significantly longer times to link to care (Table 4).

*Estimated median time to linkage by group*

Post estimation linear combinations for median days are presented in Table 5. Groups with median times to linkage of greater than 180 days are highlighted, given the recommendation that all individuals with HIV be seen at least every 6 months in the community. The median and 95% confidence interval (CI) estimates reflect the linkage experience of all persons including those not observed to link within the follow-up interval. For this reason, the estimates of median time to linkage are higher than the above reported median time to linkage among those linking to care within the follow-up interval. Significant heterogeneity in linkage was noted in both states.

Persons without prior relationships with a care provider in the community, particularly those with short-term incarcerations, had the longest times to linkage with median linkage of 575 days in RI and 302 days in NC time, for those with periods of incarceration that was shorter than 180 days. In RI, subgroups without prior relationships to care providers overall had more prolonged times to linkage. Among those not previously in care in RI, persons identified as black (n=11) had a median time to linkage of 434 days and those identified as white (n=18) had a median time to linkage of 399 days. In NC, subgroups identifying as black had the highest median times to linkage. In NC, persons identifying as black with incarceration time less than 180 days (n=258) had an observed median time to linkage of 326 days. Persons identifying as black with reported risk factor for HIV acquisition of male sexual contact (n=111) or injection drug (n=56) use in North Carolina also had prolonged times to linkage at 347 days and 279 days, respectively.

**Discussion**

Persons with HIV leaving corrections facilities in Rhode Island and North Carolina continue to experience significant delays in linkage to care after release from prison. Individuals released receive a short-term supply of medication, typically no more than 30 days. Similar to previous reports, initial visits often occur substantially after the time when medication supplies will be depleted. The finding that one-third of

TABLE 2. TIME TO SERVICE AND VIRAL STATUS AT FIRST ASSESSMENT FOLLOWING RELEASE TO THE COMMUNITY

	Rhode Island		North Carolina	
Median time to first service	57 days (1-1260)		35 days (1-1185)	
90-day % linkage	43%		49%	
Detectable virus at first service by linkage time	n (%)	p Value	n (%)	p Value
Less than 30 days	10 (26%)	0.05	53 (24%)	0.000
30-60 days	5 (21%)		21 (27%)	
60-90 days	4 (67%)		15 (34%)	
More than 90 days	25 (44%)		75 (48%)	
Overall	44 (35%)		164 (33%)	

TABLE 3. UNIVARIATE ASSOCIATIONS BETWEEN KEY SOCIAL, DEMOGRAPHIC, AND CLINICAL FACTORS AND TIME TO LINKAGE IN NORTH CAROLINA AND RI (UNIVARIATE MIXED EFFECTS SURVIVAL ANALYSIS)

	<i>Rhode Island</i> <i>Coef [95% CI]</i>	<i>North Carolina</i> <i>Coef [95% CI]</i>
Age at release	-0.07 [-0.17, 0.03]	-0.02 [-0.05, 0.02]
Race		
White	REF	REF
Black	-0.02 [-1.2, 1.1]	0.36 [-0.31, 1.03]
Other	-0.65 [-2.5, 1.2]	<b>1.7 [0.16, 3.2]</b>
Ethnicity		
Non-Hispanic/non-Latino	REF	REF
Hispanic/Latino	0.09 [-1.02, 1.2]	1.6 [-0.25, 3.4]
Sex		
Male	REF	REF
Female	0.56 [-1.02, 2.1]	0.34 [-2, 2.5]
Prior Ryan White enrollment		
Yes, in care prior	<b>-1.6 [-2.7, -0.55]</b>	-0.12 [-0.81, 0.57]
No, new to care	REF	REF
HIV risk		
MSM	0.02 [-1.1, 1.2]	0.40 [-0.65, 1.5]
IDU	-1.2 [-2.4, 0.06]	0.16 [-0.82, 1.1]
Heterosexual contact	REF	REF
Other risk	0.78 [-2.7, 4.3]	0.16 [-0.82, 1.1]
HIV/AIDS status		
HIV+	REF	REF
CDC defined AIDS	<b>-0.86 [-1.6, -0.14]</b>	-0.05 [-0.60, 0.49]
Unknown status	-	<b>1.5 [0.29, 2.7]</b>
Time Inc		
Less than 180 days	REF	REF
More than 180 days	-0.64 [-1.5, 0.25]	<b>-0.54 [-0.98, -0.10]</b>

Bold indicates significance at  $p < 0.05$ .

TABLE 4. MULTIVARIATE ADJUSTED MIXED EFFECTS SURVIVAL MODELS FOR RECENTLY RELEASED HIV+ INDIVIDUALS LINKING TO CARE IN RHODE ISLAND AND NORTH CAROLINA

	<i>Rhode Island</i>		<i>North Carolina</i>	
	<i>Coef (SE)</i>	<i>95% CI</i>	<i>Coef (SE)</i>	<i>95% CI</i>
Race				
White	REF		REF	
Black	0.09 (0.49)	[-0.88, 1.1]	0.39 (0.34)	[-0.27, 1.1]
Other	-0.59 (0.69)	[-1.9, 0.75]	<b>1.2 (0.61)</b>	<b>[0.02, 2.4]</b>
Ethnicity				
Non-Hispanic/non-Latino	REF		REF	
Hispanic/Latino	-0.08 (0.48)	[-1.03, 0.87]	1.1 (0.87)	[-0.59, 2.8]
Total time incarcerated				
Less than 180 days	REF		REF	
More than 180 days	-0.53 (0.43)	[-1.4, 0.31]	<b>-0.65 (0.24)</b>	<b>[-1.1, -0.18]</b>
Prior Ryan White enrollment				
Yes, in care prior	<b>-1.1 (0.54)</b>	<b>[-2.2, -0.06]</b>	-0.19 (0.33)	[-0.84, 0.46]
No, new to care	REF			
HIV risk				
MSM	-0.38 (0.54)	[-1.4, 0.67]	0.48 (0.50)	[-0.51, 1.5]
IDU	-1.1 (0.67)	[-2.4, 0.20]	0.38 (0.44)	[-0.49, 1.3]
Heterosexual contact	REF		REF	
Other risk	-0.15 (1.4)	[-2.9, 2.6]	1.2 (0.82)	[-0.45, 2.7]
HIV/AIDS status				
HIV+	REF		REF	
CDC defined AIDS	<b>-0.99 (0.50)</b>	<b>[-1.98, -0.01]</b>	0.01 (0.24)	[-0.45, 0.48]
Status unknown			0.88 (0.61)	[-0.32, 2.1]

Bold indicates significance at  $p < 0.05$ .

TABLE 5. MEDIAN DAYS TO CARE FOR RECENTLY RELEASED INMATES IN RHODE ISLAND AND NORTH CAROLINA FOR SPECIFIC SUBGROUPS

	<i>Rhode Island</i>			<i>North Carolina</i>		
	n	<i>Median days to care<sup>a</sup></i>	<i>95% CI</i>	n	<i>Median days to care<sup>a</sup></i>	<i>95% CI</i>
Not in care, less than 180	<b>10</b>	<b>575</b>	<b>[219, 1508]</b>	59	<b>302</b>	<b>[66, 1384]</b>
Not in care, more than 180	14	<b>289</b>	<b>[104,795]</b>	181	168	[38, 739]
In Care, less than 180	59	108	[52, 223]	144	<b>238</b>	<b>[55, 1029]</b>
In care, more than 180	50	55	[26, 116]	<b>149</b>	132	[32, 537]
White, MSM	36	167	[76, 365]	<b>25</b>	<b>192</b>	<b>[95, 387]</b>
White, IDU	27	75	[27, 207]	22	154	[70, 339]
White, Hetero	<b>13</b>	<b>238</b>	<b>[82, 693]</b>	75	108	[61, 190]
Black, MSM	32	134	[40,448]	<b>111</b>	<b>347</b>	<b>[209, 578]</b>
Black, IDU	22	60	[22, 166]	<b>56</b>	<b>279</b>	<b>[136, 571]</b>
Black, Hetero	<b>19</b>	<b>193</b>	<b>[54, 696]</b>	<b>398</b>	<b>194</b>	<b>[137, 273]</b>
White, In Care	59	75	[15, 389]	72	130	[74, 229]
White, not in care	<b>18</b>	<b>399</b>	<b>[159, 1000]</b>	55	139	[76, 253]
Black, in care	64	92	[36, 239]	<b>344</b>	<b>230</b>	<b>[159, 331]</b>
Black, not in care	<b>11</b>	<b>434</b>	<b>[131, 1452]</b>	<b>348</b>	<b>245</b>	<b>[167, 361]</b>
White, less than 180	44	169	[72, 395]	<b>47</b>	<b>193</b>	<b>[107, 349]</b>
White, more than 180	33	93	[34, 253]	80	106	[61, 183]
Black, less than 180	42	151	[48, 474]	<b>258</b>	<b>326</b>	<b>[218, 486]</b>
Black, more than 180	33	97	[38, 246]	<b>334</b>	<b>302</b>	<b>[66, 1384]</b>

<sup>a</sup>**Bold** indicates subgroups demonstrating median linkage time of greater than 180 days.

patients experiencing significant viremia at the time of their first post-release assessment is consistent with the observed delays in linkage to care.

It is significant to note, however, that 56% of persons in Rhode Island and 52% of persons in North Carolina with first service greater than 90 days from the time of release had suppressed HIV virus at the time of their follow-up visit. This may reflect individuals who had previously active prescriptions that were continued post release or individuals for whom prescriptions were written prior to the first visit. The latter may be more common for individuals who were previously established in care at a community site. This finding may also reflect incomplete capture of services in the RSR data. Despite the demographic variability between RI and NC, significant delays in linkage occurred in both states, suggesting that other common factors related to reentry may be important determinants of successful linkage.

Rhode Island and North Carolina are informative sites with regard to linkage to care in that both states have had active, academically led, initiatives to support linkage to care for persons with HIV leaving corrections facilities.<sup>31</sup> In Rhode Island, an intensive case management intervention was developed as a HRSA SPNS and then sustained with some reduction in scope and funding using state funds from the Ryan White HIV/AIDS Part B program.<sup>18</sup> The data here reflect outcomes 4 years after this transition.

In North Carolina, correctional HIV specialist nurses meet with HIV-positive inmates in preparation of inmates' release and coordinate discharge planning including making an appointment or providing a referral to a community HIV clinic. The nurses also identified sources to pay for prisoners' HIV medications following release. During the observation period, these standard discharge activities were augmented for a small proportion of prisoners—about 10% of HIV+ prisoners released from the NC state prison who were enrolled in a randomized control trial testing a multi-component inter-

vention to improve post-release linkage to community HIV care and medication adherence. Having a prior relationship with a RWHAP-funded provider was associated with shorter times to linkage. Despite the lower numbers of persons previously engaged in RWHAP-funded care in North Carolina, similar or better rates of linkage to care within 90 days were seen, which may reflect to some extent the impact of the case management interventions.

Increased incarceration time in both states was associated with shorter linkage times. Studies of interventions to support linkage to care among persons released from jails have shown that receipt of education in jail and development of a discharge plan which includes availability of housing in the community post release were significant predictors of linkage to care.<sup>32</sup> Longer incarceration periods can potentially provide more time for education as well as preparation of an effective discharge plan. The health of individuals may also be improved given the opportunity for medical stabilization during longer periods of incarceration, which may influence their ability to successfully transition on reentry. This may include both improvements in immunologic status as well as improvements in mental health and addiction through treatment received while incarcerated. Though the individuals are confined, periods of incarceration for some may offer a period of relative social stability which may create opportunities for engagement and education.

Persons identified as black experienced more significant delays in linkage to care, particularly in North Carolina, with the strongest effects seen among those identified with HIV acquisition risk of injection drug use or male sexual contact. Disparities in risk of HIV acquisition and outcomes for minorities and particularly African Americans have been well described.<sup>33-35</sup> In a study of persons with HIV in the jails, African Americans who were incarcerated were significantly less likely to have both health insurance in the community and a primary HIV care provider as compared to non-African

Americans.<sup>36</sup> African American men with male sexual contact were similarly noted in this study to be of higher risk. Given the importance of discharge planning with regard to outcomes, further investigation is needed to assess whether there are important disparities either in the access to or the success of these discharge planning services for HIV positive African Americans being released from corrections facilities. Persons identified as white with HIV risk of male sexual contact had prolonged linkage times in both states suggesting that significant disparities in linkage may exist for other marginalized groups as well.

Given the error associated with the eUCI for merging of the data sets, the potential for false positive matches exists. This may be more of a concern in Rhode Island where the corrections file was not restricted to those with known HIV positive status. Conversely, restricting the corrections file to only those with confirmed HIV status may reduce the risk of false positive matches but creates the potential for loss of individuals who do not disclose their HIV status. Our analyses have adjusted for possible false positives, which resulted in larger interval estimates. Examination of the linkage experience for those identified as positive conveys useful information regarding the efficacy of efforts to support linkage to care. Though individuals who do not disclose their HIV status are potentially eligible to be linked, their lack of disclosure makes it unlikely that they would be reached by interventions to support linkage to care. For this group, the priority would be initiatives to support disclosure so the individuals can be reached by interventions supporting linkage to care.

This analysis describes the linkage experience among those who link to care. It is important to acknowledge that there is a proportion of the population in each state who do not link to care whose experience is not fully reflected in these analyses. The experience of patients in our analysis, nonetheless, is important as the factors which cause delay in linkage in this group may reasonably be expected to contribute to the failure to link among those who do not link to care at all. Interventions to improve linkage to care may also have benefits for those not represented in this analysis.

Continual efforts need to be made, nonetheless, to identify the subset not linking to care and assess the extent to which current interventions reach this group and how improvements can be made. Additional research is needed to identify social and clinical determinants of delayed or failed linkage to care to help guide development of specific targeted interventions to high-risk individuals. Outcomes following linkage to care equally need to be examined given that many of these individuals remain at high risk for treatment interruptions and loss to follow-up.

This study demonstrates the feasibility and utility of leveraging existing data systems to assess linkage to care for persons with HIV leaving corrections facilities using data from two states. Despite targeted case management interventions in both states, delays in linkage to care and lapses in treatment are frequent. Delays in linkage to care are more pronounced for minorities, particularly African Americans, and persons without prior relationships with care providers in the community. Systematically implementing this monitoring to evaluate changes over time would provide important information to support interventions to improve linkage in high-risk populations. Given the existence of national data sets for both corrections and clinical data, this framework also could be

used to evaluate the experience of persons HIV linking to care on release from corrections facilities nationwide.

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### Author Disclosure Statement

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