Effect of Release from Prison and Re-Incarceration on the Viral Loads of HIV-Infected Individuals

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SYNOPSIS

Objectives. The purpose of this study was to determine the effect of release from prison and subsequent re-incarceration on the viral loads of HIV-infected individuals receiving highly active antiretroviral therapy (HAART).

Methods. Fifteen re-incarcerated HIV-infected prisoners on HAART were identified from a retrospective cohort of HIV-infected prison inmates released from January 1, 1997, to August 31, 1999. The re-incarcerated prisoners were matched (1:2) to 30 HIV-infected incarcerated prisoners on HAART who remained incarcerated during the re-incarcerated participants' release time period. The outcomes measured were plasma HIV RNA levels, $CD4^+$ lymphocyte counts, percentage of re-incarcerated and incarcerated participants with plasma HIV RNA levels <400 copies/mL, and the median change in plasma HIV RNA levels of the re-incarcerated and incarcerated participants at the end of the study.

Results. At the beginning of the study, 8/15 re-incarcerated participants had plasma HIV RNA levels <400 copies/mL, compared with 15/30 incarcerated participants. At the end of the study, only three of those eight re-incarcerated participants had plasma HIV RNA levels <400 copies/mL, compared with 14/15 incarcerated participants (p=0.0086). The median change in plasma HIV RNA levels of the re-incarcerated participants was 1.29 $\log_{10}$ copies/mL (interquartile range 0.04 to 1.70), compared with −0.03 $\log_{10}$ copies/mL (interquartile range −0.65 to 0.09) in the incarcerated participants (p=0.0183).

Conclusions. Release from prison was associated with a deleterious effect on virological and immunological outcomes. These data suggest that comprehensive discharge planning efforts are required to make certain that HIV-infected inmates receive access to quality care following incarceration.

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A significant number of people living with HIV infection in the U.S. are incarcerated; at least 8% of all HIV-infected people are in prison or jail.[1,2] The prevalence of AIDS among prisoners in 2001 was three times that in the general population.[2] The percentage of HIV-infected people who spend at least some time in prison or jail is even higher than the prison prevalence of AIDS. In 1997, between 150,000 and 200,000 HIV-infected inmates, or 20% to 26% of all HIV-infected people in the U.S., passed through a correctional facility.[3]

The cycling of HIV-infected individuals into and out of the correctional system provides opportunities for diagnosis, education, counseling, and treatment. State prisons have been especially successful in providing access to HIV care and antiretroviral therapies, as indicated by their 75% reduction in AIDS-related mortality from 1995 to 2001.[2] One study showed that virological outcomes were better in HIV-infected inmates than in non-incarcerated HIV-infected individuals on the same clinical trial treatment regimen.[4] This is particularly important given the levels of adherence required to forestall the development of virologic resistance and treatment failure in HIV disease.[5,6] In addition to being points of entry for HIV therapy, correctional facilities have an opportunity to assist in forging crucial links between HIV-infected individuals and community health and social services, particularly since the disruptive effect of incarceration and release exacerbates many of the problems people with HIV frequently confront. Prison release results in a move from a highly structured environment, in which administration of medications may be directly observed, to a setting in which adherence and access to care are often more challenging. Unfortunately, former inmates, who may receive complex and expensive medical regimens while incarcerated, often get little assistance in navigating the transition to care outside of prison.

Because these discontinuities have been long recognized, collaborations have evolved between correctional facilities, public health departments, academic centers, and community health care clinics to link inmates back to the community after release from prison. Although significant reductions in criminal recidivism in HIV-infected cohorts have been demonstrated at correctional institutions in Rhode Island and Massachusetts with these collaborations,[7] the effect on health outcomes to our knowledge is unknown.

Discharge planning services for HIV-infected individuals formally began in December 2000 in North Carolina's state prisons. We were able to evaluate the virological and immunological health outcomes in a cohort of treated incarcerated HIV-infected individuals released without pre-release planning from January 1, 1997, through August 31, 1999, and compare them with those of HIV-infected incarcerated individuals not released.

METHODS

This study was conducted in the North Carolina state prison system. An estimated 542 inmates, or 1.8% of the prison population, were HIV-infected during the study period.[8] Of these inmates, 88% were men, 85% were identified as African American, and 86% were ages 24–44 years.

We conducted a retrospective cohort study of a sample of HIV-infected men treated with highly active antiretroviral therapy (HAART) who were released from prison during the period from January 1, 1997, through August 31, 1999. We initially identified 592 HIV-infected men who were released from prison during the study period. Charts were available for 520 of these men. Of these, 176 men fulfilled our eligibility requirements: eligible subjects were HIV-infected men released from prison during the period from January 1, 1997, through August 31, 1999, who were treated with a HAART regimen (defined as two nucleoside reverse transcriptase inhibitors and at least one protease inhibitor and/or non-nucleoside reverse transcriptase inhibitor) and for whom at least one antiretroviral was administered by direct observation by prison staff for at least three months immediately pre-release. Of the 176 men, 22 had been released and re-incarcerated during the study period. Seven of these 22 men were excluded because they did not have plasma HIV RNA levels (Amplicor HIV Monitor Test, Roche Diagnostic Systems, Branchburg, New Jersey) and/or $CD4^+$ lymphocyte counts within three months prior to release and/or re-incarceration. Thirty controls were chosen from among the 154 eligible inmates who remained incarcerated during the entire study period. (For convenience, we will refer to the controls as "incarcerated" participants.) The 15 men who had been released and re-incarcerated were matched 1:2 with these 30 controls.

Within each matched set, the incarcerated participants were matched for baseline plasma HIV RNA levels (within 1 log), plasma HIV RNA lab test date (within three months), and time period from release to re-incarceration of the re-incarcerated participants. Each pair of incarcerated participants had their viral loads and $CD4^+$ lymphocyte counts measured within two months of the matched re-incarcerated participant's corresponding lab tests. An incarcerated participant had to be on HAART in prison for at least 75% of the time that the re-incarcerated individual with whom they were matched was out of prison.

The outcomes of interest were plasma HIV RNA levels, $CD4^+$ lymphocyte counts, percentage of re-incarcerated and incarcerated participants with plasma HIV RNA levels <400 copies/mL, and the median change in plasma HIV RNA levels of the re-incarcerated and incarcerated participants at the end of the study. These outcomes were chosen because a major goal of HAART is to achieve immunological restoration and virological suppression. During the time of the study, virological suppression was defined as a plasma HIV RNA level <400 copies/mL. Plasma HIV RNA levels/mL are expressed in this study as $\log_{10}$ copies/mL. One log represents a 10-fold difference in plasma HIV RNA levels, a significant change.

Of note, the study was limited to male prisoners because there were few eligible HIV-infected women prisoners who met the study criteria.

Analyses

The baseline sociodemographic and clinical characteristics of the re-incarcerated participants and controls were computed using descriptive statistics. Race was included as a variable to determine whether the participants and controls

were representative of the HIV-infected prison population and to show that the infected prisoners reflected the racial distribution of the HIV epidemic in the Southeastern U.S. Substance abuse and mental health history were included because incarcerated individuals have a high prevalence of substance abuse and of mental health disorders.

We used the Wilcoxon signed rank test to evaluate clinical differences at baseline (study entry) between the two groups and to compare the $CD4^+$ lymphocytes at study entry and study exit for each group. We used the Mann-Whitney rank sum test to evaluate differences in sociodemographic baseline characteristics between the re-incarcerated and incarcerated participants.

We performed multiple regression analyses of the virological outcomes to adjust for baseline differences in $CD4^+$ lymphocyte counts, viral loads, and release/incarceration times between the re-incarcerated and incarcerated participants. Specifically, SAS PROC MIXED (Version 8)[9] was used to compute the adjusted plasma HIV RNA level for each study participant. We then used the adjusted plasma HIV RNA levels to compute the median viral load changes in both groups. We used conditional logistic regression to investigate the odds of increased plasma HIV RNA levels across the two groups (SAS, Version 8).[9] All other analyses were performed by Sigma Stat (Version 2).[10]

The study was reviewed and approved by the Committee for the Protection of Human Subjects of the School of Medicine at the University of North Carolina at Chapel Hill and by the Human Subjects Review Committee at the North Carolina Department of Correction.

RESULTS

The re-incarcerated and incarcerated participants were similar with respect to age, race, education, and plasma HIV RNA levels at study entry (see Table). The re-incarcerated prisoners had a lower median $CD4^+$ lymphocyte count at the beginning of the study than that of the incarcerated participants; although this difference in median $CD4^+$ lymphocyte count was not statistically significant, it could be clinically significant. The re-incarcerated participants were released from prison for a mean of nine months (standard deviation four months) before re-incarceration.

Virological outcomes

At the beginning of the study, 8/15 re-incarcerated participants and 15/30 incarcerated participants had viral loads <400 copies/mL. By the end of the study, only three of those eight re-incarcerated prisoners were able to maintain this virological suppression. In contrast, 14 of the 15 of the incarcerated participants maintained their plasma HIV RNA viral loads at <400 copies/mL. The plasma HIV RNA levels increased ≥1 log in 9/15 re-incarcerated individuals, compared with only 3/30 incarcerated prison participants. In addition, the re-incarcerated individuals were more likely to have an increase in their plasma HIV RNA levels than were their matched incarcerated counterparts (odds ratio 8.29; 95% confidence interval 1.78, 38.69; $p=0.0071$).

The re-incarcerated participants had a greater change in their plasma HIV RNA levels between study entry and study

Table. Sociodemographic and clinical characteristics of participants at baseline

Characteristic	*Re-incarcerated (n=15)*	*Incarcerated (n=30)*	*p-value*
Sociodemographic			
Age (years)			0.85
Median	37.0	35.5	
25th percentile	33.3	33.3	
75th percentile	39.8	37.5	
African American			0.87
Number	13	27	
Percent	86.7	90.0	
Education (grade completed)			0.30
Median	12.0	11.0	
25th percentile	10.0	9.63	
75th percentile	12.8	11.9	
Substance abuse history[a]			0.87
Number	13	24	
Percent	86.7	80.0	
Mental illness history[b]			0.37
Number	4	12	
Percent	28.6[c]	46.2[d]	
HIV risk behaviors			
Sex with men			0.98
Number	3	6	
Percent	20.0	20.7[e]	
Sex with prostitutes			0.28
Number	10	12	
Percent	66.7	42.9[f]	
Multiple partners			0.17
Number	13	17	
Percent	86.7	60.7[f]	
Clinical			
Plasma HIV RNA (log_{10} copies/ml)			0.43
Median	2.60	2.91	
25th percentile	2.60	2.60	
75th percentile	3.73	3.36	
CD4 cell count (cells/mm^3)			0.14
Median	224.0	446.0	
25th percentile	81.8	217.0	
75th percentile	367.0	497.0	

NOTES: The Mann-Whitney rank sum test was used to evaluate baseline sociodemographic differences between the two groups. The Wilcoxon signed rank test was used to examine baseline clinical differences.

[a]Substance abuse was defined as self-reported history of intravenous or illicit drug or alcohol abuse.

[b]Mental illness was defined as self-reported history of depression, schizophrenia, or personality disorder.

[c]$n=14$.

[d]$n=26$.

[e]$n=29$.

[f]$n=28$.

exit than did the incarcerated participants. The median change in plasma HIV RNA level was 1.29 $\log_{10}$ copies/mL (interquartile range 0.04 to 1.70) in the re-incarcerated participants, compared with −0.03 $\log_{10}$ copies/mL (interquartile range 0.65 to 0.09) in the incarcerated participants (see Figure). Model-based, adjusted comparisons of the two groups revealed that this difference in viral load changes was significant (p=0.018).

Immunological outcomes

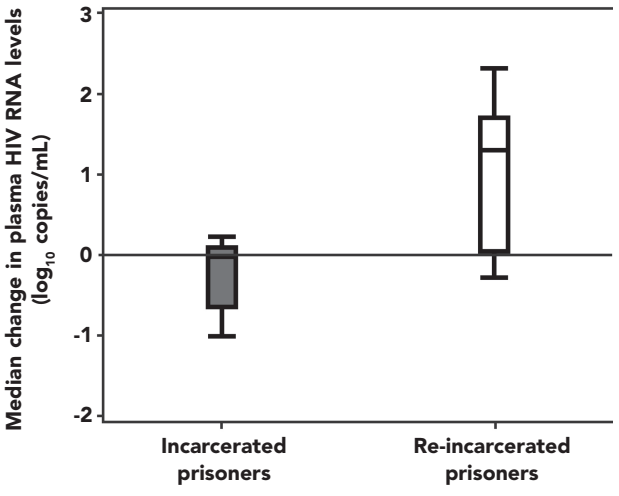
During the release period, the re-incarcerated participants' median $CD4^+$ lymphocyte counts decreased from 224 cells/mm^3 (interquartile range 82 to 367) to 157 cells/mm^3 (interquartile range 23 to 334; p=0.013). In contrast, the incarcerated participants' median $CD4^+$ lymphocyte counts increased from 446 cells/mm^3 (interquartile range 217 to 496) to 560 cells/mm^3 (interquartile range 404 to 652; p=0.003) by the end of the study. The re-incarcerated participants' decline in $CD4^+$ lymphocyte counts and the incarcerated participants' increase in CD4 lymphocyte counts were statistically and clinically significant.

DISCUSSION

Despite the burden of HIV infection on incarcerated individuals and the critical impact of continuity of care on treatment outcomes and public health, the fate of former HIV-infected inmates has received remarkably little scrutiny. Unfortunately, although appropriate HIV care is often provided to inmates within prison, few mechanisms exist to ensure that former inmates receive adequate care and social services following release. In our study, release from prison was associated with a deleterious effect on virological and immunological outcomes. Our results suggest that care within prison is effective in controlling viral replication; however, these treatment successes may be compromised after the inmate's release from prison.

Although viral replication was apparently well controlled in these inmates while they were incarcerated, viral loads increased significantly between release and re-incarceration. The precise reason for viral rebound is unclear. However, since viral replication was so well controlled while the inmates were receiving care in prison, it seems likely that lack of access to care and poor medication adherence in the post-release period were responsible for the observed treatment failure. Lack of access to care has been shown in HIV-infected inmates returning to the community.[11] Furthermore, competing subsistence needs such as food, clothing, and housing were revealed as barriers to accessing HIV-related medical care in a non-incarcerated U.S. population that demographically and socioeconomically mirrors incarcerated populations.[12] Active substance abuse and mental health disorders treated and controlled in prison may be exacerbated after release, contributing to poor medication adherence in HIV-infected individuals.[13,14]

Figure. Median changes in plasma HIV RNA levels ($\log_{10}$ copies/mL) for re-incarcerated (n=15) and incarcerated prisoners (n=30)



The figure depicts two boxplots in which the upper boundary of each box represents the 75th percentile and the lower boundary represents the 25th percentile. The upper bar shows the 90th percentile, and the lower bar shows the 10th percentile. The 50th percentile or median value is symbolized by the horizontal line within each box.

Study limitations

We were unable to avoid some potential biases. Restricting our analysis to released inmates who were re-incarcerated is a potential limitation. These individuals may not be representative of released inmates as a whole, although the high recidivism rate in North Carolina (42.6%) in 1996–1997 suggests that they may be.[15] Further, our study was limited to one prison system in a largely rural Southern state, raising questions about its generalizability. Finally, care of HIV-infected patients is a rapidly evolving enterprise; adherence may improve as therapy changes to simplified regimens with fewer side effects. A strength of the study is that we selected controls who were incarcerated during the release period of the re-incarcerated subjects, thereby accounting for the evolution of HIV care. Our ability to identify all HIV-infected inmates released during the study period also helped us to reduce potential selection biases.

Conclusions

Issues such as child care, housing, transportation, substance abuse, and mental health have been suggested as the principal areas that must be addressed to ensure medical follow-up after release.[7] In resource-poor settings in a time of declining state budgets, these programs may be in danger of elimination. These findings also have important implications for the communities to which HIV-infected inmates return. This is of particular concern in light of the suggestion that former inmates play an important role in maintaining the epidemic. Of 188 consecutive individuals whose HIV infections were reported to the North Carolina state health department (and who were identified as African American), 48% of men and 81% of women reported that one or more of their three most recent sexual partners had been incar-

cerated at some point.[16] Our data suggest that follow-up of released inmates may be important in limiting disease progression and transmission in at-risk communities.

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REFERENCES

1. Centers for Disease Control and Prevention (US). HIV/AIDS Surveillance Report 1999;11(2):7.
2. Department of Justice (US), Bureau of Justice Statistics. HIV in prisons, 2001. Washington: Government Printing Office; 2004 Jan. Pub. No.: NCJ 202293.
3. Hammett TM, Harmon MP, Rhodes W. The burden of infectious diseases among inmates of and releasees from US correctional facilities, 1997. Am J Public Health 2002;92:1789-94.
4. Fischl M, Castro J, Monroig R, Scerpella E, Thompson L, Rechtine D, et al. Impact of directly observed therapy on long-term outcomes in HIV clinical trials [abstract]. In: Foundation for Retrovirology and Human Health. Programs and abstracts of the 8th Conference on Retroviruses and Opportunistic Infections; 2001 Feb 4–8; Chicago. Alexandria (VA): The Foundation; 2001 Feb.
5. Paterson DL, Swindells S, Mohr J, Brester M, Vergis E, Squier C, et al. Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. Ann Intern Med 2000;133:21-30.
6. Liu H, Golin CE, Miller LG, Hayes RD, Beck CK, Sanandaji S, et al. A comparison study of multiple measures of adherence to HIV protease inhibitors. Ann Intern Med 2001;134:968-77.
7. Spaulding A, Stephenson B, Macalino G, Ruby W, Clarke JG, Flanigan TP. Human immunodeficiency virus in correctional facilities: a review. Clin Infect Dis 2002;35:305-12.
8. Department of Justice (US), Bureau of Justice Statistics. HIV in prisons and jails, 1999. Washington: Government Printing Office; 2001 Jul. Pub. No.: NCJ 187456.
9. SAS Institute. SAS. Version 8. Cary (NC): SAS Institute; 1999.
10. SPSS, Inc. Sigma Stat. Version 2. Chicago: SPSS, Inc.; 1997.
11. Feyler NE. Discharge planning for inmates with HIV disease [published in conjunction with conference on Infectious Disease Update II: Care of the Incarcerated Patient; 2000 May 7; New York, NY]. New York: Albert Einstein College of Medicine; 2000.
12. Cunningham WE, Andersen RM, Katz MH, Stein MD, Turner BJ, Crystal S, et al. The impact of competing subsistence needs and barriers on access to medical care for persons with human immunodeficiency virus receiving care in the United States. Med Care 1999;37:270-81.
13. Malow RM, Baker SM, Klimas N, Antoni MH, Schneiderman N, Penedo FJ, et al. Alcohol and drug abuse: adherence to complex combination antiretroviral therapies by HIV-positive drug abusers [published erratum appears in Psychiatr Serv 1998;49:1487; McPherson S corrected to Baker SM]. Psychiatr Serv 1998;49:1021-2, 1024.
14. Schultz RM, Mullenix TA, Googe HL, Grant D, Duong PT, Ortiz E. Depression scores and antiretroviral therapy adherence in HIV disease [abstract]. In: American Society for Microbiology. Program and abstracts of the 38th Interscience Conference on Antimicrobial Agents and Chemotherapy; 1998 Sep 24–27; San Diego, CA. Washington: The Society; 1998.
15. North Carolina Sentencing and Policy Advisory Commission. Correctional program evaluation: offenders placed on probation or released from prison in fiscal year 1996/1997. Raleigh: The Commission; 2000 Apr.
16. Adimora AA, Schoenbach VJ, Stancil TR, Martinson FEA, Donaldson KH, Aral SO, et al. Incarceration and heterosexual HIV infection among rural African Americans [abstract]. In: Foundation for Retrovirology and Human Health. Programs and abstracts of the 7th Conference on Retroviruses and Opportunistic Infections; 2000 Jan 30–Feb 4; San Francisco. Alexandria (VA): The Foundation; 2000.