HHS Public Access

Author manuscript

J Health Care Poor Underserved. Author manuscript; available in PMC 2017 February 01.

Published in final edited form as:

J Health Care Poor Underserved. 2016 February ; 27(1): 145–156. doi:10.1353/hpu.2016.0020.

Homelessness, HIV, and Incomplete Viral Suppression

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Abstract

Background—The importance of HIV viral suppression is widely known, however few studies have examined the effects of homelessness on HIV viral suppression

Methods—The study included HIV-seropositive patients in a health care for the homeless program (HCH). Electronic medical record data for 138 patients were analyzed to compare demographic characteristics, health characteristics, and utilization by housing status. For the 95 individuals with available HIV viral loads, multivariable logistic analysis was performed to examine factors associated with incomplete viral suppression

Results—The adjusted odds ratio of incomplete HIV viral load suppression was 3.84 times higher in homeless compared with housed (95% CI 1.36– 10.36) individuals. Illicit drug use and combined antiretrovirals (cART) were associated with HIV viral suppression

Conclusions—Homelessness predicted incomplete HIV viral suppression. Stable housing may improve viral suppression and access to cART. Drug use was associated with viral suppression, likely because of patient engagement with on-site addiction services.

Keywords

Homelessness; human immunodeficiency virus (HIV); AIDS; viremia

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Adisproportionate number of homeless individuals in the United States are HIV seropositive and face barriers to care. In a 2010 study, it was estimated that 3.3% of the homeless population in the United States were HIV positive, compared with 1.8% in the stably-housed population.[1] Homelessness has been identified as a predictor of poor physical and mental health, particularly among HIV-infected individuals.[2] Lack of housing has also been identified as a structural barrier to effective combined antiretroviral therapy (cART) in HIV seropositive patients.[3]

The importance of viral suppression and HIV treatment as prevention is widely known.[4] However, a recent study published by the United States Centers for Disease Control showed that of the 1.2 million individuals in the US estimated to be HIV-seropositive, only about 30% were virally suppressed.[5] HIV viremia has been identified as a major risk factor for transmission of HIV and disease progression.[6,7] HIV transmission rates are also estimated to be higher in homeless individuals compared with individuals with housing.[8] Suppression of viremia can reduce HIV transmission by more than 96%, and it can help prevent drug-resistance mutations, improve immune function, improve quality of life, and lower risks of both AIDS and non-AIDS-defining complications.[6,8] Housing services for HIV-seropositive individuals may also reduce HIV transmission; for this reason, they can be cost-effective because of potential HIV infections averted.[9,10] However, only a few small studies have examined the effects of homelessness on virologic outcomes in the HIV-seropositive population. One study showed that a housing program resulted in viral load suppression of 69% participants.[11] A randomized trial found that 36% of hospitalized, homeless patients had undetectable viral loads when discharged to respite care or an overnight shelter with intensive case management for permanent housing assistance. In comparison, only 19% of patients in study's the "usual care" control group, which consisted of standard case management, had undetectable viral loads. While the results of this study are promising, it was difficult to elicit whether or not the intensive case management or the housing program itself contributed to better outcomes due to the complexity of the intervention.[12,13] Thus, it is important to examine further the relationship between housing status and HIV viremia.

The primary purpose of the current study was to identify risk factors associated with incomplete viral load suppression in HIV seropositive patients enrolled in a Boston-based health care program for homeless individuals (HCH). We hypothesized that homelessness would be associated with incomplete viral suppression. In order to understand the effects of housing status in HIV seropositive patients, the second objective was to examine differences in demographics, health characteristics and health service utilization by housing status. This study is unique in that the study population has access to comprehensive outpatient services, including outreach street clinicians. Therefore, health service utilization, which includes all ambulatory visits, emergency room visits, and respite stays, were included in the analysis. The results of this study will help identify patients at high risk of incomplete viral suppression despite access to robust medical services. If high-risk patients can be better identified, then perhaps viral suppression is an achievable goal.

Methods

Study setting

The HCH program, which has more than 70 clinical sites in the Boston area and serves over 12,500 individuals annually. The only criterion for enrollment in the HCH is that participants must be homeless at the time of enrollment. Behavioral health care, primary care (including primary HIV care), medical respite care, case management, and outreach on the streets are provided by the HCH program.

Study design

This study was a retrospective analysis of 138 HIV-seropositive adult patients enrolled in a HCH in Boston. The study population was a convenience sample. Of the 138 patients in the descriptive analysis, 95 of them had available HIV viral loads and were included in the multivariable analysis.

Inclusion criteria. All patients selected for the study had an index primary care visit between July 1, 2011 and June 30, 2012, were 18 years or older, and enrolled in the HCH, with follow-up for one year following the index visit.

Data sources. Data on demographic characteristics, health characteristics, and outpatient service use were extracted from the HCH electronic medical record (EMR). Emergency room (ER) visit data were extracted from the EMR of the safety-net hospital directly across the street from the largest HCH clinic. Health service utilization data (primary care visits, medical respite stays, behavioral health encounters, case management visits, ER visits) were restricted to a one-year time period following each patient's index ambulatory care visit, while all other data ranged from July 1, 2011– June 30, 2013.

Measures

Primary outcome. The primary outcome of the study was incomplete HIV viral suppression, defined as an HIV-1 viral load of greater than 75 copies/ mm^3 obtained from a single laboratory within six months of the patient's most recent ambulatory visit.

Primary independent variable. The primary independent variable of interest was housing status. The HCH requires that patients be homeless at time of initial enrollment but housing status may change, and it is therefore documented at each visit. For this analysis, patients were categorized as "homeless" or "housed" at the time of the index visit. "Homeless" was defined as any patient living in transitional housing, shelter, doubled up, living on the street, or whose housing status was "other" or "unknown" at the index visit. "Housed" was defined as any patient whose housing status was listed as housed with or without supportive services (e.g., outreach, medical care, case management) [14,15], assisted living, rest home, or nursing home.

Covariates

Demographic covariates included age, sex, race, and housing changes. *Age* was divided into 18– 44, 45– 54, and greater or equal to 55 years old. Race was divided into Black, other

minority, and White. *Housing changes* were defined based on how often it was noted that a person changed their housing in the year of review, with “any housing change” defined as one or more changes in housing status, and “no housing change” defined as no change in housing status during the review period.

Health characteristic covariates were defined using International Classification of Diseases, Ninth Revision (ICD-9) coding and were also extracted from the patient EMR problem list. *Diabetes, renal disease*, and *chronic lung disease* were chosen as covariates, as they are part of the Charlson comorbidity index,[16] and we were interested in examining the impact of these specific health characteristics on HIV viremia. Other health characteristics generally included in the comorbidity index, such as malignancy and connective tissue disease, were excluded because few patients in the cohort carried these diagnoses. Additional health characteristics, such as mental health disorder, albumin, hepatitis C, tobacco, alcohol and drug use were included in the analysis because of their potential association with incomplete HIV viral suppression.[2,17,18] *Mental health disorder* was based on any ICD-9 codes for a mental health condition. *Hepatitis C* was based on ICD-9 codes, as well as laboratory data (hepatitis C antibodies plus detectable hepatitis C viral loads). *History of tobacco use* was defined using ICD-9 codes or patient self-report of tobacco use. *History of alcohol use* was defined using ICD-9 codes and patient self-report, or attendance at Alcoholics Anonymous. *History of illicit drug use* was also defined using ICD-9 codes, patient self-report, or positive toxicology screens for cocaine, methamphetamines, opioids or benzodiazepines (if opioids or benzodiazepines were not on the patient’s medication list). *Albumin level* was determined using laboratory data from the HCH clinical database, with a cutoff of > 3.5 g/ dL defined as high albumin level.

Health service utilization covariates. Emergency room, medical respite stays and ambulatory visits were measured in the study. *Emergency room visits* were categorized into 0– 1 versus 2 or more visits to the safety-net hospital in a one-year time period. *Medical respite stays* were defined as any patient who had stays at the HCH medical respite facility. Ambulatory visits included case management, behavioral health, and primary care visits and were categorized as 0– 2 visits versus 3 or more visits during the one-year follow-up period. *Case management visits* were defined as any visits with a HCH case manager. *Behavioral health visits* were defined as any group/ individual mental health visits, substance abuse treatment visits, or pharmacologic mental health visits. *Primary care visits* were defined as outpatient primary care visits with physicians, nurse practitioners, physician assistants, or nurses, including those encounters that occurred in outreach settings such as shelters or street.

Statistical analysis

Descriptive and multivariable analyses were performed in this study. Chi-square and fisher’s exact test statistics were used to examine differences in proportions when analyzing demographics, health characteristics, and health service utilization by housing status. Logistic regression was performed to analyze the risk factors associated with incomplete HIV viral suppression. All covariates with $p<.10$ in bivariate analyses were included in adjusted model. Additional bivariate analyses were performed to examine the association between health service utilization and incomplete HIV viral suppression specifically among

homeless individuals. Separate bivariate analyses examining the association between housing status and incomplete HIV viral suppression specifically among individuals on cART were also performed. All reported p-values were two-sided; an alpha level of .05 was taken to indicate statistical significance. STATA version 13.1 (College Station, TX) was used for the analysis.

Results

Effects of housing status on the HIV-seropositive study population Table 1 describes the differences in demographics, health characteristics, and health care utilization in HIV-seropositive, housed individuals as compared with HIV-seropositive, homeless individuals. Homeless individuals were less likely to be Black (46% vs. 66%, p=.03), but more likely to be from another racial/ ethnic minority group (23% vs. 6%, p=.03) compared with housed individuals. In addition, homeless individuals were more likely to encounter changes in housing status (22%) compared with housed individuals (6%, p = .05). In terms of health characteristics, housed participants were more likely to have a history of alcohol use (91% vs. 74%, p=.01) and tobacco use (72% vs. 55%, p=.05) compared with homeless participants. There were no statistically significant differences in CD4 count by housing status. The mean log viral load in housed individuals was 3.00, compared with 5.09 in homeless individuals (p=.01). The proportion of patients with incomplete viral suppression was higher in homeless individuals (48%) than in housed individuals (26%, p=.02) (Table 1).

Predictors of incomplete HIV viral load suppression. In the multivariable analysis, the adjusted odds ratio (AOR) of incomplete HIV viral load suppression was 3.84 times higher in homeless than in housed (95% confidence interval (CI) 1.36– 10.86) individuals (Table 2). History of illicit drug use (AOR .20, 95% CI .04– .86) and cART (AOR .02, 95% CI .002– . 32) were associated with lower odds of HIV viremia.

Incomplete HIV viral suppression and health service utilization among homeless individuals. In a separate bivariate analysis, the odds of incomplete viral suppression in homeless individuals engaged in behavioral health care was .30 (95% CI .05– 1.68) compared with homeless individuals not engaged in behavioral health care. Similarly, the odds of incomplete viral suppression in homeless individuals engaged in case management was .28 (95% CI .09– .88) compared with homeless individuals not engaged in case management (data not shown).

Incomplete HIV viral suppression and housing status among patients on cART. In this study population, 86% of homeless individuals and 89% of housed individuals were on cART. Among those on cART, 20% of housed individuals had incomplete viral suppression, whereas 47% of homeless individuals had incomplete viral suppression (p=0.008). Furthermore, homeless individuals on cART had a 3.54 times higher odds of incomplete viral suppression compared with housed individuals on cART in a bivariate analysis (95% CI 1.36– 9.21) (data not shown).

Discussion

In this study of HIV-seropositive individuals enrolled in a health care program for homeless individuals, homelessness was a significant predictor of incomplete HIV viral suppression. Not surprisingly, individuals prescribed cART had lower odds of HIV viremia.

Among HIV seropositive patients, we found several differences when stratifying demographic characteristics, health characteristics, and health service utilization by housing status. In this cohort, the group of homeless individuals included a larger percentage of non-Black minorities than the group of housed individuals. Our study was not powered to examine racial differences, but examining the relationship between homelessness and viremia particularly among Hispanic individuals and other minorities warrants further investigation, as these racial/ ethnic groups are disproportionately affected by HIV and in many cases have poor outcomes.[19] Homeless patients also differed from housed patients in that they had a higher proportion of housing changes. These results suggest that housing, once obtained, provides stability. With regards to health service utilization, homeless individuals were less likely to be engaged in ambulatory care, even despite access to such services, as compared with housed patients. These results suggest that secure housing can serve as a mechanism for engagement in ambulatory care. Indeed, prior literature has shown that housing has been shown to improve access to medical care.[20,21]

Our findings emphasize the impact of homelessness on incomplete viral suppression in HIV seropositive individuals. In the descriptive analysis, homeless individuals were more likely to have incomplete viral suppression. In the adjusted multivariable analysis, homelessness was a significant predictor of incomplete viral suppression. Providing housing may therefore may not only improve viral suppression, but also have a larger impact on patient outcomes and quality of life. In Massachusetts, the HIV continuum of care states that linkage to care for HIV-seropositive individuals is a critical part of ensuring access to cART and supportive services.[22] In this study, individuals who were prescribed cART were less likely to have HIV viremia, thus confirming extensive prior literature that cART results in suppressed viremia.[4,7] Our results suggest that housing plays an important role in linkage to care and ultimately, HIV viral suppression, which also has important public health implications. On the federal level, Ryan White programs for HIV-serpositive patients have made permanent housing a priority in order to increase access to care.[23] Indeed, in our study population, housed individuals were more engaged in primary care and with case management. A multidisciplinary team including primary care physicians, case managers, and behavioral health care providers, in addition to stable housing, appears to play an important role in engagement in HIV care. These findings are consistent with the concepts encompassed in the patient-centered medical home (PCMH) set forth by the 2010 Patient Protection and Affordable Care Act, which strives to improve access to care through team-based coordination of care while simultaneously reducing costs.[24] Stable housing has been shown to lower the costs of caring for homeless individuals; thus, housing as a structural intervention may also decrease the financial burden on the health care system.[11] Interestingly, in this study, history of illicit drug use had a protective effect. The high proportion of these patients engaged in ambulatory care, which includes on-site addiction services such as counseling and office-based opioid treatment, can likely explain these

results, as additional analyses revealed that over 88% of HIV seropositive patients with history of illicit drug use in this cohort were engaged in primary care and case management visits.

There were some limitations to this study. Patients in this cohort were enrolled in a single-site, health care program for the homeless that delivers comprehensive ambulatory care services, which makes this population unique and results may not be generalizable. However, the main purpose of our study was to determine risk factors for incomplete viral suppression in patients who have poor clinical outcomes *despite* access to these services, therefore making the population suited for this particular study. Emergency room utilization data were also limited to one urban medical center. Due to limited data availability, we could not account for ER visits that might have occurred elsewhere. However, the urban medical center from where the ER data were obtained is located across the street from the HCH and frequently accessed by our study population. Missing data were also an issue in the study—while 138 HIV seropositive patients were included in the study, viral loads were available for about 70% of the patients. These missing lab values are a representation of how clinical follow up among patients who lack housing can be difficult. We also acknowledge that the small sample size is a significant limitation to the study. While the effects of case management and behavioral health visits in the multivariable model were not statistically significant, we may have seen statistically significant results if the sample size had been larger. The odds statistics for case management and behavioral health visits do suggest that these services are associated with viral suppression. Another limitation of the study is that adherence to cART could not be measured, owing to the retrospective design of the study. While we cannot draw any conclusions about adherence and viral suppression in this study, our descriptive and bivariate analyses among individuals on cART do suggest that homelessness may negatively affect adherence to cART. In our study, a higher proportion of homeless individuals on cART had incomplete viral suppression compared with housed individuals on cART. Homeless individuals also had a higher odds of incomplete viral suppression compared with housed individuals. These results are consistent with prior literature, where poor adherence to cART has been associated with homelessness.[25,26,27] In our study population, housing potentially improved patient adherence to cART, though we cannot confirm the impact of adherence and its relationship to housing status and HIV viremia in this particular study. In addition, we were unable to examine whether individuals with history of illicit drug use were active or prior drug users, or if they were receiving substance abuse treatment. Additional studies examining the impact of substance abuse treatment on HIV outcomes and health service utilization would be useful. Despite these limitations, this study highlights important risk factors for incomplete HIV viral suppression in a homeless population. Future research involving patient perspectives on barriers to HIV viral suppression and additional studies on the impact of drug use and treatment for drug dependence on HIV viremia would enhance the findings from this study.

Conclusions

In a study population with access to comprehensive ambulatory care services homelessness was a significant predictor of incomplete viral load suppression among HIV-seropositive patients. History of illicit drug use also had a protective effect, however in this study cohort,

patients with history of illicit drug use were well-engaged in ambulatory care services that includes on-site office-based opioid treatment and counseling, which likely explains our findings. The provision of housing and engagement in ambulatory care may not only improve viral suppression, but are likely to have a larger impact on patient outcomes and quality of life.

Acknowledgments

Author Disclosures

Dr. Thakarar was primarily supported by T32 A1052074-10 from the National Institute of Health/ National Institute of Allergy and Infectious Diseases. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

The authors would like to acknowledge Linda Rosen and Dr. Howard Cabral at Boston Medical Center for their contributions.

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Table 1

Baseline characteristics in HIV seropositive patients by housing status

	Total n(%) n=138	Housed patients n(%) n=47	Homeless patients n(%) n=91	p-value
Demographics				
Age				
18–44	28 (20)	4 (9)	24 (26)	.02
45–54	70 (51)	24 (51)	46 (51)	
≥ 55	40 (29)	19 (40)	21 (23)	
Sex				
Male	105 (76)	35 (74)	70 (77)	.75
Female	33 (24)	12 (26)	21 (23)	
Race				
Black	73 (53)	31 (66)	42 (46)	.03
Other minority	24 (17)	3 (6)	21 (23)	
White	41 (30)	13 (28)	28 (31)	
Housing changes[a,b]				
No housing changes	114 (83)	44 (94)	71 (78)	.05
1 or more housing changes	24 (17)	3 (6)	20 (22)	
Health characteristics				
Illicit Drug use	118 (86)	41 (87)	77 (85)	.68
Alcohol use[a]	110 (80)	43 (91)	67 (74)	.01
Tobacco use[a]	84 (61)	34 (72)	50 (55)	.05
Mental Health disorder	96 (69)	33 (70)	62 (68)	.80
Hepatitis C	72 (52)	24 (51)	48 (53)	.85
Chronic Pulmonary disease	52 (38)	15 (32)	37 (41)	.31
Renal disease	18 (13)	8 (17)	10 (11)	.32
Diabetes	15 (11)	4 (9)	11 (12)	.52
Albumin [a]				
0–3.5 g/dL	15 (11)	6 (13)	9 (10)	<.001
≥ 3.5 g/dL	82 (59)	39 (83)	43 (47)	
Missing	41 (30)	2 (4)	39 (43)	
Prescribed ART	120 (87)	42 (89)	78 (86)	.55
Median CD4 count in cells/mm^3 (interquartile range)[c]	372 (495)	372 (462)	480 (489)	.33
CD4 count [c]				
0–200 cells/mm^3	18 (19)	6 (14)	12 (24)	.20
≥ 200 cells/mm^3	76 (81)	38 (86)	38 (76)	
Log VL (mean)a	4.15	3.00	5.09	.01
Viral load [c]				
0–75 copies/mm^3	59 (62)	32 (74)	27 (52)	.02
≥ 75 copies/mm^3	36 (38)	11 (26)	25 (48)	

	Total n(%) n=138	Housed patients n(%) n=47	Homeless patients n(%) n=91	p-value
Utilization[d]				
Emergency room				
0 visits	102 (74)	29 (62)	73 (80)	.94
1 visit	15 (11)	11 (23)	4 (4)	
2+ visits	21 (15)	7 (15)	14 (16)	
Primary care[a]				
0–2 visits	22 (16)	2 (4)	20 (22)	.01
3+ visits	116 (84)	45 (96)	71 (78)	
Behavioral health				
0–2 visits	126 (91)	43 (91)	83 (91)	.96
3+ visits	12 (9)	4 (9)	8 (9)	
Respite stays				
0–2 visits	93 (67)	37 (79)	56 (62)	.04
3+ visits	45 (33)	10 (21)	35 (38)	
Case management[a]				
0–2 visits	75 (54)	16 (34)	59 (65)	.001
3+ visits	63 (46)	31 (66)	32 (35)	

[a]Denotes statistical significance. $p < 0.05$ considered statistically significant.

[b]Defined as more than one housing status change within a 1 year follow-up period from index ambulatory visit.

[c]Total sample size for patients with available CD4 counts=94, total sample size for patients with available HIV viral loads=95.

[d]Health service utilization data collected over a 1 year follow-up time period from index ambulatory visit.

Table 2

Bi- and multivariable analysis of predictors of incomplete HIV viral load suppression

Variable (n=95)	Bivariate models Unadjusted OR (95% CI)	Multivariable models Adjusted OR (95% CI)
Demographics		
Age in years		
18–44	3.50 (.83–7.56)	
45–54	Reference	
> 55	1.05 (.40–2.78)	
Sex		
Male	Reference	
Female	1.09 (.44–3.69)	
Race		
Black	1.03 (.40–2.61)	
Other minority	1.30 (.36–4.72)	
White	Reference	
Housing Status		
Housed	Reference	Reference
Homeless	2.69 (1.12–6.46)	3.84 (1.36–10.86)
Housing changes[b]		
No housing changes	Reference	
1+ housing change	1.36 (.52–3.53)	
Health Characteristics[c]		
Illicit drug use	.25 (.07–.92)	.20 (.04–.86)
Alcohol Use	.30 (.08–1.11)	
Tobacco use	.57 (.24–1.35)	
Mental Health Disorder	.89 (.35–2.26)	
Hepatitis C	.79 (.34–1.81)	
Chronic pulmonary disease	1.29 (.55–3.02)	
Renal disease	.98 (.32–2.97)	
Diabetes	1.74 (.47–6.49)	
On cART	.11 (.01–.96)	.02 (.002–.32)
Albumin		
<3.5 g/dL	2.67 (.83–8.49)	
> 3.5 g/dL	Reference	
Missing	4.00 (.35–46.20)	
Utilization[d]		
3+ Primary care visits[e]		—
3+ Behavioral health visits	.28 (.06–1.40)	.12 (.01–1.33)
3+ Respite stays	2.04 (.86–4.80)	
3+ Case management visits	.41 (.17–.99)	.41 (.15–1.12)

[a] Multivariable models were adjusted for all variables listed.

[b] Defined as more than one housing status change within a 1 year follow-up period from index ambulatory visit.

[c] Reference group for these categories is patients without these health characteristics.

[d] Reference group for these categories is patients with 0–2 visits per year. Health service utilization data were collected over 1 year time period.

[e] All patients (n=4) with 0–2 primary care visits had incomplete virologic suppression.