ORIGINAL PAPER

Supportive Housing Promotes AIDS-Free Survival for Chronically Homeless HIV Positive Persons with Behavioral Health Conditions

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Abstract

We assessed the influence of supportive housing, incarceration, and health service use on markers of HIV infection for people living with HIV and serious mental illness or substance use disorder (SUD) participating in a New York City supportive housing program (NY III). Using matched administrative data from 2007 to 2014, we compared survivor time without AIDS, achievement of undetectable viral load, and maintenance of viral suppression between NY III tenants (n = 696), applicants placed in other supportive housing programs (n = 333), and applicants not placed in supportive housing (n = 268). Inverse probability of treatment weights were applied to Cox proportional hazards regression models to account for confounding of observed variables. Individuals not placed in supportive housing had a significantly greater risk of death or AIDS diagnosis than NY III tenants [adjusted hazard ratio = 1.84 (1.40, 2.44), p < 0.001]. Incarceration and outpatient SUD treatment were significantly associated with negative short-term outcomes (time to undetectable viral load) but positive long-term outcomes (time to death or AIDS diagnosis). Supportive housing, SUD treatment, and incarceration were associated with prolonged survival without AIDS among supportive housing applicants living with HIV.

Keywords Viral suppression · Virologic failure · Supportive housing · Health services · Jail

Introduction

People living with HIV (PLWH) are at high risk of homelessness. Housing need surveys conducted by cities and counties in the United States found that 17% to 43% of respondents experienced homelessness after their HIV diagnosis [1]. Due to the co-occurrence of homelessness, poverty, and lack of access to medical care, PLWH who lack stable housing exhibit low entry and retention in HIV care, poor adherence to antiretroviral therapy (ART), and a greater risk of immune system depletion and death [2–4]. Moreover, a lack of stable housing is associated with additional medical and behavioral health conditions that complicate and interfere with HIV care [5–7]. There are, however, few studies with strong experimental designs that demonstrate health improvements for HIV positive persons living in supportive housing.

Housing policies that combine rental subsidies, supportive services, and consumer-directed behavioral health treatment have been shown to improve residential stability [8–10] and reduce hospitalizations and emergency department (ED) visits [11] for persons with chronic medical and behavioral health conditions. Few studies examine housing interventions for PLWH and of those even fewer have strong experimental designs [12–14]. Buchanan et al. [15] randomly assigned 105 homeless PLWH to receive the usually available homelessness services or low-demand supportive housing. After one year, supportive housing tenants were more likely to be alive with CD4 count greater than or equal to 200 cells/mL and a viral load of less than 100,000 copies/ml. A randomized control trial conducted by Wolitski et al. [16] found no significant difference in the number of individuals with detectable viral load, low CD4 cell count, or opportunistic infections when comparing supportive housing tenants to persons receiving the usually available homelessness services. However, they did find that 90 days of uninterrupted housing was associated with a significant

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decrease in the proportion of participants with detectable viral load regardless of treatment assignment. Bowen et al. and Hawk and Davis found a statistically significant increase in the prevalence of undetectable viral load over time for supportive housing tenants [17, 18]. These latter two studies are limited by small samples and the lack of a comparison group.

Engagement in ART improves the health of HIV-positive individuals [19–21] and substantially lowers the risk of HIV transmission to uninfected sexual partners [22–24]. Substance misuse accelerates HIV disease progression [25–27] and is associated with a reduced likelihood of antiretroviral prescription and adherence to ART [28–30]. Studies have reported greater ART adherence among persons treated for SUD [31–33] while others report no difference between persons treated and not treated [33, 34]. Persons involved in the criminal justice system should also be targeted to receive health services as incarceration has been shown to inhibit ART adherence and HIV suppression [35, 36]. Althoff et al. note that rapid turnover rates in jails, as opposed to prisons, provide a much narrower window in which to diagnose individuals and link them to HIV care [37]. There is a need for more data regarding the role of SUD treatment and jail on HIV health outcomes for unstably housed PLWH, especially individuals with behavioral health conditions.

In order to evaluate the success of housing interventions for unstably housed PLWH, it is necessary to assess changes in biological markers of HIV infection. In the present evaluation we assessed the impact of supportive housing, jail, and receipt of health services on achievement of undetectable viral load and CD4 cell count for applicants to a supportive housing program targeting unstably housed PLWH with comorbid behavioral health conditions. Secondly, for persons who achieved viral suppression we examined the association between the use of jail, medical, and SUD treatment services and virologic failure.

Methods

Intervention

New York/New York III (NY III) is a housing program initiated by New York City and New York State, which provides single- and scatter-site supportive housing for chronically homeless, HIV positive persons with a co-occurring serious mental illness (SMI) or substance use disorder (SUD). Chronic homelessness was defined as living in a shelter or on the street for at least 12 of the past 24 months or two of the past 4 years. Serious mental illness was defined as a Diagnostic and Statistical Manual of Mental Disorders IV psychiatric diagnosis other than SUD, developmental disabilities, organic brain syndromes, or social conditions and

meets one of the following: is eligible for social security income/social security disability insurance due to mental illness or has extended impairment in functioning due to mental illness. Extended impairment in functioning due to mental illness was defined by at least two or more of the following functional limitations over the past 12 months on a continuous or intermittent basis: marked difficulties in self-care; marked restriction of activities of daily living; marked difficulties in maintaining social functioning; frequent deficiencies of concentration resulting in failure to complete work/home/school tasks in a timely manner or reliance on psychiatric treatment, rehabilitation and supports. SMI and SUD diagnosis were clinician verified. Applicants must have a comprehensive evaluation signed by a medical doctor or nurse practitioner within 6 months of the application date in order to qualify for the program. NY III housing for PLWH does not require mental health treatment, addiction treatment, or sobriety for program eligibility. Eligibility was determined by the New York City Human Resources Administration (HRA) and housing agencies were permitted to interview three eligible applicants per vacancy so that they could not select individuals with the lowest clinical severity. NY III housing is permanent and tenants have leases along with the usual tenant obligations and rights. Participants pay no more than 30% of their income towards rent and utilities. Housing agencies are expected to assess clients' connection to HIV care on a quarterly basis via in-person case management; provide assistance in obtaining government benefits; provide assistance in accessing SUD, mental health, and primary care services; and utilize harm reduction strategies to help clients reduce negative consequences of substance use.

Study Participants

We selected for evaluation eligible applicants with at least 2 years of follow-up time after their first program eligibility determination. We excluded from the study sample individuals housed in Housing Opportunities for Persons with AIDS, High Service Needs, HIV/AIDS Service Administration (HASA), NY I, NY II, and Office of Mental Health supportive housing programs less than 45 days before NY III eligibility determination (n = 233) because persons re-engaged in supportive housing after a short time interval may have different health outcomes than persons who were newly entering supportive housing. Also excluded from the study were persons with no laboratory test during the 4 year observation period (n = 81). We created two groups for comparison with individuals placed in NY III (n = 696). The first comparison group was comprised of individuals not placed in NY III due to limits in program capacity (n = 268, "not placed"). During the two-year follow-up period, persons not placed in supportive housing received temporary HASA housing an average of 181 (SD 157) days, were jailed

29 (SD 70) days, and spent 5 (SD 32) days in emergency shelters. The second comparison group consists of persons placed in one of the other government subsidized supportive housing programs listed above (n = 333, "other supportive housing"). Applicants gave signed consent to allow their administrative records to be used for program evaluation purposes. This evaluation of an extant program was exempt from review by the Institutional Review Board of the New York City Department of Health and Mental Hygiene.

Propensity Score Analysis

Propensity score methods were used to adjust for potential confounding of the evaluation outcomes with observed differences between NY III tenants and comparison group members. Participant demographics, clinical characteristics, public benefit program enrollment, service recommendations from housing agencies, and pre-eligibility public service use were entered as covariates in the propensity score model. The following variables were taken from the HRA housing application. Demographic variables included age, education, sex, veteran status, and race. Public benefit variables included current receipt of (i.e., the year of NY III application) cash assistance, food stamps, supplemental security income, and social security. Clinical variables included SUD diagnosis, SMI diagnosis, and participation in SUD treatment at eligibility determination. Applicants self-reported physical and behavioral health symptoms including history of clinical depression, hallucination, thought disorders, criminal activity, suicidal ideation, disruptive behavior, cognitive impairment, and limits to daily living activities. Physical disability was defined as limited walking, vision, and hearing. Functional disability was defined as limited cognitive ability, feeding, housekeeping, hygiene, money management, toileting, and travel.

The housing application data were matched with administrative data from HRA (fee-for-service and encounter Medicaid claims, Public Goods Pool claims), the New York City Department of Corrections, the New York City Department of Homeless Services, the New York City Department of Health and Mental Hygiene (HIV/AIDS reporting system, death registry), and the New York State Office of Mental Health. Medicaid coverage was calculated as enrolled for 80% of days in a calendar year. Public service use variables included any emergency department visits, family shelter visits, single shelter visits, hospitalizations, and incarceration in the 2 years before eligibility. Multinomial logistic regression was used to estimate the likelihood (i.e., propensity score) of placement in NY III for each comparison group member. The stabilized inverse probability of treatment weight (IPTW) was calculated from the propensity score. SAS 9.4 (Cary, NC) was used to carry out the propensity score analysis and compare NY III and comparison groups on baseline characteristics. Characteristics with a two-sided p value < 0.05 in a Chi squared test were considered to be statistically different between groups.

Regression Analysis

Cox proportional hazards regression models were used to address three questions. In model 1, we assessed survivor time from first eligibility to death or a final CD4 laboratory value of < 200 cells/mL for persons that were not deceased. Individuals with no CD4 test after eligibility (n = 12) were excluded from the analysis. In model 2, we assessed time to achievement of undetectable viral load (0 copies/mL) from the date of first eligibility for NY III tenants and comparison group members. Individuals with no viral load test after eligibility (n = 24) were excluded from the analysis. In the model 3, we assessed the association between public service use and time to virologic failure after the first instance of viral suppression in the post-eligibility period. The beginning of the viral suppression period was defined by the first test after eligibility with viral RNA < 400 copies/mL [23, 38]. Virologic failure was defined by the next test with viral RNA > 400 copies/mL. HIV diagnosis dates and laboratory tests results were taken from the HIV/AIDS reporting system. In models 1, 2, and 3 the time between eligibility date and housing move-in date were used to input housing status as a time-varying-covariate. Thus, failure events that occurred before supportive housing move-in were not attributed to any housing category. Outcome models included all propensity score model covariates and IPTW as sampling weights [39].

Public service records were left and right censored in order to select events that occurred after program eligibility but before a given failure event. Included in the cox regression models were incarceration, ED visits with a physical health diagnosis, ED visits with a mental health diagnosis, ED visits with a SUD diagnosis, hospitalizations with a physical health diagnosis, hospitalizations with a mental health diagnosis, inpatient SUD treatment, and outpatient visits for non-opioid agonist SUD treatment. Inpatient SUD treatment includes residential treatment but not substance detoxification. If a Medicaid claim had more than one diagnosis code, the categorization hierarchy was (1) substance use, (2) mental health, and (3) physical health. Physical health diagnoses are more frequent than mental health diagnoses and mental health diagnoses are more frequent than SUD diagnoses. The classification method employed privileges behavioral health diagnoses so as not to overlook the contribution of these conditions to adverse health events. Survival analyses were performed using STATA 12.1 (College Station, TX).

Results

Baseline Demographic and Clinical Characteristics

The majority of the study participants were older than 44 years of age (66%, Table 1) and non-White (28% Hispanic and 61% non-Hispanic Black). One in four participants were women. Seventy-six percent and 91% of participants had a SMI or SUD diagnosis, respectively. Forty-three percent of participants reported substance misuse at the time of program application. Alcohol (26%) and cocaine (20%) were the most common substances of misuse. After propensity score weighting, there were no statistically significant differences between NY III tenants and comparison groups on baseline characteristics.

AIDS-Free at Two-Year Follow-Up

Ninety-four individuals died during the follow-up period. There were 2.6, 9.2, and 1.8 deaths/100 person-years for NY III tenants, not placed persons, and other supportive housing tenants, respectively. Thirty-two percent of NY III tenants, 35% of not placed persons, and 28% of other supportive housing tenants had final CD4 cell counts indicative of AIDS. Individuals not placed in supportive housing had a greater hazard of (i.e., shorter survivor time until) death or AIDS diagnosis at the study end point than NY III tenants [adjusted hazard ratio (AHR) 1.84 (1.40, 2.44), $p < 0.001$] (Table 2). There was no statistical difference in the likelihood of death or AIDS diagnosis when NY III tenants were compared with persons placed in other supportive housing programs [AHR 0.92 (0.71, 1.20), $p = 0.55$]. Incarceration [AHR 0.70 (0.54, 0.90), $p = 0.006$] and outpatient SUD treatment [AHR 0.71 (0.57, 0.89), $p = 0.003$] were associated with a lower likelihood of (i.e., longer survivor time until) death or AIDS diagnosis. Hospitalization with a physical health diagnosis was associated with a greater likelihood of death or AIDS diagnosis [AHR 1.53 (1.20, 1.96), $p = 0.001$).

Undetectable Viral Load

Sixty percent of NY III tenants, 52% of not placed persons, and 62% of other supportive housing tenants achieved an undetectable viral load during the follow-up period. Individuals placed in other supportive housing programs had a greater hazard of (i.e., shorter survivor time until) undetectable viral load than NY III tenants [AHR 1.53 (1.26, 1.89), $p < 0.001$]. In this analysis, shorter survivor time was a positive outcome. There was no statistical difference in the likelihood of undetectable viral load between NY III tenants and individuals not placed in supportive housing

[AHR 1.0 (0.77, 1.27), $p = 0.9$]. Incarceration [AHR (0.45, 0.73), $p < 0.001$], ED visits for a physical health condition [AHR 0.35 (0.29, 0.42), $p < 0.001$], hospitalization for a physical health condition [AHR 0.55 (0.45, 0.67), $p < 0.001$], inpatient SUD treatment [AHR 0.73 (0.54, 0.97), $p = 0.03$], inpatient mental health treatment [AHR 0.66 (0.44, 0.98), $p = 0.04$] and outpatient SUD treatment [AHR 0.60 (0.48, 0.74), $p < 0.001$] were associated with longer lengths of time to achieve undetectable viral load. Jail and outpatient SUD treatment were associated with positive outcomes in model 1 but negative outcomes in model 2. To better understand the relationship between jail, drug treatment and viral load we implemented a model like model 2 but with an interaction term for jail and outpatient SUD treatment. The interaction was significant [AHR 1.91 (1.18, 3.08), $p = 0.008$] as were the main effects jail [AHR 0.48 (0.37, 0.64), $p < 0.001$] and outpatient SUD treatment [AHR 0.52 (0.41, 0.67), $p < 0.001$]. Thus, the number of days to undetectable viral load increased by 48% for persons not jailed and treated for SUD, while the hazard ratio is nearly flat for persons jailed and treated for SUD [AHR 1.0 (0.48, 2.08)].

Public Service Use Associated with Virologic Failure

On average, half of participants were diagnosed with HIV 13 years before their first NY III eligibility determination. As one would expect in a population that has lived with HIV/AIDS for many years, a substantial number of persons achieved viral suppression before application to NY III. About one in ten persons (n = 112) maintained suppression (i.e., viral RNA < 400 copies/mL) from their first viral load test in the pre-eligibility period to their final test in the post-eligibility period. Excluding these individuals, 75% of NY III tenants, 64% of persons not housed, and 75% of persons placed in other supported housing programs achieved viral suppression during the 2 years after eligibility determination. However, 71% of individuals that achieved suppression experienced virologic failure. The average duration of viral suppression was 173 days (SD 140). In Cox regression analysis, placement in other supportive housing [AHR 0.68 (0.52, 0.90), $p = 0.008$], ED visits for physical health [AHR = 0.53 (0.43 to 0.66), $p < 0.001$], ED visits for SUD [AHR 0.59 (0.42 to 0.84), $p = 0.003$], and outpatient SUD treatment [AHR 0.52 (0.41, 0.67), $p < 0.001$) were associated with decreased likelihood of virologic failure.

Discussion

In this large sample evaluation, we demonstrate that low-demand supportive housing is associated with slower immune system depletion and a reduced risk of death and AIDS diagnosis for chronically homeless PLWH with

Table 1 Pre-eligibility demographic and clinical characteristics

Characteristic	No. (%)[a]		
	NY III (n=696)	Not placed (n=268)	Other supportive housing (n=333)
Demographics			
Age at eligibility			
18–34 years	44 (6)	15 (7)	28 (6)
35–44 years	190 (28)	72 (28)	95 (28)
45–54 years	327 (47)	126 (7)	160 (48)
55+ years	135 (19)	55 (19)	50 (18)
Race/ethnicity			
Asian, other race	21 (3)	11 (3)	4 (5)
Hispanic	189 (30)	79 (30)	101 (28)
Non-Hispanic Black	431 (60)	150 (60)	208 (58)
Non-Hispanic White	55 (8)	28 (8)	20 (9)
Completed high school	358 (51)	140 (52)	161 (51)
Female	174 (24)	66 (25)	81 (23)
Veteran	48 (7)	15 (6)	28 (7)
Public benefit program enrollment			
Continuous medicaid coverage[b]	618 (89)	229 (88)	300 (90)
Food stamps	652 (93)	242 (93)	308 (93)
Cash assistance	243 (35)	96 (36)	109 (37)
Social security	68 (11)	34 (11)	38 (10)
Supplemental security income	348 (50)	121 (48)	168 (47)
Mental and physical health symptoms and diagnoses			
Substance use disorder diagnosis	639 (91)	242 (91)	298 (92)
Mental illness diagnosis	520 (75)	211 (77)	247 (77)
History clinical depression	320 (45)	130 (44)	132 (46)
History of suicidal ideation	172 (26)	65 (26)	97 (28)
History of disruptive behavior	170 (24)	69 (23)	78 (27)
History of criminal activity	584 (84)	234 (85)	279 (85)
History of cognitive impairments	35 (6)	19 (5)	21 (10)
History of hallucinations	127 (19)	47 (18)	64 (21)
History of delusions	66 (9)	26 (10)	28 (12)
History of thought disorders	33 (6)	15 (5)	22 (8)
Functional disability	143 (21)	64 (20)	65 (24)
Physical disability	201 (29)	88 (28)	84 (30)
Treated for SUD at application	293 (40)	95 (40)	137 (40)
Service recommendations			
Case management	44 (12)	50 (12)	64 (12)
24 h supervision	4 (2)	12 (3)	14 (3)
Medical treatment	681 (98)	259 (98)	324 (98)
Psychiatric treatment	295 (43)	117 (42)	148 (47)
Mental health treatment	272 (40)	110 (39)	137 (44)
Substance use disorder treatment	430 (60)	159 (60)	193 (59)
Mentally ill and chemical abusers program	174 (27)	76 (26)	91 (29)
Vocational or educational training	225 (33)	94 (33)	105 (33)
Primary healthcare	17 (2)	7 (2)	9 (2)
Financial management	322 (48)	146 (48)	161 (49)
Public service use 2 years before eligibility			
Jail	215 (31)	83 (32)	111 (30)
Single shelter	69 (11)	26 (3)	39 (10)
Family shelter	19 (3)	8 (3)	6 (4)
Inpatient hospital	474 (71)	204 (70)	236 (69)
Emergency department	339 (50)	145 (50)	163 (51)

Table 2 Adjusted hazard ratios (AHR) estimated from propensity score weighted Cox regression models

	Model 1 Death or AIDS AHR (95% CI)	Model 2 Undetectable viral RNA	Model 3 Virologic failure
Housing status			
NY III tenant	Reference	Reference	Reference
Not placed	1.84 (1.40, 2.44)[†]	0.99 (0.77, 1.27)	0.99 (0.75,1.31)
Other supportive housing	0.92 (0.71, 1.20)	1.54 (1.26, 1.89)[†]	0.68 (0.52, 0.90)**
Incarceration	0.70 (0.54, 0.90)*	0.58 (0.45, 0.73)[†]	0.99 (0.74, 1.33)
ED visit for physical health	0.89 (0.69, 1.15)	0.35 (0.29, 0.42)[†]	0.53 (0.43, 0.66)[†]
ED visit for mental health	0.91 (0.64, 1.30)	0.84 (0.58, 1.22)	0.94 (0.56, 1.57)
ED visit for SUD	0.81 (0.61, 1.06)	0.82 (0.63, 1.06)	0.59 (0.42, 0.84)**
Hospitalization for physical health	1.53 (1.20, 1.96)**	0.55 (0.45, 0.67)[†]	0.82 (0.64, 1.04)
Hospitalization for mental health	0.79 (0.56, 1.11)	0.66 (0.44, 0.98)*	0.73 (0.48, 1.13)
Inpatient SUD treatment	0.81 (0.62, 1.07)	0.73 (0.54, 0.97)*	0.84 (0.61, 1.17)
Outpatient SUD treatment	0.71 (0.57, 0.89)**	0.60 (0.48, 0.74)[†]	0.52 (0.41, 0.67)[†]

$*p < 0.05$; $**p < 0.01$; $†p < 0.001$

co-occurring behavioral health conditions. Nearly half of program applicants were actively misusing substances at the time of housing application. Outpatient and inpatient SUD treatment and incarceration were associated with a lower likelihood of achieving undetectable viral load. It may be that persons experiencing negative consequences of substance misuse pursue SUD treatment and it is the immediate life context of the individual rather than SUD treatment in itself that contributes to the decreased likelihood of undetectable viral load. On the other hand, outpatient SUD treatment and incarceration were associated with reduced risk of death or AIDS diagnosis. By design, CD4 cell count was observed at the end of the study period. The first undetectable viral load assay was usually observed early on during the study period. For 85% of participants, incarceration and outpatient treatment participation does not accumulate during this time interval. This suggests that in the short term outpatient treatment and incarceration delay achievement of undetectable viral load but reduce the risk of AIDS diagnosis or death in the long term. Among persons treated for SUD, jail decreased the time to undetectable viral load. This suggest that jail increases survivor time to AIDS diagnosis or death due to its positive association with SUD treatment.

During the follow-up period 71% of the suppression events ended in virologic failure. Program applicants who participated in outpatient SUD and mental health treatment and received ED care for a SUD or physical health condition had longer periods of suppression. Assuming all suppression events are mediated by ART adherence, it may be

that applicants who received SUD treatment services have better ART adherence. Alternatively, the receipt of health services may promote ART adherence as this could connect the patient to other necessary services. It is also possible that some individuals seek medical care for problems related to prescription intolerance and the receipt of care prevents transient treatment interruptions. One cannot distinguish between these possibilities using administrative records alone. Torian and Xia [38] found that the most immunocompetent individuals before viral suppression were the least likely to maintain suppression. They speculate that the absence of clinical disease might play a role in the higher risk of failure for these individuals. In keeping, clinical disease as signaled by ED and hospital stays may motivate patients to adhere to their ART regimen.

Limitations

Program applicants were not randomized to housing treatment; therefore, one cannot draw causal inferences about the effect of supportive housing on HIV-related health outcomes with these data. There is, however, a benefit of the quasi-experimental design. It would be unethical to restrict housing options for applicants not placed in NY III housing and as such the usual homelessness services includes emergency shelter, which is literal homelessness, and stable housing. In a randomized controlled trial, it would be necessary to put homeless persons and persons with permanent housing into a single group as an intention-to-treat sample in

order to produce an unbiased estimate of the average causal effect. Grouping together two completely different interventions could potentially obscure negative health consequences experienced by persons not placed in supportive housing. The results of the present evaluation cannot be interpreted as a causal effect but there is strong evidence that low-demand, supportive housing protects the immunocompetence of the tenant.

This evaluation is also limited by variation in testing frequency. Each applicant had a different number of viral load and CD4 cell tests. We reduced the totality of the testing in a 2-year period to the final laboratory observation. Infrequent tests may be indicative of nonparticipation in ART, poor ART adherence, or non-optimal HIV care. Conversely, being tested, i.e. active participation in care, may over estimate positive health outcomes. We did not have prescription information for evaluation participants. The lack of prescription information does not allow us to investigate the role of supported housing in ART participation and the influence of ART on observed outcomes. Six percent of NY III tenants, 9% of applicants not placed, 5% of other supportive housing tenants had no records in the HIV surveillance registry. As a result, we do not know the change in viral titer and CD4 count in the total population. However, a lack of connection to HIV care and the attendant poor health outcomes are not localized to a particular housing category.

Lastly, a potential limitation of this study is that we do not have information about cause of death for deceased participants. Thus, we cannot conclude that NY III supportive housing is associated with fewer HIV-related deaths. Two-thirds HIV positive New York City residents die of conditions not related to HIV [40]. As such, researchers should examine interventions that can address all causes of mortality.

Conclusions

There were significantly fewer deaths and AIDS diagnoses at the study end point among chronically homeless PLWH who received supportive housing. Our findings were mixed regarding the impact of SUD treatment on HIV health outcomes. Outpatient SUD treatment was associated with greater survivor time without AIDS and a longer duration of viral suppression. Nonetheless, outpatient and inpatient SUD treatment were associated with a longer time to achieve undetectable viral load. The analysis of incarceration yielded similar mixed findings. Thus, while supportive housing was a critical component of HIV care for program applicants the apparent impact of SUD treatment and incarceration on HIV care varied depending on the outcomes tested in the analysis and the length of time between service receipt and test date.

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