AIDS and Behavior (2019) 23:2315–2325
https://doi.org/10.1007/s10461-019-02461-4

ORIGINAL PAPER

A Randomized Controlled Trial of a Rapid Re-housing Intervention for Homeless Persons Living with HIV/AIDS: Impact on Housing and HIV Medical Outcomes

Vivian L. Towe[1] · Ellen Weiss Wiewel[2] · Yaoyu Zhong[2] · Sebastian Linnemayr[3] · Rachel Johnson[4] · John Rojas[5]

Published online: 16 March 2019

Abstract
We conducted a randomized controlled trial to determine whether, for homeless persons living with HIV/AIDS (PLWHA), rapid re-housing can improve housing and HIV viral suppression more than standard housing assistance. We recruited 236 PLWHA from HIV emergency housing in New York City (NYC) and randomized them to: (1) Enhanced Housing Placement Assistance (EHPA), i.e., immediate assignment to a case manager to rapidly re-house the client and provide 12 months of case management or (2) usual services, i.e., referral to an NYC housing placement program for which all HIV emergency housing residents were eligible. We compared time to stable housing placement and percentage virally suppressed from baseline to 12 months. EHPA clients were placed faster than usual services clients (p = 0.02; 25% placed by 150 days vs. 243 days, respectively), more likely to be placed [adjusted hazards ratio = 1.8; 95% confidence interval(CI) 1.1–2.8], and twice as likely to achieve or maintain suppression (adjusted odds ratio 2.1; 95% CI 1.1–4.0).

Keywords Homeless persons · Acquired immunodeficiency syndrome · HIV · Housing · Randomized controlled trial

Resumen
Llevamos a cabo un ensayo controlado con asignación aleatoria para determinar si la pronta reubicación de personas con VIH/SIDA sin hogar puede mejorar la condición de su estado de vivienda y la supresión viral del VIH más que la asistencia de reubicación básica. Reclutamos 236 personas con VIH/SIDA que residen en viviendas de emergencia para personas con VIH en la Ciudad de Nueva York y las asignamos aleatoriamente para: 1) Servicio de asistencia mejorada, es decir, asignación a un consejero para que rápidamente realoje al cliente y provee 12 meses de servicios sociales o 2) Servicios usuales de asistencia, es decir, referidos a un programa de colocación de vivienda de la Ciudad de Nueva York donde todos los residentes de viviendas de emergencia con VIH eran elegibles. Comparamos el tiempo de la reubicación a vivienda estable y el porcentaje de supresión de la carga viral desde la línea de base hasta 12 meses. Los clientes asignados a servicio de asistencia mejorada fueron colocados más rápido que los clientes asignados a servicios usuales de asistencia (p = 0.02; 25% colocado dentro de 150 días vs. 243 días, respectivamente), tuvieron mayor probabilidad de ser asignados a una vivienda estable (proporción de riesgos ajustada = 1.8; intervalo de confianza del 95% [IC] = 1.1-2.8), y tuvieron doble probabilidad de lograr o mantener la supresión de la carga viral (proporción de probabilidades ajustado = 2.1; 95% IC = 1.1-4.0).

Introduction

Homelessness is a widespread problem in the U.S. that frequently co-occurs with other public health issues, including HIV infection, substance abuse, and mental illness [1–6]. The co-occurrence of these conditions among homeless persons has contributed to their high rates of morbidity and mortality compared to the general population [7–12]. People who are HIV-positive are at increased risk for inadequate or unstable housing and housing loss [13]. For homeless persons living with HIV/AIDS (PLWHA), lack of stable, secure, and adequate housing is not only a significant barrier to achieving and sustaining improved HIV-related outcomes, but also a barrier to forming and maintaining stable intimate partner relationships and networks of social support [14].

✉ Ellen Weiss Wiewel
ewiewel@health.nyc.gov

Extended author information available on the last page of the article

Provision of housing not only improves long-term residential stability [15], but can also improve health [16] and substance use outcomes [17, 18]. Studies have shown that being stably housed is significantly associated with higher CD4 counts, lower HIV viral loads (VLs) [19], better adherence to antiretroviral therapy [19, 20], and reduced risk behaviors that could result in HIV transmission [21]. PLWHA taking effective antiretroviral therapy and whose viral loads are so low as to be undetectable cannot transmit HIV sexually; supporting PLWHA to achieve an undetectable VL has been a goal of the international "Undetectable is Untransmittable," or "U = U" campaign [22]. Undetectability and housing stability may be two of the most critical drivers to reducing the HIV epidemic.

Finding and providing stable housing to people with housing issues can be a lengthy and difficult process, arising from complex interactions between individual vulnerabilities and broader economic, political, and legal structural determinants of health [14]. First, low-income PLWHA may take a long time to locate appropriate housing due to a lack of affordable housing. Spending 30% of income on rent is widely considered to be an affordable amount, leaving enough money for other expenses such as food, clothing, transportation and medical care [23]. Unfortunately, in 2015, 8.3 million U.S. households were families who were very-low-income, unassisted and paying more than 50% of their monthly income for rent and/or living in severely substandard housing. The highest concentrations of such low-income renters were found in major urban areas such as New York City (NYC) [24], which is where this study took place. Due to the demands of HIV treatment and other HIV-related health issues, it may be harder for low-income PLWHA than other low-income persons to find stable housing. On the other hand, poor physical and mental health, loss of income, stigma, and policies restricting housing assistance for people with drug use or incarceration histories, as well as preexisting social disadvantages such as institutional racism, make it difficult for many PLWHA to secure or maintain adequate housing [25].

A small number of studies have examined the effects of housing interventions or programs on PLWHA housing and health-related outcomes; two of these studies were trials [26–29]. In a trial of rental assistance, 54% of treatment arm participants and 16% of comparison arm participants were in permanent housing at 6-month follow up [26]. Additionally, a trial of case management and supportive housing reported that 65% of treatment arm participants were permanently housed at 12 months post-enrollment (control group housing status not reported) [27]. These results suggest that most homeless PLWHA will not be placed in housing without rental assistance, and immediate and intensive case management, and that even with the assistance, these individuals face a housing placement process that is potentially many months long and may end in no housing placement. In terms of HIV medical outcomes, one trial found no difference in viral load suppression between the two arms [26] while the other found significantly higher achievement of suppression in treatment versus Usual Care participants (36% vs. 19%, respectively) [27]. For homeless PLWHA, a lengthy housing process may mean a delay in their ability to improve HIV medical outcomes, and thus continued higher HIV transmission risk.

Rapid re-housing into a permanent home is an approach that has been embraced recently in U.S. housing policies as a way to reduce homelessness, including among persons considered more difficult to serve [30]. Rapid re-housing stands in stark contrast to the previous approach of step-wise transitions for homeless persons through temporary housing programs [31]. Supportive housing, which includes the provision of housing in conjunction with support services (e.g., case management, medication adherence counseling), can help to maintain formerly homeless PLWHA in permanent housing. However, it is costly and may not be necessary for all homeless individuals. Unlike supportive housing, rapid re-housing is a program that aims to connect people to permanent housing as quickly as possible, and to subsequently provide temporary support services tailored to address the barriers to housing maintenance. The assistance should end and the case be closed when the individual or family is no longer facing the threat of homelessness. Clients can have mental illness, a history of incarceration, and/or substance use issues and still participate in rapid re-housing [30]. Little is known about best practices for rapid re-housing. For example, how quickly is it feasible to place a chronically ill and homeless person into permanent housing (e.g., how rapid is rapid)? How many people enrolled in a rapid re-housing program are placed? What types of rapid re-housing services work best and for whom? And can rapid re-housing have an impact upon health outcomes? Answers to these and other questions may inform the design of rapid re-housing programs to maximize impact on outcomes, as well as to benchmark program implementation.

We present here the results of a housing trial in which low-income, homeless PLWHA residing in HIV emergency housing in NYC were randomized to either (1) rapid re-housing, that is, rapid housing placement plus 12 months of case management (Enhanced Housing Placement Assistance [EHPA]; treatment) or (2) referral to an NYC housing placement program for which all HIV emergency housing residents are eligible (Usual Care). We present benchmarks for program implementation and health outcomes.

Methods

Study Population

The study population was individuals residing in emergency shelters for PLWHA in NYC at the time of study

recruitment. At that time, PLWHA living in NYC were eligible to receive benefits from NYC's Human Resources Administration's HIV/AIDS Services Administration (HASA) if they had symptomatic HIV or AIDS and were living at ≤ 150% of the Federal Poverty Level. As part of HASA benefits, persons can access HIV emergency shelters if they become homeless. Between its emergency shelters and other types of housing assistance, HASA is the largest housing provider for persons with HIV in NYC. In 2012, about 36,000 persons were enrolled in HASA, comprising one-third of all NYC PLWHA (unpublished data, NYC Department of Health and Mental Hygiene).

Recruitment

The study team recruited participants onsite at 22 HIV emergency single adult shelters across NYC. Recruitment was conducted by staff of a local community-based organization with expertise in HIV, harm reduction, and housing. In order to maximize engagement with participants, recruiters went door-to-door at the shelters and offered enrollment into the trial. Prior to approach, rooms were randomized to the treatment or Usual Care arm of the study using a computer-generated random number list. Because enrollment was capped due to resource limitations, the rooms were randomly ranked and approached in sequential order from the ranked list, maintaining random assignment into study arms, with no resident approached out of order. Each door approached and its outcome was recorded on a tracking form in order to calculate rates of response to knocking on the door. Recruitment teams returned to each shelter multiple times, varying the day of the week and time of day, to increase response rates. Rooms without response were approached on at least three separate visits before being marked as non-responsive.

Once a resident opened their door, the person was offered the opportunity to enroll in the study if they met the following eligibility criteria: aged 18 years or older, diagnosed with HIV, residing in the HIV emergency shelter (i.e., not a visiting acquaintance), and able to live alone without the assistance of a live-in aide (based on self-report). The enrollment offer was directly followed by reviewing and signing a consent form, completing a baseline interview, and then receiving study group assignment (treatment vs. Usual Care) and referral to the appropriate housing agency since both the arms involved housing services (described below). Participants in both the treatment and Usual Care arms were given $20 food vouchers at enrollment and at six- and twelve-month follow-up interviews. Residents who were not eligible or not interested in participation were given referrals for housing services available in the community.

Program Description

Enhanced Housing Placement Assistance (EHPA), the treatment arm, was a rapid re-housing program in which program participants were immediately assigned a case manager. One of EHPA's hallmark strategies was that the case manager worked to identify available and affordable housing for the participants as quickly as possible, provided rent and move-in assistance, and delivered intensive housing stabilization services up to one year post-enrollment. Two case managers were hired to support EHPA arm participants. They visited EHPA arm participants onsite at the HIV emergency shelters on an as-needed basis, which was typically weekly visits to each of the shelters. They also picked up clients and accompanied them to all housing appointments, assisted with entitlements advocacy to secure eligible housing subsidies, conducted housing quality standard reviews, and other activities related to securing housing placements. All housing stabilization services, defined as services to address issues that may threaten a participant's housing stability (e.g., substance abuse, mental illness, history of incarceration, financial management challenges) were delivered onsite at the client's HIV emergency shelter whenever possible. As a control, Usual Care arm participants were immediately referred to an organization already engaged by the City of New York prior to the initiation of this study to find housing for PLWHA. The housing stabilization services were provided as needed and typically terminated within 3 months post-enrollment. Unlike the EHPA participants, who could receive services onsite, the Usual Care participants had to travel to the program office for services, which was consistent with their HASA benefits. Differences between the EHPA (treatment) and Usual Care arms are described in Table 1.

Data Sources

Study Questionnaire

Study questionnaires were administered at baseline, 6, and 12 months after enrollment. The interviewer asked the survey questions and documented the responses on a laptop computer in real time with the participant. The questionnaire included self-reported measures of socio-demographic characteristics, enrollment in Social Security Income (SSI) or Social Security Disability Income (SSDI) benefits programs, and incarceration history.

Table 1 Comparison of characteristics between Enhanced Housing Placement Assistance (EHPA) and Usual Care housing programs for persons with HIV, New York City, 2012–2014

Characteristic	EHPA (treatment)	Usual care (control)
Immediate connection to case manager	Yes, upon recruitment in HIV emergency shelter	No, referrals made to community-based organization
Housing stabilization services provided (i.e., substance abuse issues, mental health, histories of incarceration, financial management)	Yes	Yes
Direct case management provided	Yes, weekly and then monthly	No, referrals made as needed
Length of support services	Up to one year	Short-term; services terminated on average within 3 months
Services provided onsite at client's HIV emergency shelter	Yes, whenever possible	No, clients asked to travel to the program's office

NYC HIV Surveillance Registry

New York State law began requiring the reporting of AIDS diagnoses by medical providers or laboratories conducting HIV testing in 1981, was expanded to include non-AIDS HIV infections, CD4 counts under 500 cells/mm^3, and detectable VLs in June 2000, and since June 2005 has required all CD4 and VL values and nucleotide sequences obtained for genotypic analyses. These lab reports are electronically reported as frequently as weekly and are > 95% complete within 1 month [32]. The NYC HIV Surveillance Registry (hereafter referred to as 'the Registry') contains named reports of all diagnoses of HIV and AIDS, positive Western blot and other confirmatory tests for HIV antibody, all VL and CD4 values, and HIV genotypes for persons diagnosed with or receiving care for HIV/AIDS in NYC. Surveillance data included in this analysis were reported as of April 2016. Study participants were matched to the Registry using an algorithm that incorporated first and last name, date of birth, and social security number.

Other Administrative Databases

NYC Housing Opportunities for Persons With AIDS (HOPWA)- and Ryan White HIV/AIDS Program-funded providers report client-level data, including program enrollments, housing placements, and living situation history, to the Department of Health and Mental Hygiene (DOHMH) through secure, web-based reporting systems. Provider data included in this analysis were reported as of August 2015. All study participants connected to a case manager were entered into one of these program databases and these data were matched to the study dataset.

Also linked to the study sample was the HASA administrative database, which contains historical information on enrollment in Social Security Income (SSI) or Social Security Disability Income (SSDI) benefits programs, addresses, and housing type. All participants were included in this database, based on eligibility criteria.

Analytic Variables

Outcome Variables

Housing Placement Stable housing placement was defined as placement in permanent supportive housing (either congregate or scattered-site) or independent housing, as reported to HIV housing program databases, which contained nearly all housing programs for which study participants were eligible. For survival analysis (described below), time to placement was defined as time elapsed (in days) between enrollment and initial placement in stable housing.

HIV Medical Outcomes Baseline medical outcomes were measured during the 12 months prior to enrollment, and post-enrollment medical outcomes were measured during the 12 months after enrollment, using the Registry data. Engagement in HIV medical care was defined as having ≥ 1 HIV laboratory test result (CD4 count or VL) reported to the Registry during the 12 months. Viral suppression was defined as having a latest VL test result of ≤ 200 copies/mL during the 12 months. Participants lacking a VL test result during the time period of interest were categorized as not achieving viral suppression, as it was considered the conservative approach (i.e., results are biased toward the null using this approach).

Exposure Variable

The exposure variable for this analysis was study arm (EHPA [treatment] vs. Usual Care), randomly assigned to study participants upon enrollment.

Covariates

In the analysis of this randomized controlled trial, the covariates were demographics, plus only variables that were

unbalanced between the two study arms at time of enrollment: age group, race/ethnicity, gender, baseline viral suppression, and enrollment in Social Security Income (SSI) or Social Security Disability Income (SSDI) benefits programs.

Statistical Analyses

Differences in baseline characteristics between study arms were assessed using Chi-square tests for categorical variables and t-tests for continuous variables.

Kaplan–Meier survival models were used to estimate time from enrollment to stable housing placement, stratified by study arm. Cox proportional hazards models were used to estimate risk ratios for time to placement by study arm, adjusted for all covariates.

McNemar's tests were used to determine if engagement in care and viral suppression percentages significantly improved from pre-enrollment to 1 year post-enrollment within arm. When the McNemar's test indicated significant change in the outcome in either arm, we further used conditional logistic regression to compare pre/post improvements in that outcome between the two arms, with a main effect of arm (EHPA vs. Usual Care), a main effect of time (baseline and post-enrollment), and their interaction to test whether the improvement from baseline to 12 months post-enrollment was greater in the EHPA arm than in the Usual Care arm. That interaction term would be the key indication of whether the intervention was better than Usual Care at improving engagement in care and viral suppression. The models were stratified by subject and adjusted for age group, race/ethnicity, gender, and enrollment in SSI or SSDI benefits programs. (Because of the way that the regression model assessed change in viral suppression over time, baseline viral suppression was an element of the outcome, and not a covariate.).

Housing and medical outcomes were measured through the housing administrative dataset and the Registry for all participants no matter whether they completed 6-month and 12-month follow-up interviews.

A sensitivity analysis was conducted among participants who had at least one VL at pre- and post-enrollment and were alive through 12 months post-enrollment. All analyses were conducted in SAS version 9.3 (SAS Institute, Cary NC).

Results

Between April 2012 and April 2013, homeless PLWHA were recruited from 22 different HIV emergency shelters. There were 2,026 attempts made to 1,103 unique rooms; 605 (55%) persons responded to door knocks, and of these, 236 (39%) were enrolled into the study. Over the course of the study, 10 people died, and 1 person was not matched to the HIV surveillance registry, resulting in 225 participants left in the study at the end of the 12-month study period. A CONSORT diagram is presented in Fig. 1. Study staff overseeing housing placement and services for participants and attempting to have study questionnaires completed could locate only 72% of the cohort at month six and 37% at month 12. However, housing and health outcomes could be measured up to 12 months for all enrollees because these data were obtained from linked registry and administrative databases rather than self-report. Proportions engaged in care and virally suppressed were not significantly different between participants who completed follow-up interviews and participants who did not.

The majority of study participants were male, black or Hispanic, ≥ 40 years old, disabled for work or unemployed, and chronically homeless, defined using HOPWA administrative data as at least 12 months of residence in NYC emergency housing or at least four separate instances of residence in NYC emergency housing (Table 2). Almost half reported having less than a high school education, and over three-quarters had a history of incarceration. Over half reported a history of mental health diagnosis (i.e., any of anxiety disorder, mood disorder, personality disorder, and

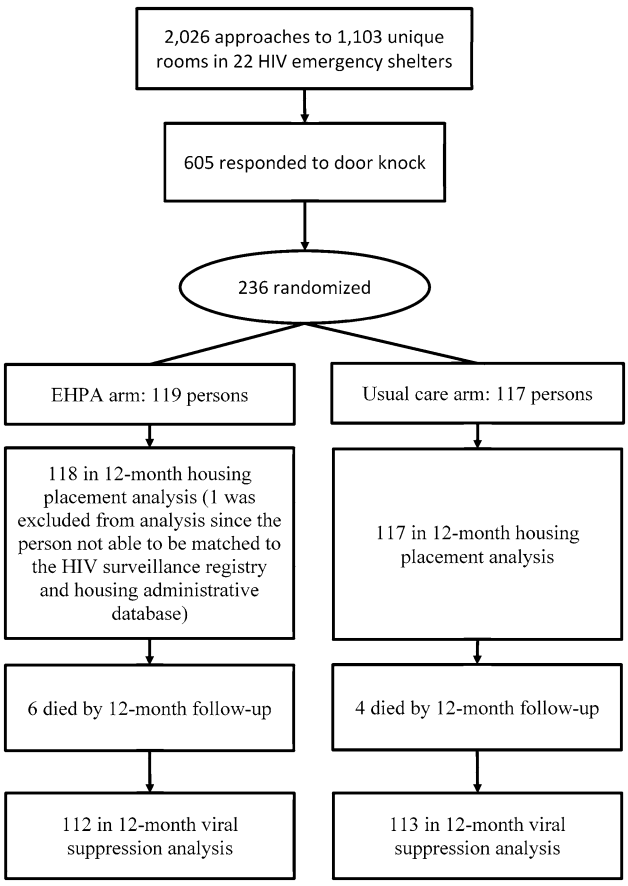

Fig. 1 Randomization, follow-up of participants, and inclusion in analyses

psychotic disorder), and over 80% reported substance use in the prior year; over one-third reported lifetime injection drug use. During the year prior to enrollment, almost all participants were engaged in HIV care, 40% were virally suppressed and just under half had CD4 count > 350. Participant characteristics that differed significantly at baseline were viral suppression and Supplemental Security Income (SSI)/Social Security Disability Insurance (SSDI) enrollment.

Housing Placement

In terms of housing outcomes, survival analysis with housing placement as the endpoint (Fig. 2) showed that participants in the EHPA arm were significantly more likely to have been placed in housing up to 12 months after enrollment compared to the Usual Care arm ($p = 0.02$, Log-rank test). Twenty-five percent of participants in the EHPA arm were placed by 150 days post-enrollment, while it took 243 days post-enrollment to place 25% of participants in the Usual Care arm. By 12 months post-enrollment, the last time point in the study period, 45% of participants in the EHPA arm had been placed in stable housing, vs. 32% of participants in the Usual Care arm. On average, the EHPA arm was associated with a 80% higher rate of housing placement than Usual Care, adjusted for covariates [adjusted hazard ratio (95% confidence interval) 1.8 (1.1–2.8)]. The interaction between baseline viral suppression and enrollment in SSI or SSDI benefits programs was not significant.

HIV Medical Outcomes

In terms of engagement in care, more than 97% of participants in both study arms were in care at both 12 months prior to and 12 months after enrollment; no statistically different changes in percentage were observed in either arm (results not shown). Significant improvement in viral suppression between pre- and post-enrollment at 12 months was observed among participants in the EHPA arm. As shown in Fig. 3, in the 12 months prior to study enrollment, only 28% of participants in the EHPA arm were virally suppressed, but in the 12 months after enrollment, this increased to 47% of participants being virally suppressed ($p < 0.01$, McNemar's test). For the Usual Care arm, non-significant increases in the percentage virally suppressed were observed (52% pre- and 57% post-enrollment). The improvement in viral suppression from baseline to post-enrollment in the EHPA arm was twice as high as in the Usual Care arm, as indicated by the significant interaction term of arm and time after adjusting for demographics (sex, race/ethnicity, and age) and receipt of SSI/SSDI [aOR (95% CI) 2.1 (1.1, 4.1); Table 3].

A sensitivity analysis including the 215 participants who had at least one VL test record at pre and post-enrollment and were alive through 1 year after enrollment had similar results with regard to changes in suppression over time within study arms, as well as the greater improvement in EHPA arm. This suggests that persons without VL data did not substantially alter findings within or between study arms. Furthermore, an analysis using the Registry as the data source and the same care definitions found that only 30% of out-of-care patients were virally suppressed, supporting our analytic assumption that participants with missing VLs were not virally suppressed [33].

Discussion

The study population in this rapid-rehousing trial lives with the challenges of HIV infection in addition to the range of issues that commonly affect chronically homeless populations, including substance use, mental illness, and disability, all of which are barriers to housing placement. The EHPA program focused primarily on housing PLWHA who have significant barriers to housing by delivering placement services to clients in a way that maximizes accessibility and shortens time to placement. Specifically, the prior knowledge that these clients have difficulty staying in touch and often miss appointments informed the decision to have case managers deliver direct services through in-person visits where clients spend their time.

Results from this trial suggest that how a rapid re-housing program is implemented can potentially impact housing and health outcomes among homeless populations. We hypothesize that delivery of housing services at sites where homeless people live can result in significantly higher rates of placement in stable housing by 6 months and continuing through at least 12 months post-enrollment, compared to in-office service delivery as is typically provided. For example, in our case, 45% of EHPA participants were placed by 12 months versus 32% of Usual Care participants. Given the evidence that housing reduces risk behaviors that could result in HIV transmission (e.g., unprotected sex, needle use) [21], design of housing placement strategies may have public health consequences. Furthermore, results of this study may inform the design or selection of rapid re-housing strategies for many organizations working with difficult-to-engage populations.

In terms of health outcomes, for those participants who were placed and had at least 12 months of HIV Registry data, EHPA arm participants happened to have a lower rate of viral suppression at baseline than Usual Care arm participants (28% vs. 52%, respectively), yet experienced a significantly better improvement in suppression at 12 months post-enrollment (19% increase vs. 5% increase). The overall

Table 2 Baseline characteristics between Enhanced Housing Placement Assistance (EHPA) and Usual Care housing programs for persons with HIV, New York City, 2012–2014

	Total		EHPA (treatment)		Usual Care (control)		Statistic[a]	p-value[a]
	N	%	N	%	N	%		
Gender								
Male	173	73%	83	70%	90	77%	$\chi^2 = 1.96$	0.38
Female	51	22%	30	25%	21	18%		
Transgender	11	5%	5	4%	6	5%		
Race/ethnicity								
Non-Hispanic Black	142	60%	72	61%	70	60%	$\chi^2 = 1.90$	0.39
Hispanic	78	33%	41	34%	37	32%		
Non-Hispanic White	15	6%	5	4%	10	9%		
Age at recruitment								
Mean	46.3		46.5		46.2		t = 0.22	0.82
Median (IQR)	48 (41.5–54)		48 (42–54)		48 (40–54)		z = −0.25	0.81
Born outside of US/US dependencies	12	5%	8	7%	4	3%	$\chi^2 = 1.37$	0.24
Employment status								
Disabled for work	126	53%	60	50%	66	56%	$\chi^2 = 2.12$	0.55
Unemployed	97	41%	53	45%	44	38%		
Full-or part-time employment	4	2%	1	1%	3	3%		
Other	8	3%	4	3%	4	3%		
Income < $834/month	167	71%	85	71%	82	70%	$\chi^2 = 0.11$	0.74
Enrolled in SSI/SSDI	114	48%	49	41%	65	56%	$\chi 2 = 4.63$	0.03*
Education								
Less than high school	93	39%	50	42%	43	37%	$\chi^2 = 0.91$	0.63
High school diploma/GED	75	32%	37	31%	38	32%		
Some college or other degree	67	28%	31	26%	36	31%		
History of incarceration								
Recent (within 2 years)	61	26%	39	33%	22	19%	$\chi^2 = 5.56$	0.06
Ever, not recent	121	51%	55	46%	66	56%		
Never	54	23%	25	21%	29	25%		
Chronic homelessness	156	66%	81	68%	75	64%	$\chi^2 = 0.54$	0.46
Mental health diagnosis[b]	136	58%	68	57%	68	58%	$\chi^2 = 0.01$	0.94
Substance use, prior year								
Any alcohol or drug use	192	81%	99	83%	93	79%	$\chi^2 = 0.76$	0.38
Alcohol use	151	64%	78	66%	73	62%	$\chi^2 = 0.35$	0.55
Injection drug use	24	10%	11	9%	13	11%	$\chi^2 = 0.21$	0.65
Non-injection drug use	144	61%	75	63%	69	59%	$\chi^2 = 0.52$	0.47
Crack/cocaine use	97	41%	52	44%	45	38%	$\chi^2 = 0.76$	0.38
Heroin use	29	12%	14	12%	15	13%	$\chi^2 = 0.05$	0.82
Injection drug use, ever	88	37%	43	36%	45	38%	$\chi^2 = 0.10$	0.75
Sex behavior, prior year								
Sex without a condom	85	36%	40	34%	45	38%	$\chi^2 = 0.53$	0.47
Sex with partner of HIV-negative or unknown status	108	46%	59	50%	49	42%	$\chi^2 = 1.56$	0.21
Exchange sex	28	12%	17	14%	11	9%	$\chi^2 = 1.40$	0.24
ART status								
On ART, complete adherence	56	24%	24	20%	32	27%	$\chi^2 = 1.63$	0.44
On ART, incomplete adherence	136	58%	72	61%	64	55%		
Not on ART	43	18%	22	18%	21	18%		
AIDS diagnosis	162	69%	83	70%	79	68%	$\chi^2 = 0.22$	0.64
Engaged in HIV care, prior year	233	99%	116	97%	117	100%	$\chi^2 = 2.0$	0.16

Table 2 (continued)

	Total		EHPA (treatment)		Usual Care (control)		Statistic[a]	p-value[a]
	N	%	N	%	N	%		
Viral suppression (≤200 copies/mL),prior year	94	40%	33	28%	61	52%	$\chi^2=1.3$	<0.01*
CD4 Count, prior year								
<200	62	26%	33	28%	29	25%	$\chi^2=3.58$	0.46
200-350	52	22%	24	20%	28	24%		
350–499	55	23%	30	25%	25	21%		
>500	64	27%	29	24%	35	30%		
Missing	2	1%	2	2%	0	0%		
HIV transmission risk								
Injection drug use	108	46%	51	43%	57	49%	$\chi^2=4.38$	0.22
Men who have sex with men	47	20%	20	17%	27	23%		
Heterosexual	42	18%	23	19%	19	16%		
Other/unknown	38	16%	24	20%	14	12%		

[a]Chi-square tests were used for categorical variables, t test for continuous variables, and U test for median age

[b]Mental health diagnosis defined as diagnosed any of anxiety disorder, mood disorder, personality disorder, and psychotic disorder

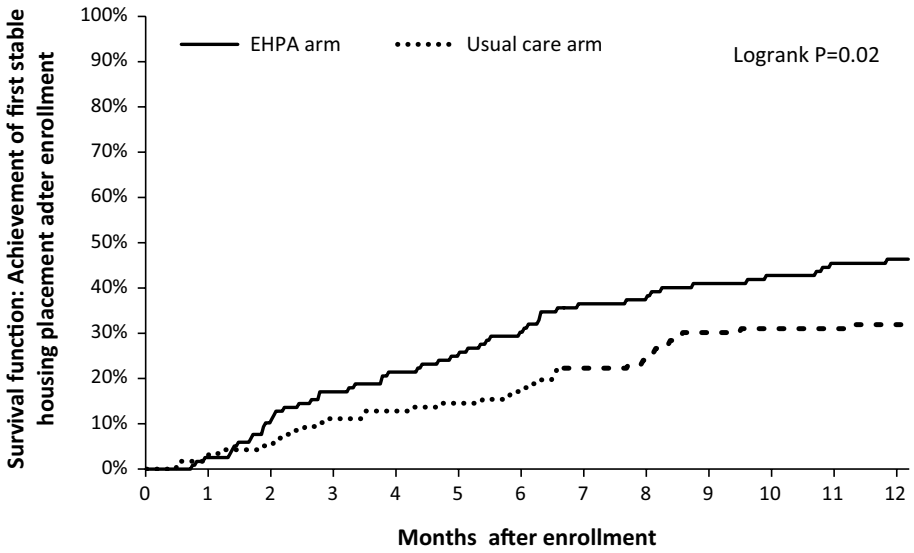

Fig. 2 Kaplan-Meier curves of time to stable housing placement, comparing Enhanced Housing Placement Assistance (EHPA) and Usual Care arms of a randomized controlled trial, New York City, 2012–2014. Stable housing placement: placement in permanent supportive housing (either congregate or scattered-site) or independent housing

importance of placing participants as quickly as possible in housing was captured in this study. A much higher percentage of those from the EHPA arm were placed in housing within 6 months of enrollment compared to UC (35% vs. 18%, respectively, p = 0.0048), which may explain the improved viral suppression outcome among EHPA participants at 12 months post-enrollment.

Results from this study provide an opportunity to share lessons learned with rapid re-housing providers and may also inform the use of benchmarks for rapid re-housing performance. The National Alliance to End Homelessness developed a toolkit to help evaluate the performance of rapid re-housing programs [34]. Suggested performance benchmarks include households moving into permanent housing within 30 days of program entry and placement of at least 80% of households in prior 12-month period. Yet in this trial, the average amount of time to placement was 143 days for EHPA participants and 153 days for Usual Care participants. At the last study time point of 12 months, most Usual Care participants still had not been placed in permanent housing and about half the EHPA participants also had not been placed. It may be the case that the health conditions (HIV infection plus other comorbidities) of the participants contributed to difficulties in housing placement. But given that homeless populations have high rates of disease [35], and much higher rates of HIV infection compared to the

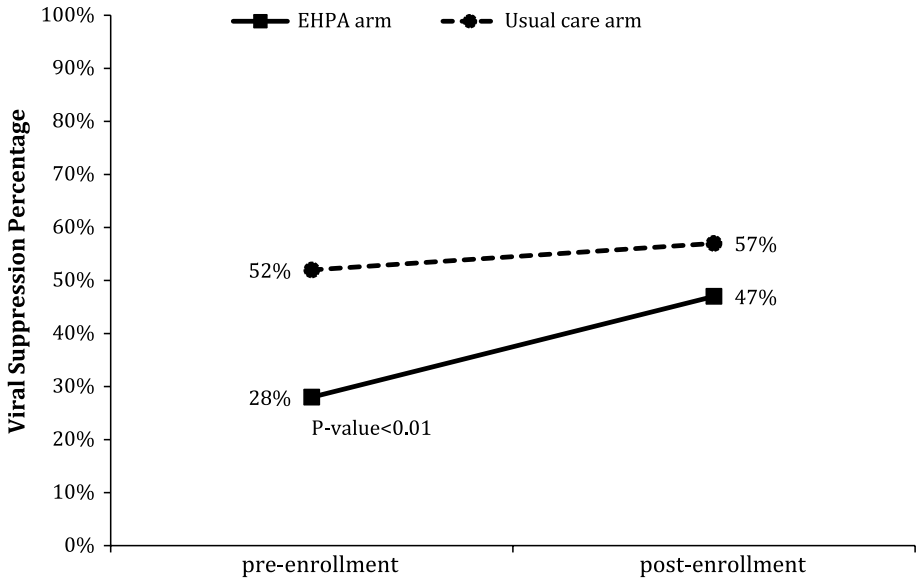

Fig. 3 Differences in the percentage of HIV virally suppressed participants 12 months pre- and 12 months post-enrollment within the Enhanced Housing Placement Assistance (EHPA) and Usual Care arms of a randomized controlled trial, New York City, 2012–2014

Table 3 Conditional logistic regression of study arm on HIV viral suppression at 12 months post-enrollment in the Enhanced Housing Placement Assistance (EHPA) randomized controlled trial, New York City, 2012–2014

Variable	Crude Odds Ratio[b] [95% confidence interval]	*P* value	Adjusted Odds Ratio[b] [95% confidence interval]	P-value
Arm				
Usual Care (control) arm (ref)				
EHPA (treatment) arm	0.4 [0.2–0.6]	< 0.01	0.3 [0.2–0.6]	< 0.01
Time				
Pre-enrollment (ref)				
Post-enrollment	1.2 [0.8–1.8]	0.42	1.1 [0.7–1.8]	0.60
Arm*Time	**1.9 [1.1–3.4]**	**0.03**	**2.1 [1.1,4.0]**	**0.03**
Age				
< 35				
35–44			1.7 [0.7–4.0]	0.21
45–49			1.6 [0.6–3.7]	0.32
50–54			2.3 [1.0–5.3]	0.05
55+			2.5 [1.1,5.6]	0.03
Gender[c]				
Cisgender Male (ref)				
Cisgender Female			0.5 [0.3–0.9]	0.02
Transgender			0.2 [0.0–0.7]	0.02
Race				
Non-Hispanic White (ref)				
Hispanic/Latino			0.5 [0.2–1.3]	0.18
Non-Hispanic Black			0.4 [0.1–0.9]	0.02
SSI/SSDI[d]				
Yes (ref)				
No			1.4 [0.8–2.2]	0.21

Viral suppression was defined as having a latest VL test result of ≤ 200 copies/mL during the 12 months

[b]Crude odds ratios were based on model with arm, time, and arm*time, and adjusted odds ratios were adjusted for all covariates in the table additionally

[c]Persons not known to be transgender were classified as cisgender (i.e., not transgender)

[d]Enrollment in Social Security Income (SSI) or Social Security Disability Income (SSDI) benefits programs

general population [7], rapid re-housing providers should consider these issues when setting performance benchmarks.

Strengths and Limitations

Our study had two strengths. First, control arm participants also received housing placement assistance, which suggests the better outcomes were associated with the enhanced assistance that the EHPA model provides. Second, the lab tests and stable housing placement were retrieved from the NYC HIV registry and housing administrative database rather than self-reported, which ensured accurate and longitudinal data for all participants.

There are also limitations to the study. First, baseline viral suppression percentages were unbalanced between arms, although we randomized rooms prior to approach. However, it did not substantially impact our study. In analysis, we accounted for these baseline differences by conducting McNemar's test and then conditional logistic regression. These methods allowed us to compare viral suppression improvement before and after enrollment within and between arms, instead of comparing post-enrollment viral suppression only. Second, it is difficult to ensure consistency of services across people. After randomization, some services may have been tailored for the individuals, so it is likely that there was some variation in services within the EHPA arm and within the Usual Care arm. Third, we cannot distinguish routine and acute medical care. It is possible that some people who we classified as engaged in care had HIV-related lab tests only as part of emergency visits.

Conclusion

The EHPA randomized controlled trial demonstrated that, compared with usual housing services for persons with HIV, housing services that are delivered to persons with HIV where they live, and immediate case management that continues for up to a year, produce greater improvements to stable housing placement and viral suppression. Refining best practices for rapid re-housing and addressing barriers to housing will allow housing providers to set and meet aggressive benchmarks to reduce chronic homelessness.

Acknowledgements First and foremost, the authors thank the housing consumers, who offered us time, patience, and honesty. Their participation and candor made it possible to conduct this study. We are also grateful to the staff of CitiWide Harm Reduction (now BOOM!Health) who participated in recruitment and case management, particularly Sandy Guillaume. We also thank the New York City HIV/AIDS Services Administration (HASA) for collaborating with us to help consumers of emergency housing transition to more stable living situations. The authors also thank current and former staff of the Housing Services Unit of the New York City Department of Health and Mental Hygiene, including Giovanna Novoa, Laura McAllister-Hollod, Roland Torres, Dave Magno, X. Pamela Farquhar, Christopher M. Beattie, and Joanne Hsu, who helped with study administration, conduct, monitoring, analysis, and/or interpretation. Thank you to evaluation interns from the Columbia University Mailman School of Public Health who helped interview consumers: Jenny Doyle, Michelle Dixon, Lorlette Haughton, Lindsay DuBois, Abigail Greenleaf, and Hannah Cohen-Blair. Finally, we thank Eleonora Jimenez-levi, Raquel Silverio, and Dr. Luis Roberto Rodriguez-Porras for their assistance in preparing the Spanish abstract.

Funding The study's evaluation was covered through existing responsibilities of staff at the New York City Department of Health and Mental Hygiene.

Compliance with Ethical Standards

Conflict of interest All the authors declared that they have no conflict of interest.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Research Involving Human Participants and/or Animals All procedures performed involving human participants were in accordance with the ethical standards of the 1964 Helsinki declaration, its later amendments, and the New York City Department of Health and Mental Hygiene, and were reviewed and approved by that agency's Institutional Review Board. The study has been registered on ClinicalTrials.gov (record ID: NCT03334825). This article does not contain any studies with animals performed by any of the authors.

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Affiliations

Vivian L. Towe[1] · Ellen Weiss Wiewel[2] · Yaoyu Zhong[2] · Sebastian Linnemayr[3] · Rachel Johnson[4] · John Rojas[5]

1 RAND Corporation, Arlington, VA, USA

2 Division of Disease Control, New York City Department of Health and Mental Hygiene, 42-09 28th Street, CN-44, Long Island City, NY 11101, USA

3 RAND Corporation, Santa Monica, CA, USA

4 International Clinical Research Center (ICRC), University of Washington, Seattle, WA, USA

5 New York City Department of Social Services, New York, NY, USA