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Examining Homeless-Experienced Adults' Smoking Cessation Treatment Use Pre- and Post-Entry into Permanent Supportive Housing

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ABSTRACT

BACKGROUND: Homeless-experienced adults smoke at rates 5 times that of the general adult population, and often have limited access to cessation treatments while homeless. Permanent Supportive Housing (PSH) can be a catalyst for cessation treatment utilization, yet little is known about use of these treatments following PSH entry, or how to tailor and implement cessation care that meets homeless-experienced adults' vulnerabilities.

METHODS: Using Department of Veterans Affairs (VA) administrative data, we assessed smoking status (ie, current, former, non/never) among a cohort of homeless-experienced Veterans (HEVs) housed in Los Angeles-based PSH. We compared cessation treatment use rates (ie, nicotine replacement therapies, cessation medications, psychosocial counseling) pre- and post-housing using Chi-square tests. Predisposing (ie, demographics), enabling (eg, primary care, benefits), and need characteristics (ie, health, mental health, substance use diagnoses) were examined as correlates of cessation treatment utilization pre- and post-housing in univariable and multivariable logistic regression models.

RESULTS: Across HEVs (N = 2933), 48.6% were identified as currently-smoking, 17.7% as formerly-smoking, and 14.0% as non/never smoking. Among currently- and formerly-smoking HEVs (n = 1944), rates of cessation treatment use post-housing were significantly lower, compared to pre-housing, across all treatment types. Health, mental health, and substance use was more prevalent among currently- and formerly-smoking HEVs compared to non/never-smoking HEVs, and most diagnoses were positively associated with utilization univariably. However, in multivariable models, cessation clinic referrals and primary care engagement were the only significant ($P < .001$) predictors of pre-housing and post-housing cessation treatment utilization.

CONCLUSION: Among HEVs, we found high smoking rates and low cessation treatment utilization pre- and post-PSH entry. Efforts to educate providers about this population's desire to quit smoking, support primary care engagement, and increase cessation clinic referrals may bolster their utilization. For homeless-experienced adults, optimizing cessation treatment accessibility by embedding cessation services within PSH and homeless service settings may reduce utilization impediments.

KEYWORDS: Tobacco use, smoking, homelessness, housing, cessation, service utilization, treatment

Introduction

Rates of cigarette smoking among adults experiencing homelessness are approximately 5 times the rate of the general adult population.[1] Though adults experiencing homelessness desire to quit smoking,[2,3] and make cessation attempts at rates comparable to housed adults,[4] they have limited access to cessation services during experiences of homelessness. Psychosocial counseling and pharmacotherapies (nicotine replacement therapy [NRT], bupropion, or varenicline) are impactful, cost-effective treatments for persons who smoke, with each cessation aide demonstrating superior efficacy compared to controls in clinical trials.[5] However, most quit attempts made by adults experiencing homelessness are unassisted,[6] largely due to the barriers this population faces accessing cessation treatments, and their competing health and social needs.

Permanent Supportive Housing (PSH), which combines affordable, subsidized housing, and supportive services for persons experiencing homelessness,[7] may serve as a catalyst for cessation treatment utilization. The security and stability PSH can offer may reduce pervasive access barriers experienced while homeless, and facilitate increased engagement in cessation treatments. Yet, there is a dearth of research examining smoking behavior, including use of cessation treatments, once homeless-experienced adults are housed in PSH. We know little about whether cessation treatment use changes following entry into PSH, or how to tailor and support the implementation of cessation services for persons housed in PSH.

Research to date highlights predisposing (eg, demographics), enabling (eg, health resources and supports), and need (eg, health status) characteristics associated with smoking initiation and cessation among homeless-experienced adults and other vulnerable populations.[8,9] However, it is unclear if these factors are associated with utilization of cessation services among previously homeless PSH residents. Characteristics common among homeless-experienced persons, including being impoverished,[10] self-identifying with minoritized Racial or Ethnic groups—given their disproportionate exposure to tobacco marketing efforts and broad health disparities—and engagement in healthcare are associated with continued smoking.[11,12] Additionally, research has consistently identified chronic mental illness and substance use (eg, methamphetamine, alcohol), which are prevalent among homeless-experienced persons, as factors that impede smoking cessation outcomes.[13]

Compared to other populations with homeless histories, homeless-experienced Veterans (HEVs) are uniquely positioned for smoking cessation via the Department of Veterans Affairs (VA) robust smoking cessation services, which include a breadth of pharmacotherapies and psychosocial counseling. Despite widespread dissemination of these evidence-based treatments, and HEVs' potential access to them, there is limited understanding of their use by HEV tobacco users housed in PSH; who are particularly at-risk for sequelae of smoking, given their health and social vulnerabilities. To date, there is a single longitudinal study that examined smoking behavior among HEVs, some of whom were housed in PSH; this study found no changes in smoking across the observation year, despite 75% of the sample speaking with providers about cessation and 48% attempting cessation.[14]

There is an absence of research characterizing the utilization of cessation services among HEVs, and studies examining utilization of cessation treatments pre- and post-housing in PSH. This study fills this gap by using VA Electronic Health Record (EHR) data to assess smoking cessation treatment use among a cohort of Veterans housed through the Housing and Urban Development-VA Supportive Housing (HUD-VASH) program, the VA's PSH initiative. Specifically, this study characterizes rates of cessation treatment utilization 1 year pre- and post-housing among HEVs housed through HUD-VASH and

examines predisposing, enabling, and need characteristics associated with their use of cessation treatments. Examining these relationships can inform efforts to enhance delivery of smoking cessation treatments and increase their adoption by PSH residents, within and beyond the VA.

Materials and Methods
Setting

This retrospective cohort study was conducted at the VA Greater Los Angeles, which hosts the VA system's largest HUD-VASH program. Across the nation, HUD-VASH recipients receive a voucher that subsidizes rental costs, supplemented by 30% to 40% of the Veteran's income. In addition to financial rental subsidies, HUD-VASH provides field-based case management that includes linkages to non-mandated medical and behavioral health services within and outside VA. As HUD-VASH primarily serves chronically homeless Veterans, many recipients have multiple medical, mental health, and substance use conditions, compounded by social vulnerabilities, such as low income and limited social support.

Data sources and sample

We drew from the VA's homeless service registry—the Homeless Operations Management and Evaluation System (HOMES) database—to identify the sample of HEVs who were housed in HUD-VASH at VA Greater Los Angeles between 2016 and 2019 (N = 2938). Using social security numbers, the sample of HEVs identified in HOMES were linked with administrative data from the VA's EHR via the Corporate Data Warehouse (CDW), which documents utilization of health services (eg, engagement in smoking cessation treatments, referrals to smoking cessation clinic), demographic characteristics, and diagnostic information. To obtain the analytic sample, duplicate entries were removed, along with records from HEVs whose social security numbers could not be linked to CDW data (n = 5). There were no other inclusion or exclusion criteria used to determine the cohort or analytic sample of Veterans.

This study involved secondary analysis of existing VA administrative data and no more than minimal risk, therefore the need for participant informed consent to participate was waived. All study procedures and ethical approval were received by the VA Greater Los Angeles' Institutional Review Board on September 7, 2021 and were determined as constituting quality improvement (Reference # 1630424-1).

Measures
The Behavioral Model for Vulnerable Populations—a leading conceptual framework for examining factors associated with health behavior and health service utilization—was used to organize variables predicting smoking status and cessation treatment use across predisposing- (ie, pre-existing

characteristics, such as demographics), enabling- (ie, those that facilitate or hinder access to services, such as income), and need- (ie, those that represent health disabilities) characteristics.[8,9] This model is particularly helpful in identifying factors common among vulnerable populations that support and impede their utilization of needed health services, enhancing our understanding of strategies for promoting their access to care.[8,9]

Smoking status

Smoking status was determined using a validated, unsupervised clustering algorithm that draws upon counts of structured health factors (ie, fields that can be queried through the VA's EHR within a specified period of time) to predict categories of *Current*, *Former*, and *Non/Never* smoking.[15,16] The output of the algorithm provides the probability value from 0 to 1 of *Current*, *Former*, and *Non/Never* smoking status for each Veteran, as well as a threshold value used to classify each category; those with probability values higher than the threshold are designated to be positive cases for that category.[15,16] If the Veteran's smoking status could not be classified, they were categorized as "*unknown*" and coded as missing. Prior studies using these methods to determine smoking status have demonstrated moderate to good agreement using Kappa statistics, and good to excellent sensitivity and specificity.[16-18]

For the present study, we determined Veterans' smoking status based on the year of health factors data preceding their housing entry dates. Additionally, the International Classification of Disease, Tenth Revision (ICD-10) codes indicating a current tobacco use disorder in the 2 years prior to housing entry was abstracted from medical records for the cohort of HEVs. If a Veteran had a positive indicator of tobacco use disorder from ICD-10 code data, and "*unknown*" smoking status using the algorithm, their smoking status was recoded to *Current*.

Tobacco cessation treatment utilization

Veterans' housing entry date (ie, their HUD-VASH move-in date) served as the index date to determine use of cessation treatments 1 year pre- and post-PSH entry. Binary indicators were initially created for 3 measures of cessation treatment utilization: (1) Any prescription for nicotine lozenges, gum, patches, nasal spray, or inhalers was considered a proxy for *Nicotine Replacement Therapy*; (2) Any prescription for varenicline and bupropion was considered a proxy for *Cessation Medications*. As bupropion is commonly prescribed to treat depression, we limited bupropion prescriptions to ≥150 mg per day, which is consistent with dosing recommendations for smoking cessation; and (3) *Psychosocial Counseling* denoted one or more visits to the Greater Los Angeles VA's cessation clinic (which provides in-person and virtual/telephone-based

care) where the HEV received one-on-one counseling with a cessation clinic staff member, or in a support group with other tobacco-using Veterans, led by a multidisciplinary team of cessation clinic staff (eg, psychologist, pharmacist, health educator).

Each tobacco cessation treatment type was assessed independently to compare rates pre- and post-housing. Cessation treatments were combined to create 2 binary outcome measures of any cessation treatment utilization pre-housing and post-housing used in predictive models.

Predisposing characteristics

Demographics. Demographic variables included age at the time of move-in to PSH (modeled as a continuous variable); gender (women or men); marital status (married or not married [ie, divorced, widowed, single and never married]); and a combined measure of Race and Ethnicity resulting in 4 Racial-Ethnic subgroups: African American or Black; White, non-Hispanic or Latino; Hispanic or Latino; and Other and Mixed Race which included all HEVs who identified as Asian; American Indian or Alaskan Native; Native Hawaiian or Other Pacific Islander; or Mixed Race. The combined Other and Mixed Race category was created due to small representation of the races included in this composite measure.

Enabling characteristics

Service-connected disability status. Service-connected disability status uses the Schedule for Rating Disabilities to calculate benefits for lost vocational productivity due to conditions related to military service.[19] Each Veteran is assigned a percentage disability rating based on disability severity and number of dependents.[19] The rating ranges between 0% (no disability) and 100% (total disability) in increments of 10%. Ratings of 10% or more qualifies the Veteran for disability compensation.[20] We modeled patient service-connected disability status at the time of move-in to PSH as a binary variable (yes or no) based on 10% or higher level of service connection.

Primary care. Primary care empanelment drew from the EHR capturing Veterans empaneled to primary care "Patient Aligned Care Teams (PACTs)," the VA's patient-centered medical home model.[21,22] We included Veterans assigned to specialty PACTs (eg, Homeless-PACT [H-PACT] with teams and services tailored to HEVs) as empaneled. PACT empanelment was modeled as a binary variable at the time of move-in.

Primary care engagement was assessed using the number of primary care visits 1 year pre- and post-PSH move-in via encounter data that identifies activities specific to primary care provider visits.[21] The number of visits were limited to 1 per day. Veterans with ≥10 visits per year were grouped due to variable distribution, and for purposes of analyses.

Cessation clinic referrals. Referrals to the VA's Greater Los Angeles tobacco cessation clinic were anchored to the same index date as cessation treatment utilization measures to assess as a predictor of cessation treatment utilization pre- and post-housing. Referrals to the cessation clinic are typically made by VA providers in primary care, mental health, or medical sub-specialty clinics following positive screens for tobacco-use and/or Veterans expressed interest in cessation treatment. Cessation clinic staff follow up with the Veteran via an initial phone call to assess interest and coordinate access to cessation treatments offered.

Need characteristics

Mental health diagnoses. Binary indicators of mental health diagnoses drew from primary or secondary ICD-10 codes associated with VA outpatient visits or inpatient admissions during the 2 years prior to PSH entry. Mental health diagnoses assessed as predictors included schizophrenia and other psychotic spectrum disorders, bipolar disorder, post-traumatic stress disorder (PTSD), depressive disorders (eg, major depression, dysthymia), and anxiety disorders (eg, panic disorder, generalized anxiety disorder, social anxiety).

Substance use diagnoses. The presence or absence of substance use diagnoses other than tobacco use—including alcohol use disorder, cannabis use disorder, and a combined measure indicating "other drug use disorder" (ie, opioids, sedatives/hypnotics or anxiolytics, cocaine, other stimulants, hallucinogens, inhalants, or other psychoactive substances)—drew from primary and secondary ICD-10 codes indicating treatment for the diagnosis within 2 years prior to PSH entry.

Physical health diagnoses. Physical health diagnoses were assessed via the Elixhauser comorbidity index score, altered to include diagnoses not already adjusted for in the present study's models (ie, mental health diagnoses and substance use disorders).[23] The Elixhauser comorbidity index algorithm indicates the present or absence of major chronic health conditions (eg, diabetes, cancer, hypertension) which are combined to assess health morbidity. We created a sum score using 25 physical health conditions.[23]

Analyses

Descriptive statistics of predisposing, enabling, and need characteristics were examined across the analytic cohort of HEVs (N = 2933), and each smoking status condition (ie, current-, former-, and non/never smoking). Multinomial logistic regression was used to compare predisposing, enabling, and need characteristics across smoking statuses, with the non/never smoking subgroup serving as the reference group. Chi-square tests were conducted to identify significant differences across rates of cessation service use pre-housing compared to post-housing rates, among HEVs with current or former smoking status. Using univariate logistic regression, each predisposing, enabling, and need characteristic was initially examined individually to determine their significance as predictors of cessation treatment utilization pre-housing and post-housing, among former and current smoking statuses. All characteristics statistically significant at the $P \leq .05$ level in univariable model were then included in multivariable logistic regression models. Basic demographic variables (ie, age, Race and Ethnicity, gender, and marital status) were retained in multivariate logistic regression tests regardless of their significance in univariate analyses. All descriptive statistics and statistical tests were conducted using STATA v.18.

Results

Participants

The health factors algorithm initially identified 1823 Veterans made up the former and current smoking statuses. The ICD 10-code data indicated 569 Veterans had a positive tobacco use diagnosis documented in their EHR. Of the Veterans with a positive tobacco use diagnosis, 121 were initially identified as missing from the health factors data; these Veterans were then incorporated into the current smoking subgroup, bringing the total number of Veterans with former (n = 520) and current (n = 1424) smoking statuses to 1944.

Across all HEVs in the sample (N = 2933; see Table 1), the average age was 53.40 years (SD = 13.68; range: 22-92). The sample was predominantly male (89.7%) and approximately half were Black and African American (50.4%). On average, HEVs engaged in 5.08 (SD = 6.89) primary care visits pre-housing and 4.37 (SD = 5.96) visits post-housing. The most prevalent mental health and substance use diagnoses were depressive disorders (n = 1034, 35.3%), PTSD (n = 859, 29.3%) and alcohol use disorder (n = 877, 29.9%). HEVs identified as currently smoking made up approximately half of the cohort (48.6%) and 17.7% formerly smoked.

Smoking status comparisons

When compared to non/never smoking HEVs in the sample, women had 0.34 lower odds than men of being classified as formerly smoking ($P < .001$), and 0.32 lower odds of currently smoking status ($P < .001$). HEVs who identified as Mixed/Other Race had 0.50 lower odds of being a current smoker compared with White Veterans ($P < .01$). Service-connected disability upon PSH move-in (42.7%) was associated with reduced odds of former ($P = .03$) and current ($P = .01$) smoking status compared to non/never smoking status. Those who were primary care empaneled were 2.18 times as likely to formerly smoke ($P < .001$) and 2.89 times as likely to currently smoke ($P < .001$) compared to non-tobacco users. Additionally formerly and currently smoking HEVs had significantly more primary care engagement, indicating they had higher numbers of primary care visits, compared to non/never smoking HEVS

Table 1. Characteristics and health outcomes/service utilization of HEVs housed in PSH, by tobacco smoking status (n=2933).

PREDISPOSING, ENABLING & NEED CHARACTERISTICS	TOTAL, N=2933		SMOKING STATUS					
			NON/NEVER, N=414 (14%)		FORMER, N=520 (18%)		CURRENT, N=1424 (49%)	
	N	%	N	%	N	%	N	%
Predisposing characteristics								
Demographics								
Age (mean ± SD)	(53.40 ± 13.68)		(49.90 ± 15.31)		(54.98 ± 14.15)		(53.41 ± 12.57)	
Gender								
Men	2630	89.67	327	78.99	477	91.73	1312	92.13
Women	303	10.33	87	21.01	43	8.27	112	7.87
Race and ethnicity								
African American or Black	1388	50.36	190	50.26	240	49.38	693	51.49
Hispanic or Latino	330	11.97	43	11.38	66	13.58	142	10.55
Other or mixed race	123	4.46	25	6.61	24	4.94	48	3.57
White, non-Hispanic	915	33.2	120	31.75	156	32.1	463	34.4
Marital status								
Married	368	12.62	53	12.6	67	12.98	178	12.56
Not married[a]	2547	87.38	356	87.04	449	87.02	1237	87.44
Enabling characteristics								
Service connectedness, primary care, and cessation clinic referrals								
Service-connected status upon PSH entry	1252	42.73	108	50.24	223	42.88	608	42.73
Primary care empanelment upon PSH entry	1443	49.2	118	28.5	242	46.54	763	53.58
Primary care visits pre-PSH (mean ± SD)	(5.08 ± 6.89)		(4.35 ± 5.77)		(6.80 ± 7.36)		(6.66 ± 7.39)	
Primary care visits post-PSH (mean ± SD)	(4.37 ± 5.96)		(3.55 ± 4.91)		(5.10 ± 6.22)		(4.57 ± 5.72)	
Cessation clinic referral pre-PSH	235	8.01	0	0	25	4.81	207	14.54
Cessation clinic referral post-PSH	141	4.81	0	0	7	1.35	131	9.20
Need characteristics								
Substance use, mental health, and physical health diagnoses								
Alcohol use	877	29.9	67	16.18	157	30.19	561	39.40
Other drug use	725	24.72	39	9.42	134	25.77	487	34.2
Cannabis use	448	15.27	40	9.66	70	13.46	303	21.28
Schizophrenia and psychotic disorders	364	12.41	32	7.73	69	13.27	208	14.61
Bipolar disorder	217	7.40	22	5.31	34	6.54	134	9.41
Post traumatic stress disorder	859	29.29	100	24.15	165	31.73	493	34.62
Depressive disorders	1034	35.25	114	27.54	205	39.42	589	41.36
Anxiety disorders	560	19.09	86	20.77	108	20.77	299	21.00
Elixhauser comorbidity score (mean ± SD)	(2.09 ± 2.26)		(1.40 ± 1.88)		(2.32 ± 2.41)		(2.23 ± 2.31)	

(Continued)

Table 1. (Continued)

PREDISPOSING, ENABLING & NEED CHARACTERISTICS	TOTAL, N = 2933		SMOKING STATUS					
			NON/NEVER, N = 414 (14%)		FORMER, N = 520 (18%)		CURRENT, N = 1424 (49%)	
	N	%	N	%	N	%	N	%
Cessation treatment utilization pre-PSH								
Cessation counseling	143	7.36	0	0	18	3.46	125	8.78
Medication-assisted therapy	260	16.83	0	0	47	38.84	213	14.96
Nicotine replacement therapy	348	22.52	0	0	51	42.15	297	20.86
Cessation treatment utilization post-PSH								
Cessation counseling	106	5.45	0	0	8	1.54	98	6.88
Medication-assisted therapy	253	16.38	0	0	51	42.15	202	14.19
Nicotine replacement therapy	283	18.32	0	0	20	16.53	26	18.47

Abbreviation: PSH, permanent supportive housing.
[a]Not married = never married, separated, divorced, widowed.

($P < .001$). For every 1-point increase in the Elixhauser comorbidity score, there was a 1.25 increase in the odds of former smoking status ($P < .001$) and a 1.23 increase in the odds of current smoking status ($P < .001$). Nearly all mental health and substance use diagnoses were associated with a greater likelihood of former and current smoking status (see Table 2).

Table 2 presents results from multinomial logistic regression models comparing predisposing, enabling, and need characteristics across smoking status subgroups, with non/never smoking Veterans serving as the reference group. All variables significant at the $P \leqslant .05$ level are indicated in bold.

Cessation treatment utilization

Across HEVs identified as currently or formerly smoking (n = 1944), 28% (n = 562) utilized any cessation treatment pre-housing while 24% used any cessation treatment post-housing (n = 482). Across treatment types, there was significantly less use of NRT, cessation medications, and counseling post-housing; all comparisons were statistically significant at the $P < .001$ level (see Table 3).

Univariate findings
Pre-housing

In univariable models (Table 4), being primary care empaneled and having service-connected disability compensation increased HEVs' likelihood of using cessation treatments, pre-housing. For every additional visit with a primary care provider there was a 1.07 increase in the odds of using cessation treatments prior to housing entry ($P < .001$). The strongest predictor of utilizing cessation treatments prior to being housed was a referral to the cessation clinic—the odds of

utilizing cessation treatments were 7.30 times greater for those with a cessation clinic referral compared to those without a referral. All physical health, mental health, and substance use diagnoses, except for schizophrenia and other psychotic spectrum disorders, were associated with increased odds of smoking cessation treatment use in the year prior to housing entry.

Post-housing

In the year following PSH entry, age was associated with cessation treatment utilization; for every 1-year increase in age, there were 1.02 greater odds of using cessation treatment post-housing. Each additional visit with a primary care provider was associated with a 1.22 increase in the odds of cessation treatment use ($P < .001$) and a referral to the cessation clinic increased the odds of utilizing cessation treatments by 6.28 in post-housing univariate analyses ($P < .001$). Like the pre-housing correlates, most mental health, substance use, and physical health diagnoses were positively associated with cessation treatment use, except for schizophrenia and other psychotic spectrum disorders. Of note, though cannabis use disorder, primary care empanelment, and service-connected disability compensation were significant predictors of cessation treatment use pre-housing, they were not significant in post-housing analyses.

Multivariate findings
In multivariable models (Table 5), primary care engagement and cessation clinic referrals significantly predicted cessation treatment use in both pre- and post-housing models. Specifically, for each additional visit to a primary care provider there was a 1.19 increase in the odds of using cessation treatment pre-housing ($P < .001$) and a 1.09 increase in the odds post-housing ($P < .001$). Having a referral to the cessation

Table 2. Comparisons of predisposing, enabling, and need characteristics across smoking status subgroups.

NON/NEVER SMOKING (REFERENCE) (N=414)	FORMERLY SMOKING (N=520)			CURRENTLY SMOKING (N=1424)		
	ODD RATIO (OR)	P VALUE (P>Z)	95% CONFIDENCE INTERVAL (CI)	ODD RATIO (OR)	P VALUE (P>Z)	95% CONFIDENCE INTERVAL (CI)
Predisposing characteristics						
Demographics						
Age	**1.03**	**<.001**	**1.02** **1.04**	**1.02**	**<.001**	**1.01** **1.03**
Women	**0.34**	**<.001**	**0.23** **0.50**	**0.32**	**<.001**	**0.24** **0.44**
Race and ethnicity						
White, Non-Hispanic (Reference)						
African American/Black	0.97	.85	0.72 1.32	0.95	.67	0.73 1.22
Latino/Hispanic	1.18	.47	0.75 1.86	0.86	.44	0.58 1.27
Other/Mixed	0.74	.33	0.40 1.36	**0.50**	**<.01**	**0.29** **0.84**
Married	1.00	.99	0.68 1.47	0.96	.83	0.69 1.34
Enabling characteristics						
Service connectedness and primary care						
Service-connected status	**0.74**	**.03**	**0.70** **0.96**	**0.74**	**<.01**	**0.90** **0.92**
Primary care empanelment	**2.18**	**<.001**	**1.65** **2.87**	**2.89**	**<.001**	**2.28** **3.67**
Primary care engagement pre-PSH	**1.11**	**<.001**	**1.08** **1.16**	**1.12**	**<.001**	**1.08** **1.15**
Primary care engagement post-PSH	**1.09**	**<.001**	**1.05** **1.14**	**1.06**	**<.001**	**1.03** **1.10**
Need characteristics						
Substance use, mental health and physical health diagnoses						
Alcohol use	**2.24**	**<.001**	**1.62** **3.09**	**3.37**	**<.001**	**2.54** **4.46**
Cannabis use	1.45	.08	0.96 2.20	**2.53**	**<.001**	**1.78** **3.56**
Other drug use	**3.33**	**<.001**	**2.27** **4.90**	**4.99**	**<.001**	**3.53** **7.07**
Schizophrenia and psychotic disorders	**1.82**	**<.01**	**1.18** **2.84**	**2.04**	**<.001**	**1.38** **3.01**
Bipolar disorder	1.25	.43	0.72 2.17	**1.85**	**<.01**	**1.16** **2.94**
Post traumatic stress disorder	**1.46**	**.011**	**1.09** **1.95**	**1.66**	**<.001**	**1.29** **2.13**
Depressive disorders	**1.71**	**<.001**	**1.30** **2.26**	**1.85**	**<.001**	**1.46** **2.36**
Anxiety disorders	0.99	.99	0.73 1.37	1.01	0.92	0.77 1.32
Elixhauser comorbidity score	**1.25**	**<.001**	**1.16** **1.34**	**1.23**	**<.001**	**1.16** **1.31**

clinic was associated with 48.14 greater odds of using cessation treatments pre-housing (*P*< .001), and 56.23 greater odds post-housing (*P*< .001).

We examined each substance use and mental health diagnoses individually (ie, without other substance use or mental health diagnoses) in multivariable models to test for possible multicollinearity. In each of these multivariable models, the mental health or substance use diagnostic variable was no longer significant and primary care visits and cessation clinic referrals remained statistically significant.

Table 3. Results from Chi-square comparisons of tobacco cessation treatment use among Homeless-Experienced Veterans, pre- and post-housing entry.

TOBACCO CESSATION TREATMENT UTILIZATION	PRE-PSH (N = 562)		POST-PSH (N = 482)		χ²	P VALUE
	N	%	N	%		
Cessation clinic referral	234	8.01	141	4.81	**85.14**	**<.001**
Cessation counseling	143	7.36	106	5.45	**227.49**	**<.001**
Cessation medications	260	16.83	253	16.38	**264.04**	**<.001**
Nicotine replacement therapy	348	22.52	283	18.32	**90.01**	**<.001**
Any cessation service use	562	100.00	482	100.00	**145.48**	**<.001**

All variables significant at the $P \leqslant .05$ level are indicated in bold.

Table 4. Results from univariate tests examining predictors of tobacco cessation treatment utilization among formerly and currently smoking Homeless Experienced Veterans, 1 year pre- and post-housing entry.

PREDICTORS OF TREATMENT UTILIZATION	CESSATION TREATMENT USE PRE-HOUSING				CESSATION TREATMENT USE POST-HOUSING			
	ODD RATIO (OR)	P VALUE (P > Z)	95% CONFIDENCE INTERVAL (CI)		ODD RATIO (OR)	P VALUE (P > Z)	95% CONFIDENCE INTERVAL (CI)	
Predisposing characteristics								
Demographics								
Age	1.01	.12	0.99	1.01	**1.02**	**<.01**	**1.01**	**1.04**
Women	0.91	.632	0.62	1.34	0.42	.06	0.17	1.04
Race and ethnicity								
White, non-Hispanic (Reference)								
African American or Black	0.88	.27	0.7	1.11	0.86	.49	0.55	1.33
Hispanic or Latino	1.10	.61	0.76	1.58	1.08	.81	0.58	2.03
Other or mixed race	0.81	.48	0.45	1.46	0.41	.22	0.10	1.7
Married	0.56	.07	0.30	1.05	0.89	.71	0.48	1.64
Enabling characteristics								
Primary care, service connectedness, and cessation clinic referrals								
Service-connected disability[a]	**1.40**	**<.01**	**1.14**	**1.73**	1.11	.34	0.89	1.38
PACT empanelment[a]	**1.60**	**<.01**	**1.13**	**2.24**	1.19	.12	0.95	1.47
Primary care engagement *Pre-Housing*[b]	**1.07**	**<.001**	**1.05**	**1.09**				
Cessation clinic referral *Pre-Housing*[b]	**7.30**	**<.001**	**5.28**	**10.09**				
Primary care engagement *Post-Housing*[c]					**1.22**	**<.001**	**1.17**	**1.30**
Cessation clinic referral *Post-Housing*[c]					**6.28**	**<.001**	**4.26**	**9.25**

(Continued)

Table 4. (Continued)

PREDICTORS OF TREATMENT UTILIZATION	CESSATION TREATMENT USE PRE-HOUSING			CESSATION TREATMENT USE POST-HOUSING		
	ODD RATIO (OR)	P VALUE (P>Z)	95% CONFIDENCE INTERVAL (CI)		ODD RATIO (OR)	P VALUE (P>Z)	95% CONFIDENCE INTERVAL (CI)	
Need characteristics									
Substance use, mental health and physical health diagnoses									
Alcohol use	**2.71**	**<.001**	**2.19**	**3.35**	**1.49**	**<.001**	**1.20**	**1.86**
Cannabis use	**1.36**	**0.02**	**1.06**	**1.74**	1.19	.19	0.92	1.58
Other substance use	**2.44**	**<.001**	**1.96**	**3.03**	**1.57**	**<.001**	**1.26**	**1.96**
Schizophrenia spectrum disorders	1.23	.16	0.92	1.64	1.18	.27	0.87	1.59
Bipolar disorder	**1.48**	**.03**	**1.05**	**2.08**	**1.45**	**.04**	**1.02**	**2.06**
Post traumatic stress disorder	**2.27**	**<.001**	**1.83**	**2.81**	**1.59**	**<.001**	**1.27**	**1.97**
Depression disorders	**2.48**	**<.001**	**2.29**	**3.52**	**1.81**	**<.001**	**1.46**	**2.26**
Anxiety disorders	**1.78**	**<.001**	**1.39**	**2.27**	**1.41**	**<.01**	**1.10**	**1.81**
Elixhauser comorbidity score	**1.16**	**<.001**	**1.12**	**1.21**	**1.11**	**<.001**	**1.06**	**1.16**

Abbreviation: PSH, permanent supportive housing.
[a]Assessed at time of move-in to PSH.
[b]Predictor assessed in the year prior to entry into PSH, used to predict pre-housing cessation treatment utilization.
[c]Predictor assessed in the year post-entry into PSH, used to predict post-housing cessation treatment utilization.
All variables significant at the $P \leqslant .05$ level are indicated in bold and were retained for multivariate analyses.

Table 5. Results from multivariate tests examining predictors of tobacco cessation treatment utilization among formerly and currently smoking Homeless Experienced Veterans, 1 year pre- and post-housing entry.

PREDICTORS OF TREATMENT UTILIZATION	CESSATION TREATMENT USE PRE-HOUSING				CESSATION TREATMENT USE POST-HOUSING			
	ODD RATIO (OR)	P VALUE (P>Z)	95% CONFIDENCE INTERVAL (CI)		ODD RATIO (OR)	P VALUE (P>Z)	95% CONFIDENCE INTERVAL (CI)	
Predisposing characteristics								
Demographics								
Age	1.01	.55	0.98	1.03	1.00	.53	0.98	1.04
Women	0.91	.63	0.62	1.34	0.42	.06	0.17	1.04
Race and ethnicity								
White, Non-Hispanic (Reference)								
African American or Black	0.99	.97	0.61	1.61	0.81	.47	0.46	1.43
Hispanic or Latino	1.38	.40	0.64	2.96	1.67	.20	0.76	3.68
Other or mixed race	0.39	.19	0.10	1.59	0.38	.27	0.07	2.18
Married	0.46	.05	0.21	1.01	0.69	.37	0.31	1.55
Enabling characteristics								
Primary care, service connectedness, and cessation clinic referrals								
Service-connected disability[a]	1.45	.11	0.92	2.31				
PACT Empanelment[a]	1.23	.86	0.76	1.98				

(Continued)

Table 5. (Continued)

PREDICTORS OF TREATMENT UTILIZATION	CESSATION TREATMENT USE PRE-HOUSING			CESSATION TREATMENT USE POST-HOUSING		
	ODD RATIO (OR)	P VALUE (P > Z)	95% CONFIDENCE INTERVAL (CI)		ODD RATIO (OR)	P VALUE (P > Z)	95% CONFIDENCE INTERVAL (CI)	
Primary care engagement *Pre-Housing*[b]	**1.19**	**<.001**	**1.11**	**1.29**				
Cessation clinic referral *Pre-Housing*[b]	**48.14**	**<.001**	**30.17**	**76.80**				
Primary care engagement *Post-Housing*[c]					**1.09**	**<.001**	**1.01**	**1.18**
Cessation clinic referral *Post-Housing*[c]					**56.23**	**<.001**	**33.31**	**94.92**
Need characteristics								
Substance use, mental health, and physical health diagnoses								
Alcohol use	0.98	.94	0.57	1.69	0.69	.25	0.36	1.30
Cannabis use	0.80	.02	0.46	1.40				
Other drug use	1.13	.65	0.66	1.94	1.05	.87	0.55	2.03
Bipolar disorder	1.03	.93	0.51	2.08	1.45	.32	0.69	3.06
Post traumatic stress disorder	0.86	.57	0.53	1.41	1.69	.07	0.96	2.97
Depression disorders	1.44	.14	0.89	2.34	1.42	.23	0.80	2.55
Anxiety disorders	0.79	.41	0.47	1.36	0.84	.58	0.44	1.58
Elixhauser comorbidity score	0.95	.39	0.85	1.06	1.14	.02	1.02	1.26

Abbreviation: PSH, permanent supportive housing.
All variables included were significant at the $P \leqslant .05$ level in univariable models were included in multivariable models presented in Table 5, with the exception of predisposing demographic characteristics, which were retained as controls in multivariate analyses regardless of their significance in univariate tests. All significant findings are indicated in bold.
[a]Assessed at time of move-in to PSH.
[b]Predictor assessed in the year prior to entry into PSH, used to predict pre-housing cessation treatment utilization.
[c]Predictor assessed in the year post-entry into PSH, used to predict post-housing cessation treatment utilization.

Discussion

To our knowledge, the present study is the first to examine cessation treatment utilization pre- and post-housing among homeless-experienced tobacco users in PSH. Our results suggest that, among HEVs housed through HUD-VASH, there are high smoking rates, with nearly 70% of the sample identified as currently or formerly smoking. Despite this prevalence, we found low use of cessation treatments during the pre- and post-housing periods assessed. Moreover, a smaller proportion of HEVs in this sample used cessation treatments post-housing, across all treatment types. We identified higher clinical needs among HEVs who currently or formerly smoke compared to those without tobacco use histories, and found most substance use, mental health, and physical health diagnoses to be significant positive predictors of cessation treatment use in univariate analyses. We also found enabling characteristics trended as positive correlates of cessation treatment use pre-housing, while only primary care engagement and cessation clinic referrals predicted use post-housing; the 2 factors that proved to be key predictors of cessation treatment use in our final models.

Our findings indicate that among currently and formerly smoking HEVs housed through HUD-VASH, there is a greater prevalence of substance use, mental health, and physical health diagnoses compared to non/never smoking HEVs. Additionally, HEVs identified as currently and formerly smoking are more likely to be older, men, primary care empaneled, and utilize primary care at higher rates, and are less likely to have service-connected disability benefits. These findings are consistent with prior work demonstrating higher rates of morbidity and poor mental health among persons who smoke tobacco—characteristics that likely facilitate more engagement with the VA healthcare system, and thus ideally generate more opportunities to deliver and access smoking cessation treatments.[24,25]

We found lower rates of cessation treatment use post-PSH entry compared to pre-PSH. Though surprising, as PSH can reduce access barriers, which may facilitate more healthcare engagement, our findings align with previous work that found less use of routine, non-acute health services in the year post-PSH entry.[26] Lower rates of non-acute health service use post-housing is a notable concern—particularly during transitions

to PSH—given the chronicity of HEVs' health conditions that likely necessitate routine care, and the resultant limitations it may have on their utilization of cessation treatments. The few studies that have examined smoking behavior pre-housing (ie, while homeless) and post-housing have indicated smoking rates are largely maintained in PSH,[14,27] further echoing homeless-experienced persons' ongoing critical need for cessation care beyond housing entry.

Overall, we identified few distinctions between characteristics associated with cessation treatment utilization pre-housing versus post-housing. This likely demonstrates the ongoing health and social impediments to successful cessation that remain after HEVs transition to PSH, that housing alone cannot address. While primary care empanelment and service-connected disability may be critical enabling characteristics for cessation treatment use pre-housing, these may become less important for facilitating utilization post-PSH entry, as basic needs are increasingly met and the extent to which HEVs engage in primary care becomes the prevailing factor for using cessation treatments.

As key predictors of cessation treatment use, our findings speak to the importance of primary care services and cessation clinic referrals in promoting cessation treatment use for HEVs. Within the VA, as screenings for tobacco use are repeated the likelihoods of prescriptions for cessation pharmacotherapies and cessation clinic referrals have been found to also increase.[12] More frequent routine tobacco screenings,[28] and the likelihood of strong continuity and quality of care that accompanies increased primary care engagement, can break down mistrust, expand cessation motivation, and increase use of other health services.[29]

For providers serving homeless-experienced populations—who commonly present with multimorbid conditions—tobacco cessation often becomes secondary to their acute health needs[30-32]; the burden placed on providers to respond to multiple needs in short visit timeframes is an identified hindrance to provisioning cessation treatments for this population. This barrier has also been central to providers' voiced desires to be equipped to provide brief cessation interventions tailored to homeless-experienced persons, or to have external resources and providers to refer to, for ensuring this population receives the cessation care they greatly need. Enhancing engagement in primary care, including through HUD-VASH case manager linkages, increasing tobacco screenings across other types of providers, and improving care coordination may be valuable for distributing cessation efforts across the array of providers they engage with.

Limitations

Our study comes with limitations, including that these are administrative data which introduces bias and challenges in data quality control. These data also draw solely from Veterans served by the Greater Los Angeles VA; data from other facilities may yield alternative results. The algorithm for determining smoking status is validated for use with VA's electronic health record and has been used in other studies of tobacco use among VA users[15,16]; however, we lacked resources to use manual extraction methods to validate this algorithm in the context of this study. The smoking status algorithm also results in a portion (~20%) of Veterans whose smoking statuses cannot be determined; we do note that this study's unknown proportion is aligned with other studies using this algorithm.[17,18] As the algorithm relies on health factors data derived from clinical encounters, Veterans whose smoking statuses were unclassified are likely less frequent users of VA care, and perhaps reflect a healthier subpopulation of Veterans. We lacked some important data across predisposing, enabling, and need characteristics, including income, other forms of social support, and competing needs. Our data also did not capture brief tobacco cessation counseling within primary care and mental health visits; findings from this work highlight the importance of a comprehensive examination of the role brief cessation counseling plays in HEVs' cessation treatment use in future research. Last, our pharmacotherapy variables represent prescriptions for NRT and cessation medications and we lacked relevant details about cessation treatment utilization (eg, length of treatment use, adherence to treatment) that would have enabled an examination of within-person change pre- to post-housing.

Conclusion

Findings from this work highlight the critical need for improving smoking cessation efforts within homeless-experienced persons' care, including by tailoring cessation services and implementation strategies to this population, to enhance their adoption of cessation treatments. Despite HEVs' unique positioning for cessation resources and VA providers' ability to refer to a cessation clinic within an embedded healthcare system, we found strikingly low uptake of cessation treatments within the sample. This further supports the need for specialty cessation services that are highly accessible, integrated within homeless services and PSH settings, and are considerate of predisposing, enabling, and need characteristics that impede homeless-experienced persons' cessation. For HEVs in HUD-VASH, efforts to inform providers, across specialties, about the population's desire to quit, as well as the value of linkages to primary care and cessation clinics are warranted. Addressing homeless-experienced persons' preferences for tobacco cessation treatment, competing needs, and improving cessation services to enhance their cessation treatment use carries the opportunity to drastically improve their cessation outcomes and reduce their health disparities.

Author Contributions

TH designed and directed the project, performed statistical tests, interpreted results, and drafted and led writing and revisions of

the manuscript, with input from all authors. TP performed data cleaning and management, and contributed to manuscript writing. LH performed data cleaning and statistical tests, and helped write the manuscript. AEM, JT, and LG contributed to the project's conceptualization, and provided mentorship and feedback on manuscript drafts. SG supervised the project and mentored the lead author, contributed to conceptualization and interpretation, and supported manuscript development and refinement. All authors provided critical feedback and helped shape the research, analysis, and final manuscript.

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