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Healthcare service utilization for formerly homeless Veterans in permanent supportive housing: do neighborhoods matter?

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Abstract

Neighborhood characteristics are associated with residents' healthcare use. However, we understand less about these relationships among formerly homeless persons, who often have complex healthcare needs, including mental health and substance use disorders. Among formerly homeless Veterans, we examined: 1) how neighborhood characteristics are associated with Veteran Health Administration (VHA) healthcare use and, 2) if these relationships varied by Veterans' level of healthcare need. We obtained data on our cohort of 711 Veterans housed through VHA's permanent supportive housing program (HUD-VASH) in 2016–2017 from VHA's Homeless Registry, VHA's electronic health records and the U.S. Census. We studied the relationships between neighborhood characteristics (% Veteran, % in poverty, % unemployed, % using public transportation, and % vacant properties) and VA healthcare use (primary care visits, outpatient mental health visits, and "high use" of emergency departments [>4 visits]) using mixed-effects logistic and negative binomial regression models, controlling for patient demographics. We further

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examined moderation by patient healthcare need (calculated from cost and clinical data). We found that veterans in neighborhoods with higher percentages of residents who a) were Veterans or b) used public transportation were more likely to have high emergency department use. Those in neighborhoods with higher public transportation use had more primary care visits while those in neighborhoods with more property vacancies had more outpatient mental health visits. Among those with high healthcare needs, residents of areas with more Veterans had higher emergency department use. Promoting public transportation use and social engagement with other Veterans in residential neighborhoods may influence HUD-VASH Veterans' VA healthcare use.

Keywords

Veterans; permanent supportive housing; healthcare need; neighborhoods

Introduction

Research in the general population suggests that residential neighborhood characteristics can influence healthcare utilization independent of residents' own characteristics (Bender, Kawachi, Jorgensen, & Pisinger, 2015; Derose & Varda, 2009; Haley et al., 2017; Hussein, Diez Roux, & Field, 2016; Kim & Kawachi, 2017; Kirby & Kaneda, 2005; Prentice, 2006; Rust et al., 2008; Syed, Gerber, & Sharp, 2013; Willems et al., 2013). For example, residents of lower socioeconomic status neighborhoods have a lower likelihood of having a usual source of care or using of preventive healthcare, but have higher emergency department use, even after accounting for their own socioeconomic status (Bender et al., 2015; Hussein et al., 2016; Kirby & Kaneda, 2005; Willems et al., 2013). Physical aspects of neighborhoods, such as public transportation availability, can affect whether residents can easily access routine primary healthcare, whereas transportation can lead to more emergency department use, or unmet medical needs (Haley et al., 2017; Rust et al., 2008; Syed et al., 2013). Neighborhoods' social environment, including their sociodemographic composition, social cohesion, social connection, and social support, can influence residents' healthcare-seeking behaviors, through social norms, information exchange, and "functional support" (e.g., neighbors providing rides to medical appointments) (Derose & Varda, 2009; Kim & Kawachi, 2017; Prentice, 2006).

For Veterans, living among other Veterans may be an important aspect of their social environments. Veterans trust and rely on each other for social support in part because of their shared "band of brothers" military experiences (Drebing et al., 2018; Laffaye, Cavella, Drescher, & Rosen, 2008; Oh & Rufener, 2017). Living in communities with more Veterans might increase opportunities for Veterans to interact with each other to form important social connections and provide "functional" support that facilitates healthcare access (e.g., sharing rides to medical appointments) (Prentice, 2006). For example, Veterans value opportunities to interact with other Veterans in their community, such as community-based peer support groups held in local coffee shops (Gorman, Scoglio, Smolinsky, Russo, & Drebing, 2018).

Formerly homeless individuals have high rates of mental health and substance use disorders (Lebrun-Harris et al., 2013), so they might be more susceptible to poor neighborhood

conditions (e.g., mental health stressors, neighbors using drugs) than other people (Alegría, NeMoyer, Falgàs Bagué, Wang, & Alvarez, 2018; Dickson-Gomez et al., 2017). However, little research has been conducted on how neighborhoods might relate to formerly homeless individuals' health and healthcare use (Dickson-Gomez, McAuliffe, Obidoa, Quinn, & Weeks, 2016; Henwood, Cabassa, Craig, & Padgett, 2013). The dominant housing model for homeless persons is permanent supportive housing (Dickson-Gomez et al., 2017), which offers permanent and affordable housing and links individuals to healthcare and supportive services, but does not require use of these services or sobriety for housing (Dickson-Gomez et al., 2017). The most common type of supportive housing is scattered-site housing where individuals receive rental assistance subsidies to rent housing in the community (Office of the Assistant Secretary for Planning and Evaluation), and typically clusters in high poverty, predominately minority neighborhoods with fewer primary care providers (Dickson-Gomez et al., 2016; Patterson, Nochajski, & Wu, 2014).

The Veterans Health Administration (VHA) has a large, established permanent supportive housing program called the Department of Housing and Urban Development-Veterans Affairs Supportive Housing (HUD-VASH). HUD-VASH is the lynchpin of the VA's strategic plan to end Veteran homelessness (U.S. Department of Housing and Urban Development, 2013) and provides homeless Veterans with subsidized housing and field-based case management. HUD-VASH is unique because it offers residents full access to VA's healthcare system, which may reduce barriers to care (Gaskin, Dinwiddie, Chan, & McCleary, 2012; Lovasi, Hutson, Guerra, & Neckerman, 2009). Examining how neighborhoods could affect Veterans in HUD-VASH might inform how permanent supportive housing programs can support the healthcare needs of vulnerable populations, particularly those with high prevalence of mental health and substance use disorders. In fact, nearly 80% of homeless Veterans have either mental health or substance use disorders (Ding, Slate, & Yang, 2018). Adequate mental healthcare is especially important for this population because mental health and substance use issues commonly prevent Veterans from remaining stably housed in HUD-VASH (Cusack & Montgomery, 2018). Primary care and supportive services are also important for this population, as use of these services is associated with lower rates of eviction from HUD-VASH housing (Montgomery, Cusack, Szymkowiak, Fargo, & O'Toole, 2017).

Not only are neighborhood characteristics related to residents' health and healthcare, those relationships can vary for each individual, depending on their characteristics (Barber, Hickson, Kawachi, Subramanian, & Earls, 2016; Boylan & Robert, 2017; Lisabeth, Diez Roux, Escobar, Smith, & Morgenstern, 2007; Lovasi et al., 2009; Wong et al., 2018). One such potentially important moderating characteristic of formerly homeless persons is whether they have high healthcare needs. Homeless-experienced persons, especially Veterans, usually have numerous physical and mental health conditions (Bowen et al., 2019; Schanzer, Dominguez, Shrout, & Caton, 2007; Weber, Lee, & Martsolf, 2017). Having these complex, multimorbid conditions can potentially strongly influence their healthcare use regardless of where they live, such that neighborhood characteristics might have little effect on their healthcare use. Conversely, others with fewer healthcare needs might be more influenced by neighborhood conditions. Despite studies showing that several characteristics of individuals (e.g., age, sex, and individual socioeconomic status) moderate

the relationships between neighborhoods and health outcome and healthcare use, no study has examined moderators among formerly homeless individuals (either Veteran or non-Veterans).

Within a cohort of HUD-VASH-housed Veterans, we addressed these gaps by addressing two questions: 1) whether Veterans' residential neighborhood characteristics were associated with their VA healthcare utilization and 2) whether their level of healthcare needs moderated these relationships. We hypothesized that Veterans living in neighborhoods with more Veterans, higher average socioeconomic status, and more public transportation use would use the emergency department less and use primary and outpatient mental healthcare more. We further hypothesized that these neighborhood-healthcare utilization relationships would be weaker in patients with high health needs.

Formerly homeless Veterans are among the most vulnerable and highest utilizers within VA's healthcare system. VA has an interest in understanding how to provide care to these patients, while also promoting appropriate healthcare use (e.g., reducing emergency department use for conditions that can be managed in primary care). Moreover, supportive housing can potentially reduce formerly homeless individuals' overall healthcare expenditure by redirecting care from more costly to less costly settings while improving quality and access (Wright, Vartanian, Li, Royal, & Matson, 2016). Additionally, promoting access to primary and mental healthcare can also help to prevent use of high cost services (Starfield, Shi, & Macinko, 2005). Examining individual and neighborhood level risk factors for high utilization can inform how VA and HUD-VASH address the healthcare needs of this high-cost and vulnerable population. This may include future HUD-VASH program planning, broader VA healthcare service allocation and delivery, and plans for other permanent supportive housing programs.

Methods

We conducted a multi-level, observational study among formerly homeless Veterans who attained housing through the VA Greater Los Angeles's HUD-VASH program (the largest such program in the nation). The VA Greater Los Angeles Institutional Review Board approved this study.

Conceptual model.

We used the Socioecological Model, which emphasizes that multiple levels of society influence health and health behaviors, and focused on the individual level (our outcome) and neighborhood levels (our independent variables) (Bronfenbrenner, 1994). At the neighborhood level, we examined 1): social (Veteran composition), 2) socioeconomic status (poverty, unemployment, property vacancies, and a socioeconomic status index) and 3) physical (public transportation) environments. We explored both a composite index and separate measures of socioeconomic status, as indices may mask mechanisms of action and individual components driving observed relationships.

Sample and Data.

Our sample consisted of Veterans who moved into HUD-VASH housing between October 2016 to September 2017 (n = 711). Veteran outcomes were observed for 12-months following their individual housing placement date, resulting in different 12-month periods for each Veteran, dependent on their move-in date. We used VHA's homeless registry, which includes all HUD-VASH Veterans, to define our analytic cohort and obtain data on their demographic characteristics, prior episodes of homelessness, and prior HUD-VASH participation. We obtained data on their healthcare use and need from the VA's electronic medical records (EMR). We defined neighborhoods as census tracts and linked Veterans' geocoded residential addresses to U.S. Census data (2011–2015 American Community Survey) and the Center for Disease Control and Prevention (CDC)'s Social Vulnerability Index (SVI).

Variables.

We examined three dependent variables of healthcare use during the year following each individual's HUD-VASH housing placement date: 1) dichotomous "high" use of emergency department/urgent care for all indications, including medical and mental health complaints (>4 admissions/year) (Hunt, Weber, Showstack, Colby, & Callaham, 2006; Kushel, Perry, Bangsberg, Clark, & Moss, 2002; LaCalle & Rabin, 2010), 2) number of primary care visits, and 3) number of outpatient mental healthcare visits (visits for medication management and/or psychotherapy; we excluded intensive outpatient programs such as those for addictive disorders or day treatment programs for serious mental illness. as these patients often have daily treatment, which may lead to very high counts for some patients; and use of intensive programs are more likely to be driven by need rather than contextual factors, such as neighborhood characteristics).

Our main independent variables included five continuous measures of residential neighborhood characteristics from US Census data: 1) percent of residents that were Veterans; 2) percent of residents below poverty level; 3) percent of residents that were unemployed; 4) percent of properties that were vacant; and 5) percent of households that used public transportation (bus or train) to commute to work. To assist in the interpretation of findings, these neighborhood variables were scaled by 10% increments. We also included a neighborhood socioeconomic index, the CDC's Social Vulnerability Index neighborhood socioeconomic index, (Center for Disease Control and Prevention, 2018) which combines percentile ranking from Census measures of poverty, unemployment, income, and population without a high school diploma.

We examined Veterans' level of healthcare needs as an effect-moderating variable, which we defined using their VA "Nosos risk score" (Wagner et al., 2016). This VA measure is calculated from expected VA costs based upon Veterans' clinical profiles and socio-demographic characteristics for risk adjustment to capture health conditions, use of medication, and demographic characteristics. To align our work with previous research (Rosen et al., 2018), we used the Nosos score to create a categorical variable of the level of healthcare need: 0 to <1 (low), 1 to <2 (moderate), and 2+ (high).

We controlled for Veteran demographics (age, gender, race/ethnicity, marital status), whether or not Veterans had children in custody, and homeless duration at HUD-VASH program entry (<1 year or 1+ years, based upon the definition for homeless chronicity of being homeless for 1+ years (Department of Housing and Urban Development, 2015)). We also included a variable indicating whether or not they exited the HUD-VASH program in the same year, because prior HUD-VASH exit in the same year may indicate increased challenges with maintaining stable housing.

Analyses.

We calculated descriptive statistics of means and proportions for all variables of interest, and correlations between individual neighborhood measures. To examine the relationships between neighborhood characteristics and healthcare utilization, we fit multivariate logistic regression mixed-effects model to examine high use of emergency departments and fit negative binomial mixed-effects regression models to examine primary care and mental healthcare visits outcomes, accounting for overdispersion of outcome data. Since individuals clustered within neighborhoods, our mixed effects models included a neighborhood random intercept to account for potential within-neighborhood correlation of study outcomes (Diggle et al., 2002).

To examine whether the level of healthcare need moderated these relationships, we included an interaction term between healthcare need and neighborhood characteristics. We used an F-test to assess if interactions were jointly significant across all three healthcare need levels. If there was evidence of an interaction, we used the margins command to calculate the neighborhood characteristic-healthcare use association stratified by healthcare need level. All adjusted analyses controlled for all covariates described above. We modeled each neighborhood characteristic in separate models due to the high degree of multicollinearity that is typically seen between neighborhood characteristics (see Table 1 for correlations). Statistical significance was assessed at $p<0.05$. All analyses were conducted in Stata 15.1. (StataCorp LLC)

Results

Sample characteristics.

Among 711 formerly homeless Veterans, approximately 90% of the sample was male, nearly half were non-Hispanic Black, more than half had previously been married, and their mean age was 53 years (Table 2). Nearly two-thirds had been chronically homeless, but only 8% had a prior HUD-VASH exit in the same fiscal year. In the neighborhoods where the sample resided, on average 6% of residents were Veterans, 12% were unemployed, and 17% of households used public transportation. Approximately 40% of the sample had high healthcare need. Neighborhood characteristics were correlated (Table 1).

Relationships between neighborhood characteristics and healthcare use.

As shown in the adjusted associations in Table 3, for each 10% increase in the proportion of households using public transportation and of residents who were Veterans, HUD-VASH Veterans' odds of being an emergency department-high utilizer increased by 25% and 13%,

respectively. Regarding primary care use, for each 10% increase in households using public transportation, HUD-VASH Veterans' expected number of visits increased by 3%. Finally, for each 10% increase in property vacancies in the neighborhood, HUD-VASH Veterans' expected number of outpatient mental healthcare visits increased by 25%. The following neighborhood characteristics were not associated with emergency department, primary care, or outpatient mental health use: percent of residents below the poverty line, percent of unemployed residents, and the neighborhood socioeconomic status index.

Moderating Effect of Veterans' Level of Healthcare Needs.

The relationship between Veterans' emergency department use and the proportion of Veteran residents in the neighborhood differed by the HUD-VASH Veterans' level of healthcare need (interaction p-value=0.057). HUD-VASH Veterans with low healthcare need living in neighborhoods with more Veterans were less likely to have high use of emergency departments, while those with high healthcare need were more likely to be high emergency department users (Figure). Veterans' level of healthcare need did not moderate other neighborhood-healthcare use relationships.

Discussion:

In this study of formerly homeless Veterans, we examined whether where they lived was related to their VA healthcare use, and whether their healthcare need moderated these relationships. We found that several aspects of Veterans' neighborhoods, including the percent of residents who were Veterans, households using public transportation, and properties that were vacant, were associated with Veterans' VA emergency, primary and mental healthcare use. We also found Veterans' level of healthcare need mattered for one of those associations.

We found that Veterans in neighborhoods with more Veterans were more likely to have high emergency department use. This finding was unexpected giving existing research that found greater preventive care use among residents living in socially cohesive neighborhoods (Kim & Kawachi, 2017). We do not know, though, the mechanism through which the proportion of Veterans influences social aspects of neighborhoods. It could be that living in neighborhoods with other HUD-VASH Veterans may reinforce norms around using the emergency department for their usual source of care (Gabrielian et al., 2017; Gabrielian, Yuan, Andersen, Rubenstein, & Gelberg, 2014). It is also possible that this measure does not accurately capture the lived experiences for all HUD-VASH Veterans, particularly for scattered-site residents who may not be aware of other Veterans in their neighborhoods, have minimal interactions with these neighbors, or live in different parts of the neighborhood from other Veterans. However, the Greater Los Angeles HUD-VASH program has cultivated relationships with landlords leading frequently to scattered-site placements in buildings or communities with other HUD-VASH-housed Veterans, and HUD-VASH case managers may inform them about their Veteran neighbors, especially those who are in HUD-VASH. However, it is less clear whether Veterans desire to form relationships with other Veterans who were also formerly homeless and in recovery (Chinchilla, Gabrielian, Glasmeier, & Green, 2020), nor did our study distinguish whether other Veterans residents were also

HUD-VASH participants. It is also possible that this population, with a high burden of mental illness (Weber et al., 2017), may prioritize long-standing relationships with family and older, non-Veteran friends over newer relationships with their neighbors. Future research can explore underlying mechanisms through which living among other Veterans may influence HUD-VASH-housed Veterans' healthcare utilization behaviors. Finally, we found differences by the level of Veterans' healthcare need that might explain these unexpected findings, which we discuss in more detail below.

We also found that Veterans living in neighborhoods where residents used more public transportation were more likely to have high emergency department use. This finding differs from research in the general population where transportation barriers, including a lack of public transportation, contributed to more emergency department use (Pheley, 1999) and less primary care use (Henwood et al., 2013). However, since homeless-experienced individuals often use emergency departments as their regular source of care (Gallagher, Andersen, Koegel, & Gelberg, 1997), HUD-VASH Veterans may continue to rely on the emergency department for their primary care needs. Consistent with research in the general population (Henwood et al., 2013), we found greater primary care use among Veterans in neighborhoods where more households used public transportation. Although we did not directly measure transportation quality and accessibility, it is possible that residents used public transportation more when it was more accessible in their neighborhoods, which normalized public transportation use. Taken together, our findings of greater emergency department high utilization and primary care visits in neighborhoods with greater public transportation use might suggest that HUD-VASH-housed Veterans who live in neighborhoods where residents commonly use public transportation may also use public transportation to access healthcare at VA facilities—in both primary care and emergency department settings.

The only neighborhood characteristic in our study associated with individuals' use of mental healthcare was property vacancies. More outpatient mental health visits in this population with a high burden of mental health issues is generally viewed positively, as an indicator of adequate mental healthcare access. It is promising that we found fewer relationships between neighborhood characteristics and mental healthcare use, because this suggests that characteristics of the neighborhood do not seem to impede mental healthcare use. However, its association with living in neighborhoods with more property vacancies may suggest greater mental health need in these neighborhoods. Property vacancies might contribute to mental health stressors through perceptions of increased neighborhood disorder, and promoting neighborhood disorder by providing spaces for illicit activities (Messer, Maxson, & Miranda, 2013; Polling, Khondoker, Hatch, & Hotopf, 2014; Wei, Hipwell, Pardini, Beyers, & Loeber, 2005). More vacant properties may indicate higher resident turnover, which weakens social support (Messer et al., 2013). It is also possible that Veterans with mental illness—and thus greater mental healthcare use—experience challenges in navigating the rental markets, so had fewer rental options, and ended up living in neighborhoods with more property vacancies. Neighborhoods with greater physical and structural inadequacy, which includes have more vacant property and lower property values, tend to have higher concentrations of individuals with serious mental illness (Byrne et al., 2013).

We found that Veterans' level of healthcare need only moderated one neighborhood–healthcare use relationship. Specifically, Veterans living in neighborhoods with more Veterans were more likely to have high use of emergency departments if they had high healthcare need and less likely if they had low healthcare need. One potential explanation for why this relationship might differ by level of healthcare need is that those with high healthcare need are sicker, requiring more emergent care, and their Veteran neighbors help them get to VHA emergency departments for this care. Another potential explanation is that those with high healthcare need might be more likely to live in neighborhoods with other HUD-VASH Veterans, who have fewer resources to help each other while reinforcing norms around frequent emergency department use. These Veterans are often socially complex, with a history of incarceration, fragmented use of care, and social vulnerabilities (Weber et al., 2017), which might limit their housing and neighborhood options. Conversely, Veterans with low healthcare need might be able to find housing in better resource neighborhoods with Veteran neighbors with more resources and who can provide social and functional support (e.g., sharing rides to VA facilities or exchanging knowledge about VA resources) that promotes going to scheduled appointments instead of emergency department care.

HUD-VASH-housed Veterans, who often have more healthcare needs than the general population (Gabrielian et al., 2014), may require more emergent care that warrants emergency department use. While our analysis of differences by healthcare need may serve as a proxy for this, more research is needed to understand whether neighborhood characteristics, including living in neighborhoods with more Veterans and more public transportation use, are associated with emergency department visits for primary care or for true emergent needs. For Veterans in the former group, HUD-VASH can potentially help redirect nonemergent healthcare needs to primary care (e.g., educate Veterans on how to access VA care and encourage social connections between Veteran neighbors to help them come to their scheduled VA appointments).

Limitations.

Our study had several limitations. Cross-sectional data limited our ability to infer causal relationships between the Veterans' residential neighborhood characteristics and their healthcare utilization. There is also a potential for selection-bias in the types of neighborhoods that Veterans choose or can move to. Also, we did not account for differences between project-based and scattered-site housing, or for non-VA care use. However, a previous study conducted in a similar cohort of Veterans using VA's homeless-tailored population-based medical home found high reliance on VA for outpatient and hospital care (Trivedi et al., 2018); we anticipate HUD-VASH Veterans' use of VA care will be similar or higher since HUD-VASH enables VA healthcare utilization and outpatient care for formerly homeless Veterans (Gabrielian et al., 2014). Additionally, our cohort of predominately racial/ethnic minority Veterans may use less non-VA care, as other studies have found that racial/ethnic minority Veterans are more likely than non-Hispanic White Veterans to rely on VA for their care (Gurmankin, Polsky, & Volpp, 2004; Halanych et al., 2006). While we defined neighborhood by census tracts, this might not accurately capture how Veterans experience their neighborhoods. We examined proportion of residents who were Veterans as a single measure of the neighborhood social domain, but more

research is needed to understand the underlying mechanisms through which living among more Veterans influences Veterans' social environment. Additionally, this measure did not capture whether those in our sample actually interacted with other Veterans in their neighborhood, or distinguish between HUD-VASH and non-HUD-VASH Veterans in the neighborhood (Chinchilla et al., 2020). We may have omitted confounding variables (e.g., community integration, military service-connected disability, frequency of HUD-VASH case management). We did not include multiple neighborhood measures in the same model due to correlation between these variable and sample size limitations. We did not control for the diagnosis of specific health conditions that may drive healthcare use, such as mental health conditions (e.g., psychosis or other serious mental illness) or substance use disorder, or the type of multi-morbidity combinations underlying differing levels of healthcare need. Because individuals with mental illness, substance use disorder, or co-occurring disorders may have higher emergency department use (Owens, Mutter, & Stocks, 2010), we may have overestimate the neighborhood-emergency department use association for these individuals, since their emergency department use might be influenced by need rather than neighborhood characteristics. We also did not separate emergency psychiatric visits from other types emergency department visits. Finally, while our findings can be generalizable to urban areas similar to Los Angeles with significant shortage of affordable housing and served a VA Medical Center (e.g., San Francisco), it may be less generalizable to rural areas or areas with more affordable housing options and are not near VA facilities. In these areas, Veterans may have housing options in more neighborhoods, including in neighborhoods that are not restricted to lower-income areas, and other factors (e.g., long distances to VA, limited public transportation use) may be stronger determinants of VA healthcare use. Additionally, our findings may not be generalizable to other homeless Veterans, including formerly homeless Veterans who were not enrolled in HUD-VASH (Veterans who are referred to HUD-VASH typically have more complex needs that require more complex case management), and more vulnerable homeless Veterans who are referred to HUD-VASH but are unable to achieve housing though this program. However, unlike existing studies that have not been able to differentiate between healthcare access and utilization, an important strength of this study is that, since all subjects had health coverage, we could explore how residential context relates specifically to healthcare utilization.

Policy and Practice Implications.

Despite limited affordable housing options in many metropolitan areas, which limits the types of neighborhoods where permanent supportive housing residents can live, HUD-VASH and other permanent supportive housing programs can consider ways to take advantage of neighborhoods' characteristics and resources to promote formerly homeless Veterans' healthcare use. Our study identified three relevant neighborhood characteristics related to healthcare use in this population: the presence of other Veterans in the community, vacant properties in the neighborhood, and public transportation use. HUD-VASH can potentially promote social support and social engagement with other Veterans in the community. For example, social workers and peer support specialists can put HUD-VASH Veterans in touch with other Veterans in their neighborhoods. Although VA provides some transportation services to VA clinics and medical centers, HUD-VASH can supplement this service by educating Veterans on how to use public transportation in their neighborhood

to help Veterans travel to VA for outpatient appointments. While scattered site housing is often limited and concentrated in lower resourced neighborhoods that typically have more property vacancies, HUD-VASH may consider ways to expand housing options, such as through working with local housing authorities to pay landlords more than the Fair Market Rent for housing in communities with greater resources, as has been done in Houston (Montgomery AE, 2017).

Although we conducted our study among HUD-VASH Veterans, our findings may also inform other non-VHA permanent supportive housing programs and healthcare systems. While these programs often have limited options for where they can house residents, they can target specific neighborhoods to provide additional supportive services, outreach, and community partnerships. For example, HUD-VASH Veterans living in neighborhoods with greater property vacancies might benefit from enriched VHA mental health services and outreach. Other health systems are increasingly investing in housing options for high need, unstably housed patients. These ventures are premised on a return-on-investment on cost and healthcare utilization. Housing placement might lead to initial increases in inpatient and outpatient healthcare costs as patients become engaged in healthcare and receive treatment for untreated conditions.

Conclusion

Veterans in the HUD-VASH program are a vulnerable population with complex medical needs, including a high prevalence of mental health and substance use disorders. In considering factors that can influence healthcare utilization, our findings suggest that residential neighborhood characteristics might influence healthcare use. Future research can explore the role of other neighborhood characteristics, particularly from the social environment (e.g., social ties, social capital), on healthcare utilization. More research is also needed to understand the pathways through which the presence of other Veterans in the neighborhood can influence healthcare utilization, particularly for those with high healthcare need. For example, future work can examine whether these pathways differ based on whether or not other Veterans in the neighborhood are also HUD-VASH participants. Understanding the ways that HUD-VASH and other permanent supportive housing programs can harness neighborhood characteristics and resources to support appropriate healthcare utilization, especially access to primary and mental healthcare, is critical.

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Impact statement:

For formerly homeless Veterans housed through HUD-VASH, characteristics of their residential neighborhoods, such as public transportation access, property vacancies, and having a larger proportion of residents who are Veterans, may influence their VA healthcare use. HUD-VASH and other permanent supportive housing programs can potentially harness neighborhood resources to facilitate appropriate healthcare use in this vulnerable population that is often also medically complex.

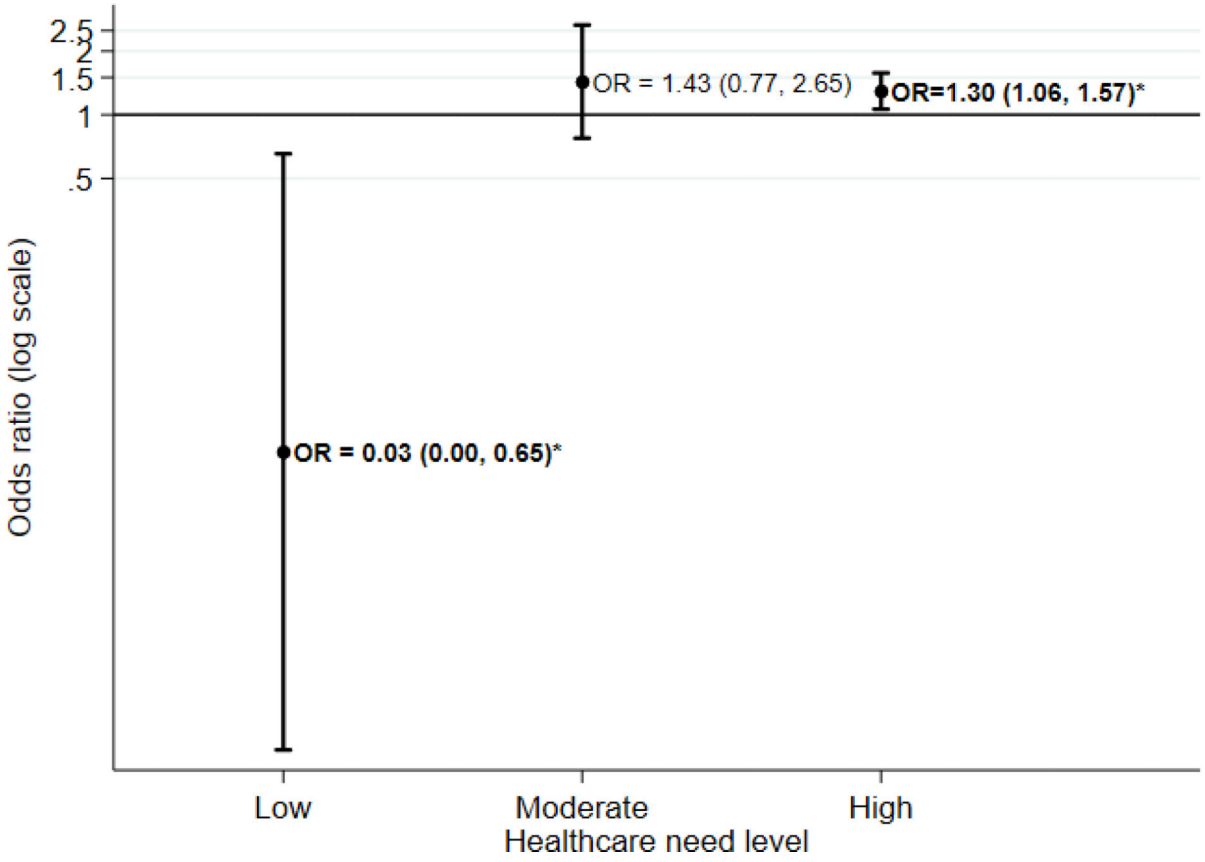

Figure.

Adjusted association Between the Percent of Veteran Residents in the Neighborhood and Odds of Emergency Department High-Utilization (>4 visits, past year) Stratified by Level of Healthcare Need, among Formerly Homeless HUD-VASH Veterans

Notes:

* Denotes statistically significant odds of emergency department high-utilization at $p<0.05$

Model controlled for age, gender, race/ethnicity, marital status, child custody, homeless duration, prior VASH exit

Table 1.

Correlation between neighborhood characteristics among neighborhoods included in analytic sample

	% Veteran	% Poverty	% Unemployed	% Vacant	% Public Transit Use
% Veteran	1.000				
% Poverty	0.40	1.000			
% Unemployed	0.48	0.60	1.000		
% Vacant	−0.30	−0.04	−0.06	1.000	
% Public Transit Use	0.77	0.42	0.47	−0.29	1.000

Table 2 -

Sample Characteristics of Formerly Homeless Veterans in HUD-VASH

	Mean or % (n = 711)
Veteran demographic characteristics	
Age at move-in, years (SD)	52.9 (13.9)
Gender	
Male	89.9
Female	10.1
Race/ethnicity, %	
Non-Hispanic White	31.4
Non-Hispanic Black	44.5
Hispanic	20.5
Other[1]	3.6
Marital Status, %	
Never married	36.3
Currently partnered/married	9.5
Previously married	54.2
Children in custody, %	
No custody	10.5
Yes custody	11.7
No children	77.9
Level of healthcare need[2], %	
Low	41.6
Moderate	20.8
High	37.7
Homelessness characteristics	
Homeless duration at HUD-VASH program entry, %	
Not chronically homeless (< 1 year)	36.2
Chronically homeless (1+ year)	63.8
Prior VASH exit in same fiscal year, %	
No	91.7
Yes	8.3
VHA health service utilization during year following housing placement	
Emergency Department high utilization[3], %	12.4
Primary care visits, counts (SD)	6.2 (7.7)
Outpatient mental health visits, count (SD)	25.7 (23.5)
Residential neighborhood[4] characteristics	
% Veterans, mean (SD)	6.4 (10.3)

	Mean or % (n = 711)
% Poverty, mean (SD)	25.5 (12.8)
% Unemployed, mean (SD)	12.0 (5.4)
% Property vacancies, mean (SD)	7.0 (4.2)
% Households using public transportation[5], mean (SD)	17.4 (26.4)
Social Vulnerability Index – neighborhood socioeconomic index, mean[6] (SD)	0.70 (0.23)

Notes:

1. Other race/ethnicity includes American Indian/Alaskan Native, Asian, Native Hawaiian/Other Pacific Islander

2. Based on the following cut-offs of VA's Nosos Score: low: <1; moderate: 1 to <2; high: 2+

3. Emergency department high-utilization defined as having 4+ emergency department/urgent care visits in a yea

4. Neighborhood is defined as the census tract

5. Public transportation includes bus or train

6. Percentile

Table 3 -

Main Effects Regression Results of the Associations Between Veterans' Residential Neighborhood Characteristics and their VA Healthcare Use among Formerly Homeless HUD-VASH Veterans during the year following HUD-VASH housing placement

	Emergency department high-utilization[1] OR (95% CI)	# Primary care visits IRR (95% CI)	# Outpatient mental health visits IRR (95% CI)
Neighborhood characteristics			
% Veterans[2]	1.25 (1.04, 1.50)*	1.06 (0.98, 1.14)	0.94 (0.86, 1.03)
% Poverty[2]	1.14 (0.89, 1.44)	1.02 (0.96, 1.09)	0.96 (0.90, 1.03)
% Unemployed[2]	0.74 (0.38, 1.45)	1.02 (0.85, 1.23)	0.89 (0.77, 1.03)
% property vacancies[2]	0.65 (0.29, 1.43)	0.88 (0.72, 1.07)	1.25 (1.04, 1.51)*
% households using public transportation[2]	1.13 (1.05, 1.21)*	1.03 (1.00, 1.06)*	0.98 (0.95, 1.01)
Social vulnerability index: Socioeconomic status index	1.33 (0.40, 4.45)	1.23 (0.85, 1.77)	0.98 (0.70., 1.37)

Notes:

1. High-utilization defined as having 4+ emergency department/urgent care visits in a year;

2. Per 10 percentage point increase

* denotes statistical significance at $p<0.05$; OR = Odds Ratio; IRR = incident rate ratio. Each neighborhood characteristics modeled in a separate regression model. Models controlled for age, gender, race/ethnicity, marital status, child custody status, level of healthcare need, homelessness history, and prior HUD-VASH exit in the same year.