

# Association of Home-Based Primary Care Enrollment with Social Determinants of Health for Older Veterans

ANNA-RAE MONTANO, PhD, RN, MEDSURG-BC, OCN; AUGUSTUS GE, MA; CHRISTOPHER W. HALLADAY, ScM; SAMUEL T. EDWARDS, MD, MPH; JAMES L. RUDOLPH, MD, SM; PORTIA Y. CORNELL, PhD

## ABSTRACT

**BACKGROUND:** Home-based Primary Care (HBPC) provides comprehensive primary care to Veterans who may be at risk of adverse health outcomes due to their social determinants of health. Area Deprivation Index (ADI) can be used as a surrogate measure of a Veteran's social needs.

**OBJECTIVE:** To estimate the effect of neighborhood disadvantage, as measured by ADI, on HBPC enrollment for a sample of Veterans.

**METHODS:** We estimated a linear multivariate model in which the exposure was ADI and the outcome was enrollment in HBPC. Controls included clinical and demographic characteristics.

**RESULTS:** In a final sample of 12,005,453 observations (total Veteran months) on 353,485 individual Veterans, 18.4% lived in high-deprivation neighborhoods (ADI greater than 80). Mean monthly probability of new HBPC enrollment was 0.0061. Controlling for clinical characteristics, housing instability, and distance from the medical center, Veterans residing in high-deprivation neighborhoods were 1.4% to 14.8% less likely to enroll in HBPC, though the association was not statistically significant.

**CONCLUSIONS:** More research is needed to determine the relationship between Veterans' social needs and HBPC enrollment.

**KEYWORDS:** Veterans, social determinants of health, Home-Based Primary Care

## BACKGROUND

Socioeconomic disparities continue to exist within health systems and it is imperative to investigate and dismantle these disparities. Wong and colleagues assert that eliminating disparities will require an examination of social determinants of health (SDH).<sup>1</sup> One critical SDH is the neighborhoods in which people live. Neighborhoods with lower socioeconomic status typically have more factors that negatively affect health such as fewer healthy food options, fewer recreational spaces, more crime, and subpar housing.<sup>2-3</sup> One measure of neighborhood socioeconomic disadvantage is the Area Deprivation Index (ADI). Previous research has demonstrated that patients residing in more disadvantaged

neighborhoods have significantly higher 30-day hospital readmission risks than those residing in less disadvantaged neighborhoods.<sup>4,5</sup> While ADI has been used to predict readmission risk, little is known about the association between ADI and enrollment in other comprehensive primary care services.

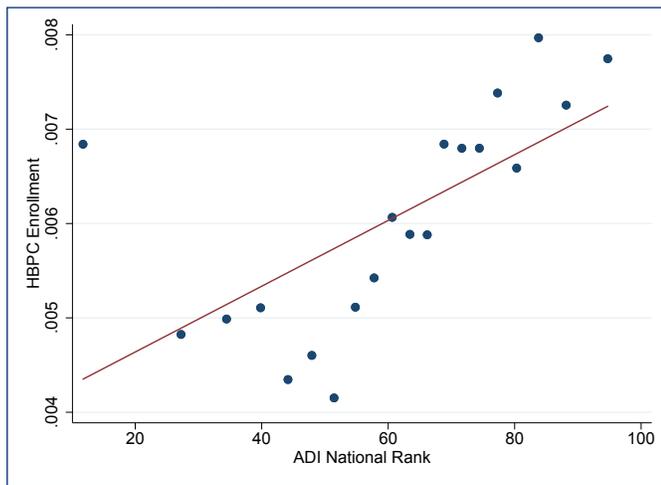
The Department of Veterans Affairs (VA) Home Based Primary Care (HBPC) program was established in 1972 to provide in-home interdisciplinary care to chronically ill or disabled Veterans with complex social, behavioral, or medical needs.<sup>6</sup> The primary goal of the HBPC program is to promote maximum functioning and independence of the Veteran in their home to maintain quality of life and reduce institutionalization, hospitalization, and emergency room visits.<sup>7-8</sup> Veterans are referred by their primary care physician or upon hospital discharge and are subsequently evaluated for admission by HBPC staff using a standardized screening tool.<sup>9</sup> HBPC becomes the primary care provider and this role is fulfilled by the HBPC medical director alone or in collaboration with a nurse practitioner or physician assistant. The frequency of home visits depends on the composition and structure of the team, which is ultimately determined by the needs of the Veteran.<sup>8</sup> The interdisciplinary care team assesses the enrollees, develops a plan of care, provides all necessary primary care services, and refers enrollees to other services as needed. The HBPC interdisciplinary teams are comprised of the physician, nurse practitioners (NPs) or physician assistants (PAs), nurses, social workers, rehabilitation therapists, psychologists, dietitians, pharmacists, and administrative personnel.<sup>10</sup>

Veterans enrolled in HBPC are predominantly male, over the age of 75, with more than eight chronic conditions.<sup>8</sup> The number of Veterans aged 85 and older tripled between 2000 and 2012, and the HBPC census increased from 7,300 to 30,000.<sup>11</sup> Edwards and colleagues found that the further a Veteran lived from a HBPC site, the less likely that they were to be enrolled in HBPC and that those Veterans enrolled in HBPC had the highest quartile of medical complexity with significantly lower odds of ambulatory care-sensitive condition hospitalizations.<sup>7</sup> Thus far, the impact of a Veteran's neighborhood socioeconomic status on HBPC enrollment has not been examined.

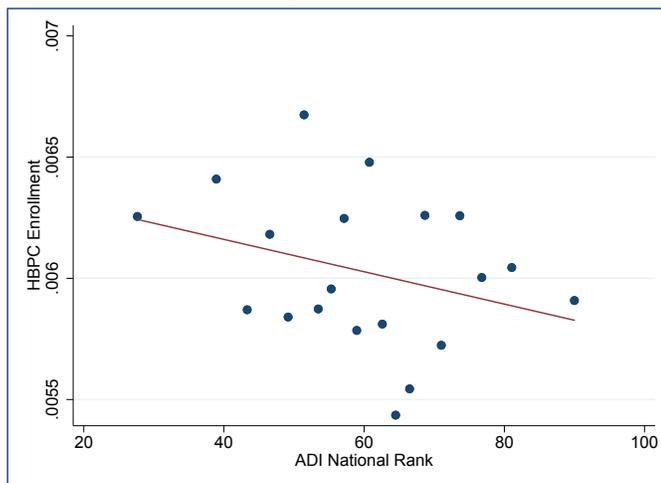
As a first step to investigating socioeconomic disparities in HBPC enrollment, we assessed associations between

neighborhood disadvantage and HBPC enrollment for a sample of older Veterans. Thus, we aimed to address the question: What is the effect of neighborhood socioeconomic status, as measured by ADI, on enrollment in the VA's HBPC program? The authors hypothesize that Veterans in neighborhoods with lower socioeconomic status, or high-deprivation, are less likely to enroll in HBPC than Veterans in higher SES, or low-deprivation, neighborhoods at the same VA Medical Center (VAMC). (Figures 1 A, B)

**Figure 1.** Association of Veteran Neighborhood National ADI on Probability of Enrollment in the VA's Home-Based Primary Care Program. **Panel A.** Unadjusted regression



**Panel B.** Covariate-adjusted regression



Notes: These graphs are visual representations of a multivariate regression, with 12,005,453 Veteran months, of the change in probability of enrolling in home-based primary care (HBPC) at different values of a Veteran's neighborhood area deprivation index (ADI). Panel A represents the linear regression of HBPC enrollment on neighborhood ADI without adjustments, while Panel B represents the regression of controlling for Veteran demographic and clinical characteristics (see Table 1). To create Panel B, we regressed ADI and HBPC on the set of control variables, and generated residuals from these regressions. We then grouped these residuals into 20 equal-sized bins, computed the mean of ADI and HBPC enrollment in each bin, and created a scatter plot of these 20 data points. Panel A shows the average HBPC enrollment for a given level of ADI, holding the controls constant.

## METHODS

### Sample

Data were obtained from the VA's Corporate Data Warehouse. The study sample began with Veterans age 65 and older who received primary care at one of 156 sites (VA medical centers or outpatient clinics) that participated in a Social Work PACT Staffing Program<sup>12</sup> and had an active HBPC program in the period from October 1, 2016 to September 30, 2019. Veterans who had primary care visits at more than one site were assigned to the site where they had the most primary care visits in that year. Observations were at the Veteran-month level. Clinical characteristics were identified within 12 months of an index date, either the fifteenth of a calendar month or the day of their first primary care visit in that month. In order to identify new enrollment, Veterans were excluded from the sample if they had any HBPC visits in the 12 months prior to the study start date. We also excluded Veterans who died within the month of their index date or if they resided in a nursing home for greater than 90 days within the previous 120 days of their index month. Veterans with prolonged nursing home stays were excluded from the sample as these Veterans were likely still residing in nursing homes and not eligible for enrollment in HBPC.

### Outcome

We measured one main outcome: Veteran enrollment in HBPC. We measured this outcome over a thirty-day period from the index date.

### Exposure

We operationalized neighborhood deprivation using the area deprivation index (ADI), a composite measure of census variables related to health outcomes reported as a percentile rank among census blocks.<sup>16</sup> We used the national ADI measure. We defined exposure as living in a "high deprivation" neighborhood in three ways: the 50th, 80th, and 95th percentile or higher, compared to the lower percentiles. In order to assign ADI to the census tract in which a Veteran lived, we took the average ADI of the census blocks within a tract and matched it to the federal information processing system (FIPS) code associated with a Veteran's home address in file in the VA record.

### Covariates

Demographic characteristics were included from each Veteran's enrollment file, and included sex, race, age, number of hospitalizations in the prior year, Rural-Urban Commuting Area code of the Veteran's home residence, driving distance from closest VAMC and VA enrollment priority group for a service-connected disability. We operationalized age in 5-year bins in the OLS model. Based on diagnoses recorded in the electronic health record within twelve months before the index date, we included indicators for congestive heart failure, hypertension, complicated hypertension, lymphoma, fluid

Table 1.\* Demographic and Clinical Characteristics and HBPC Enrollment, Stratified by Neighborhood Disadvantage Levels

Characteristics	Overall (n= 12,005,453)	ADI Grouping of the Patient's Neighborhood of Residence	
		Least Disadvantaged (National ADI Rank <80) (n=9,799,012)	Most Disadvantaged (National ADI Rank >80) (n=2,206,411)
Age	74.90 (7.43)	74.89 (7.36)	74.24 (7.21)
<b>Sex</b>			
Male	12,467,336 (97.87%)	9,600,937 (97.98%)	2,158,217 (97.81%)
<b>Race</b>			
White	10,871,366 (85.34%)	8,502,797 (86.77%)	1,781,779 (80.75%)
Black	517,115 (4.06%)	267,464 (2.73%)	229,242 (10.39%)
Unknown Race	930,894 (7.31%)	710,480 (7.25%)	146,569 (6.64%)
Native Hawaiian or Other Pacific Islander	151,201 (1.19%)	107,562 (1.10%)	11,282 (0.51%)
Asian	161,096 (1.26%)	145,285 (1.48%)	982 (0.04%)
American Indian or Alaska Native	106,808 (0.84%)	65,424 (0.67%)	36,587 (1.66%)
<b>Comorbidity</b>			
Congestive Heart Failure	647,423 (5.08%)	465,562 (4.75%)	136,609 (6.19%)
Hypertension	7,136,665 (56.02%)	5,529,485 (56.43%)	1,372,805 (62.22%)
Anemia	1,029,546 (8.08%)	741,381 (7.57%)	232,300 (10.53%)
Renal Failure	1,086,400 (8.53%)	806,099 (8.23%)	220,754 (10.00%)
Stroke	637,665 (5.01%)	476,838 (4.87%)	129,771 (5.88%)
Hypothyroidism	1,094,583 (8.59%)	844,941 (8.62%)	208,261 (9.44%)
Peripheral Vascular Disease	894,137 (7.02%)	675,948 (6.90%)	178,096 (8.07%)
Depression	1,273,940 (10.00%)	969,447 (9.89%)	261,607 (11.86%)
Post-traumatic Stress Disorder	1,096,126 (8.60%)	848,081 (8.65%)	220,347 (9.99%)
Psychiatric Diagnosis	2,395,800 (18.81%)	1,845,650 (18.84%)	472,717 (21.42%)
Obesity	1,462,809 (11.48%)	1,155,659 (11.79%)	270,074 (12.24%)
Diabetes Mellitus	3,082,909 (24.20%)	2,347,855 (23.96%)	626,386 (28.39%)
Pulmonary Disease	2,017,033 (15.83%)	1,497,169 (15.28%)	427,124 (19.36%)
Dementia	396,950 (3.12%)	295,446 (3.02%)	67,269 (3.05%)
Alzheimer's Disease and Related Dementias	402,359 (3.16%)	300,976 (3.07%)	66,753 (3.03%)
Substance Use Disorder	507,064 (3.98%)	377,573 (3.85%)	112,553 (5.10%)
Alcohol Use	411,606 (3.23%)	310,421 (3.17%)	86,735 (3.93%)
Current Smoker	1,587,615 (12.46%)	1,155,699 (11.79%)	373,591 (16.93%)
Former Smoker	2,914,525 (22.88%)	2,274,671 (23.21%)	518,146 (23.48%)
Homeless	55,885 (0.44%)	37,866 (0.39%)	15,751 (0.71%)
Unstably Housed	191,601 (1.50%)	133,157 (1.36%)	45,337 (2.05%)
<b>VA Priority group</b>			
Group 1: Service-Connected Disability ( >50% disabling)	3,136,027 (25.28%)	2,448,800 (24.99%)	586,934 (26.60%)
<b>Veteran Residence Rural-Urban Commuting Area</b>			
Urban	4,229,849 (33.21%)	3,356,760 (34.26%)	641,253 (29.06%)
Rural	7,195,575 (56.49%)	5,463,717 (55.76%)	1,322,058 (59.92%)
Highly Rural	1,262,530 (9.91%)	978,535 (9.99%)	243,130 (11.02%)
HBPC Enrollment	78,151 (0.61%)	55,978 (0.57%)	16,391 (0.74%)

and electrolyte imbalances, obesity, coagulopathy, stroke, traumatic brain injury, psychoses, valvular disease, renal failure, peripheral vascular disease, depression, post-traumatic stress disorder, paralysis, other neurological conditions, hypothyroidism, liver disease, peptic ulcer disease, pulmonary hypertension, human immunodeficiency virus, diabetes, complicated diabetes, substance use disorder, psychiatric diagnosis, metastatic cancer, solitary tumor, rheumatoid arthritis, weight loss, blood loss anemia, and anemia. (Table 1)

**Analysis**

To estimate the effect of neighborhood disadvantage on HBPC enrollment, we estimated the following linear probability model:

$$HBPC_{ijkt} = \beta_0 + \beta_1 HighDep_j + X_{ijt}\gamma + Y_t + \lambda_k + \epsilon_{ijt}$$

In this model, *i* indexes the individual Veteran, *j* is the census tract, *k* is the site where the Veteran gets their primary care, and *t* is month. *HBPC<sub>ijkt</sub>* is a binary variable that is 1 if a Veteran enrolls in HBPC visits in month *t*, and 0 otherwise, and *HighDep* is an indicator for national ADI rank >=80. We also estimated specifications with high deprivation as ADI>50 and ADI>95. The main coefficient of interest,  $\beta_1$ , represents the difference in probability in a given month that a Veteran from a high-deprivation neighborhood will enroll in HBPC, compared to Veterans in lower-deprivation neighborhoods. *X<sub>ijt</sub>* is a vector of Veterans' demographic and clinical characteristics,  $\lambda_k$  are fixed effects for the VA medical center to control for differences between hospital systems in their HBPC programs, and *Y<sub>t</sub>* are year fixed effects. To account for serial correlation of a Veteran's outcomes, we estimated robust standard errors clustered at the Veteran level.

Datasets were assembled using SQL and R. Regression models were estimated and binscatter plots were generated using Stata version 15. The binscatter plots serve as visual representations of the multivariate regression of the change in probability of enrolling in HBPC at different values of a Veteran's neighborhood ADI. We used one panel (Panel A) to represent the linear regression of HBPC enrollment on neighborhood ADI without adjustments, and a second panel (Panel B) to represent the regression of controlling for Veteran demographic and clinical characteristics. To create Panel B, we regressed ADI and HBPC on the set of control variables, and generated residuals from these regressions. We then grouped these residuals into 20 equal-sized bins, computed the mean of ADI and HBPC enrollment in each bin, and created a scatter plot of these 20 data points.

As part of quality-improvement activities, this work was determined exempt from review by the Providence VA Medical Center institutional review board.

**RESULTS**

In our final analytic sample, we had 12,005,453 observations on 353,485 individual Veterans, 18.4% of whom have addresses in high-deprivation (ADI greater than 80) neighborhoods. Veterans had slightly higher prevalence of chronic conditions in high-deprivation neighborhoods than in low-deprivation neighborhoods, such as hypertension (62.2% vs. 56.4%), diabetes (28.3% vs. 23.9%) psychiatric diagnosis (21.4% vs. 18.8%), and substance use disorders (5.1% vs. 3.8%). Veterans in high-deprivation neighborhoods were also more likely to be unstably housed (2.0% vs. 1.3%) and homeless (0.7% vs. 0.3%). The unadjusted rate of enrollment in the high-deprivation neighborhoods was 0.74% per month and in low-deprivation neighborhoods was 0.57% per month, and 0.61% overall.

Table 2 shows our adjusted estimates for the effect of selected Veteran characteristics on probability of HBPC enrollment, per month. Each estimated coefficient can be interpreted as the difference in probability of a Veteran enrolling in the program per month, compared to the reference group, adjusting for demographic and clinical characteristics. In high-deprivation neighborhoods where ADI is greater than 80, Veterans had a 0.00008 lower likelihood of enrolling in HBPC in a month (a 1.4% difference from the overall mean of .0061) than those in neighborhoods with ADI less than 80 (95% confidence interval: [-0.00059, 0.00043]).

**Table 2.** Association of SDH with HBPC Enrollment By ADI Ranking of the Veteran's Neighborhood of Residence (n=12,005,453)

	High-deprivation definition		
	ADI>50	ADI>80	ADI>95
High-deprivation neighborhood	-0.00039* (-0.00081, 0.00002)	-0.00008 (-0.00059-0.00043)	-0.00096 (-.00223-0.00031)
Homeless	-.0296*** (-.0327, -.0265)	-.02958*** (-.03267, -.02649)	-.02957*** (-.03266, -.02647)
Unstably housed	.04433*** (.04046, .048.20)	.04349*** (.03962, .04736)	.04350*** (.03963, .04737)
Driving distance to nearest VAMC	-0.00002*** (-0.00003, -0.01)	-0.00002*** (-0.00003, -0.00001)	-0.00002*** (-0.03, -0.00001)

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Notes: Each column represents a linear multivariate model of the probability of enrolling in HBPC with different specifications for high-deprivation neighborhoods. Model covariates not shown included: age, sex, race, Veteran residence Rural-Urban Commuting Area, service connection, hospitalizations, congestive heart failure, hypertension, lymphoma, fluid and electrolyte imbalances, obesity, coagulopathy, stroke, traumatic brain injury, psychoses, complicated hypertension, valvular disease, renal failure, peripheral vascular disease, depression, post-traumatic stress disorder, paralysis, pulmonary hypertension, other neurological conditions, hypothyroidism, liver disease, peptic ulcer disease, human immunodeficiency virus, diabetes, complicated diabetes, substance use disorder, psychiatric diagnosis, metastatic cancer, solitary tumor, rheumatoid arthritis, weight loss, blood loss anemia, and anemia. HBPC = Home-Based Primary Care. SDH = Social Determinants of Health. ADI = Area Deprivation Index. VAMC=Veterans Administration Medical Center.

In high-deprivation neighborhoods where ADI is greater than 95, Veterans had a 0.0009 lower likelihood of enrolling in HBPC in a given month (a 14.8% difference from the overall mean) than those in neighborhoods with ADI less than 95 [-0.00223, 0.00031]. In neighborhoods with ADI greater than the median, Veterans had a .00039 lower likelihood of HBPC enrollment (a 6.4% difference from the overall mean) than below the median [-0.00081, 0.00002]. In Figure 1 we show two plots that illustrate the relationship between National ADI Rank and the likelihood of HBPC enrollment for our sample of Veterans. In Panel A, the unadjusted association is positive, suggesting that as neighborhood deprivation increases, so does HBPC enrollment. However, when we adjust for demographic and clinical characteristics in Panel B, the correlation of ADI with HBPC enrollment is weakly negative.

Distance and other social factors significantly affected enrollment. For every additional mile a Veteran lived from a VAMC, probability of HBPC enrollment decreased by 0.00002 (a 0.3% difference from the overall mean). Homeless Veterans had .0296 lower likelihood of enrollment [-.03267, -.02649] than Veterans with stable housing, a more than fourfold difference from the overall mean; while Veterans with unstable housing had .044 higher likelihood of enrolling [.03962, .04736] than Veterans with stable housing, more than seven times the average rate of enrollment.

## DISCUSSION

This analysis of the impact of ADI on HBPC enrollment serves as an example of a novel utilization of ADI to examine the influence of SDH on HBPC enrollment. Clinicians can evaluate Veterans' social needs utilizing measures of SDH, such as ADI, to broaden access to those Veterans most in need of comprehensive primary care services. Although our results were not statistically significant, we found a slight decrease in enrollment associated with living in a higher-deprivation neighborhood, suggesting that after controlling for clinical characteristics, neighborhood characteristics may present some obstacles to participation in the HBPC program.

Unadjusted differences showed that the marginal probability of enrolling in HBPC increases with neighborhood deprivation, which is consistent with the goals of the HBPC program because Veterans in more deprived neighborhoods also had more chronic conditions, hospital admissions, and overall acuity than Veterans in less-deprived neighborhoods. The engagement of HBPC with unstably housed Veterans suggests consideration of the social fragility necessary to manage their care. The logistic concerns of managing HBPC programs likely limit enrollment of Veterans experiencing homelessness, which is supported by this analysis. HBPC teams do not generally enroll homeless Veterans, as they do not have an address or physical residence at which to

provide the care in the home. However, Veterans who are unstably housed and residing in high-deprivation neighborhoods may have more complex medical needs and be most in need of HBPC services. This is consistent with findings from previous work that Veterans who are frail or have complex medical needs are likely to benefit more from HBPC, but that more research is needed to determine who benefits most from HBPC services.<sup>18</sup> Our findings are also consistent with previous reports that the farther a Veteran resides from a HBPC site, the less likely they are to be enrolled.<sup>9</sup>

Two mechanisms drove our hypothesis regarding ADI and HBPC enrollment. First, ADI served as a surrogate measure of Veteran socioeconomic status and second, ADI served as a surrogate of actual neighborhood effects such as environmental health, food deserts, housing safety, and perceived safety of the HBPC team. It is important to note that area level measures, such as ADI, are aggregate measures of individual-level statuses of people living in that area. Consequently, not all Veterans living in high-deprivation neighborhoods have high social needs and conversely, there may be Veterans living in low-deprivation neighborhoods that have high social needs. Generally, our findings support the hypothesis that a surrogate measure for SDH, such as ADI combined with other social needs identified in the health record, may be useful for health care planning and clinical practice in order to identify Veterans in need of social support or to flag potential barriers of access to care.<sup>17</sup>

It is important to acknowledge that Veterans residing in lower-deprivation neighborhoods or urban areas surrounding VAMCs may have more access to HBPC, yet those Veterans in highest need of comprehensive primary care management may reside in higher-deprivation neighborhoods or highly rural areas. Therefore, by serving Veterans residing closest to HBPC sites, and potentially not serving highly rural Veterans, HBPC may not be serving the Veterans with the greatest need for in-home medical care.

Other barriers related to access to care for Veterans in high-deprivation neighborhoods near urban centers may include the ability of clinicians to obtain parking nearby Veteran's homes and traffic congestion in urban neighborhoods. These barriers are especially challenging to HBPC clinicians who are caring for Veterans surrounding VAMCs in major cities, where VAMCs are often located. VA employees are not reimbursed for, and therefore do not utilize, public transportation when travelling to Veteran homes, so traffic and lack of available and affordable parking present barriers to care in high-deprivation or urban neighborhoods surrounding VAMCs within cities.

Perceived safety for clinicians providing home-care services may also present a barrier to enrollment in HBPC. While there is limited literature systematically measuring home health care workers' perceived safety of neighborhoods where they provide care, reports of home health care workers experiencing violence in dangerous or urban neighborhoods

or feeling threatened by neighbors, family or weapons in the home are prevalent.<sup>19-20</sup> These threats may contribute to a decreased likelihood of enrollment in HBPC of at-risk Veterans residing in high-deprivation or urban neighborhoods. Telehealth HBPC services could mitigate some of these risks to HBPC clinicians and improve access to HBPC services for Veterans residing in these communities.

Our findings have potential implications for clinical practice, not only for the clinicians in the HBPC program but perhaps more so for the providers who may wish to refer their patients in to the program. In the VA, primary care is organized into interprofessional teams called Patient Aligned Care Teams (PACTs). Rarely would a Veteran independently seek to enroll in HBPC; instead, a member of the Veteran's PACT often identifies a patient who is homebound and/or has complex medical needs, and refers them to the program. Therefore, issues that potentially affect access to HBPC are particularly salient to any members of the PACT – such as primary care physicians, nurse care managers, specialists, or social workers – who are in a position to recognize a Veteran's need for more comprehensive services. PACT social workers play a pivotal role in assessing the SDH that present barriers to timely and appropriate care. Social workers can serve as a bridge between the Veteran's primary care provider and the HBPC team. Because PACT social workers identify social needs and develop rapport with a Veteran, they are well positioned for a warm hand-off to the HBPC social worker if a Veteran chooses to enroll in HBPC. Thus, a strong connection between the PACT social worker and the HBPC interdisciplinary team can improve access to care. Physicians, too, should be aware that their social workers can play this pivotal role in reducing barriers to access for Veterans with social needs.

The Covid-19 pandemic has also presented a unique opportunity for HBPC programs to utilize and improve home telehealth services for at-risk Veterans. Anecdotally, HBPC clinicians have utilized telephone and video encounters to bridge the gap between Veteran care needs and the risks of providing and receiving in-person care during the Covid-19 pandemic. This presents a broader opportunity for HBPC to establish sustainable and effective home telehealth encounters for Veterans who live farther away from HBPC programs or who may encounter barriers to HBPC as a result of their neighborhood of residence. There remains room for improvement with regards to Veteran access to these home telehealth services due to the complexity of home telehealth interventions, the lack of home telehealth adaptability and usability, and adherence issues for Veterans.<sup>21</sup> Shigekawa and colleagues identified that video telehealth in HBPC may be underutilized, as well.<sup>22</sup> Veterans residing in highly rural areas may experience a lack of access to traditional in-person HBPC because the long drive times from an HBPC site to their homes make home visits burdensome for HBPC staff. Home telehealth encounters in HBPC could serve to

improve care for rural and highly rural at-risk Veterans or those residing in high-deprivation neighborhoods. Utilizing ADI as a measure of SDH is a novel approach to examining access to HBPC for older Veterans.

## LIMITATIONS

Limitations are important to note. First, we linked Veterans' addresses to census tracts blocks and used the mean ADI of the census blocks associated with that tract. By introducing (likely random) measurement error, this may have attenuated our estimates toward zero. Second, although we included an extensive list of diagnoses, there were many aspects of their frailty and medical acuity that we did not control for in our model. For instance, we did not have a measure of functional status. If Veterans in high-ADI neighborhoods also have more need for HBPC in unmeasured ways, that also would bias our estimates toward the null. Third, in terms of external validity, although the VAMCs that participate in the Social Work PACT Staffing Program represent a broad, national sample, they may not be representative of the VA as a whole. In order to participate in the program, VAMCs must serve some rural Veteran populations, and they may have higher PACT social work staffing levels than non-participating sites.

## CONCLUSIONS

The VA HBPC program provides beneficial comprehensive, primary care services to Veterans at risk of poor health outcomes. However, a Veteran's SDH could prevent enrollment. More research is needed to explore the relationship between social needs and access to services such as HBPC.

## References

1. Wong MS, Steers WN, Hoggatt KJ, Ziaieian B, Washington DL. Relationship of neighborhood social determinants of health on racial/ethnic mortality disparities in US veterans-Mediation and moderating effects. *Health Serv Res.* 2020;55 Suppl 2:851-862.
2. Prentice JC. Neighborhood effects on primary care access in Los Angeles. *Soc Sci Med.* 2006;62(5):1291-1303.
3. Gaskin DJ, Dinwiddie GY, Chan KS, McCleary RR. Residential segregation and the availability of primary care physicians. *Health Serv Res.* 2012;47(6): 2353-2376.
4. Kind AJH, Jencks S, Brock J, et al. Neighborhood socioeconomic disadvantage and 30-day rehospitalization: a retrospective cohort study. *Ann Intern Med.* 2014;161(11):765-774.
5. Hu J, Kind AJH, Nerenz D. Area Deprivation Index Predicts Re-admission Risk at an Urban Teaching Hospital. *Am J Med Qual.* 2018;33(5):493-501.
6. Department of Veterans Affairs, Veterans Health Administration. Home Based Primary Care Program. Washington, DC; Jan 31 2007:25. VHA Handbook 1141.01.
7. Shay K, Hyde B, Burris J: Strategic plan for geriatrics and extended care in the veterans health administration: background, plan, and progress to date. *J Am Geriatr Soc.* 2013;61:632-638

8. Edes T, Kinoshian B, Vuckovic NH, et al: Better access, quality, and cost for clinically complex veterans with homebased primary care. *J Am Geriatr Soc.* 2014;62:1954–1961
9. Edwards ST, Saha S, Prentice JC, Pizer SD. Preventing Hospitalization with Veterans Affairs Home-Based Primary Care: Which Individuals Benefit Most? *J Am Geriatr Soc.* 2017;65(8):1676-1683.
10. Karuza J, Gillespie SM, Olsan T, Cai X, Dang S, Intrator O, Li J, Gao S, Kinoshian B, Edes T. National structural survey of Veterans Affairs home-based primary care programs. *J Am Geriatr Soc.* 2017 Dec;65(12):2697-701
11. Beales JL, Edes TE. Veteran's Affairs home based primary care. *Clin Geriatr Med.* 2009;25:149–154.
12. Cornell PY, Halladay CW, Ader J, et al. Embedding Social Workers In Veterans Health Administration Primary Care Teams Reduces Emergency Department Visits. *Health Aff.* 2020;39(4):603-612.
13. Department of Veterans Affairs, Veterans Health Administration. Patient Aligned Care Team (PACT) handbook [Internet]. Washington (DC): VHA; [amended 2017 May 26; cited 2020 Mar 3]. [VHA Handbook 1101.10[1]]. Available for download from: [https://www.va.gov/vhapublications/ViewPublication.asp?pub\\_ID=2977](https://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=2977) Google Scholar
14. In the VHA, all social workers are required to be licensed or certified by a state to independently practice social work at the master's degree level. See Department of Veterans Affairs. Social worker qualification standard [Internet]. Washington (DC): VA; 2019 Sep 10 [cited 2020 Mar 3]. [VA Handbook 5005/120, Part II, Appendix G39]. Available for download from: [https://www.va.gov/vapubs/viewPublication.asp?Pub\\_ID=1061&FTType=2](https://www.va.gov/vapubs/viewPublication.asp?Pub_ID=1061&FTType=2) Google Scholar
15. Department of Veterans Affairs, Veterans Health Administration. Integrated case management standards of practice [Internet]. Washington (DC): VHA; 2019 Sep 6 [cited 2020 Mar 3]. [VHA Directive 1110.04]. Available for download from: [https://www.va.gov/vhapublications/ViewPublication.asp?pub\\_ID=8489](https://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=8489) Google Scholar
16. Kind AJH, Buckingham W. Making Neighborhood Disadvantage Metrics Accessible: The Neighborhood Atlas. *N Engl J Med.* 2018;378:2456-2458. DOI: 10.1056/NEJMp1802313..
17. Knighton AJ, Savitz L, Belnap T, Stephenson B, VanDerslice J. Introduction of an Area Deprivation Index Measuring Patient Socioeconomic Status in an Integrated Health System: Implications for Population Health. *EGEMS (Wash DC).* 2016;4(3):1238.
18. Totten AM, White-Chu F, Wasson N, Morgan E, Kansagara D, Davis-O'Reilly C, Goodlin S. Comparative Effectiveness Review Number 164: Home-Based Primary Care Interventions. 2016. [https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/home-based-care\\_research.pdf](https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/home-based-care_research.pdf).
19. Gershon RRM, Pogorzelska M, Qureshi KA, et al. Home Health Care Patients and Safety Hazards in the Home: Preliminary Findings. In: Henriksen K, Battles JB, Keyes MA, Grady ML, eds. *Advances in Patient Safety: New Directions and Alternative Approaches (Vol. 1: Assessment)*. Rockville (MD): Agency for Healthcare Research and Quality; 2011.
20. Markkanen P, Galligan C, Quinn M. Safety Risks Among Home Infusion Nurses and Other Home Health Care Providers. *J Infus Nurs.* 2017;40(4):215-223.
21. Dang S, Olsan T, Karuza J, et al. Telehealth in Home-Based Primary Care: Factors and Challenges Associated With Integration Into Veteran Care. *J Am Geriatr Soc.* 2019;67(9):1928-1933.
22. Shigekawa E, Fix M, Corbett G, Roby DH, Coffman J. The current state of telehealth: a rapid review. *Health Aff.* 2018;37:1975-1982.

## Acknowledgments

We would like thank Angela Giles, DBH, LCSW, and the leadership of the PACT Social Work Staffing Program for their comments and insights on this manuscript. This work was supported by the *Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, Health Services Research & Development (HSR&D), Center of Innovation for Long-Term Services and Supports (CIN 13-419; C19-20-213); HSR&D Quality Enhancement Research Initiative (PEC 18-012); the VA National Social Work Program Office; the VA Office of Rural Health; the VA Office of Connected Care.*

## Disclaimer

The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the United States government.

## Authors

Anna-Rae Montano, PhD, RN, MEDSURG-BC, OCN, Center of Innovation for Long-term Services and Supports, Providence Veterans Administration (VA) Medical Center, Providence, RI; Department of Health Services, Policy, and Practice, Brown University School of Public Health, Providence, RI.

Augustus Ge, MA, Center of Innovation for Long-term Services and Supports, Providence Veterans Administration (VA) Medical Center, Providence, RI.

Christopher W. Halladay, ScM, Center of Innovation for Long-term Services and Supports, Providence Veterans Administration (VA) Medical Center, Providence, RI.

Samuel T. Edwards, MD, MPH, Section of General Internal Medicine, Veterans Affairs Portland Health Care System, Portland, Oregon; Division of General Internal Medicine and Geriatrics, Oregon Health and Science University, Portland, Oregon.

James L. Rudolph, MD, SM, Center of Innovation for Long-term Services and Supports, Providence Veterans Administration (VA) Medical Center, Providence, RI; Department of Health Services, Policy, and Practice, Brown University School of Public Health, Providence, RI.

Portia Y. Cornell, PhD, Center of Innovation for Long-term Services and Supports, Providence Veterans Administration (VA) Medical Center, Providence, RI; Department of Health Services, Policy, and Practice, Brown University School of Public Health, Providence, RI.

## Correspondence

Anna-Rae Montano, PhD, RN, MEDSURG-BC, OCN  
Advanced Research Fellow  
Providence VA Medical Center  
830 Chalkstone Ave., Building 32  
Providence, RI 02908  
[anna-rae\\_montano@brown.edu](mailto:anna-rae_montano@brown.edu)