

# Integrated Service Delivery and Health-Related Quality of Life of Individuals in Permanent Supportive Housing Who Were Formerly Chronically Homeless

Vanessa Schick, PhD, Lindsey Wiginton, MPH, Cathy Crouch, LCSW, Ali Haider, MBA, and Frances Isbell, MA

**Objectives.** To investigate the impact of an integrated care model on the health-related quality of life (HRQOL) of formerly chronically homeless individuals in permanent supportive housing.

**Methods.** From 2014 to 2017, eligible individuals in Houston, Texas (n = 323), were placed in 1 of 2 permanent supportive housing service delivery models. Both models included coordinated care teams. In the intervention group, teams had a single plan of care with the partnering clinic. The 9-item Patient Health Questionnaire and 36-item Short Form Survey were administered at baseline and every 6 months for 30 months. We assessed intervention group emergency department use at 2 years. We evaluated change by using hierarchical linear growth models.

**Results.** There was a significant and clinically meaningful increase in HRQOL in the intervention group, with the intervention group reporting improvement over the comparison group. Intervention group emergency department use decreased by 70% (no comparison group).

**Conclusions.** Those in the intervention group with a single, coordinated plan of care reported significant and clinically meaningful increases in their HRQOL.

**Public Health Implications.** Coordinated care models have potential to reduce societal costs and increase HRQOL, providing a financial and humanitarian justification for the continued investment in collaborative care in permanent supportive housing. (*Am J Public Health.* 2019;109:313–319. doi:10.2105/AJPH.2018.304817)

Each night in the United States, there are nearly 87 000 individuals who meet the US Department of Housing and Urban Development's criteria for chronic homelessness.<sup>1</sup> This includes individuals with a disabling condition who have been homeless (without a nighttime residence) for at least 12 consecutive months or 4 times within the past 3 years.<sup>1,2</sup> The current number of chronically homeless individuals reflects a 25% decrease in chronic homelessness over the past decade.<sup>1</sup> This reduction is likely a reflection of the increase in permanent supportive housing (PSH), a long-term housing solution for individuals with disabling conditions (i.e., serious mental illness, diagnosable substance use disorder, developmental disability, disability attributable

to injury or chronic illness) who have been chronically homeless.<sup>1,2</sup>

In addition to providing long-term housing, depending on the available resources of the service provider, services are made available to PSH tenants to address the complex medical and behavioral health needs associated with frequently co-occurring disabling condition(s).<sup>3–5</sup> The continued housing of the new tenants is not, however,

contingent upon their willingness or commitment to accessing these services.<sup>3,4,6</sup> Thus, this model is designed to provide a comprehensive system of care without imposing retribution for those who are unwilling, unready, or unable to take advantage of services. Because service access is voluntary for PSH tenants, the likelihood that they will seek care may depend on the number of barriers that they encounter and the ease with which these barriers are overcome. Asking someone in PSH to prioritize and address their needs individually, as is done in the traditional fragmented health care system, may be unrealistic for someone with competing mental, behavioral, and physical health needs.<sup>7</sup> Instead, these individuals may benefit from a model of collaborative care to help them navigate the complex system and address their concurrent biopsychosocial needs simultaneously.<sup>7</sup>

Collaborative care models differ in the degree to which they integrate services, with levels of collaboration ranging from minimal communication between health care providers to full integration with an interdisciplinary coordinated care team working together toward shared patient biopsychosocial goals.<sup>8</sup> The degree of service collaboration has been found to be related to improved housing outcomes,<sup>9,10</sup> with existing research supporting the value of collaborative care models in increasing health

## ABOUT THE AUTHORS

Vanessa Schick is with the University of Texas Health Science Center at Houston, School of Public Health, Houston. Lindsey Wiginton is with the Houston Health Department, Houston. Cathy Crouch and Ali Haider are with SEARCH Homeless Services, Houston. Frances Isbell is with Healthcare for the Homeless-Houston, Houston.

Correspondence should be sent to Vanessa Schick, PhD, 1200 Pressler St, Rm E-917, Houston, TX 77030 (e-mail: vanessa.schick@uth.tmc.edu). Reprints can be ordered at <http://www.ajph.org> by clicking the "Reprints" link.

This article was accepted October 8, 2018.

doi: 10.2105/AJPH.2018.304817

and wellness among individuals in PSH.<sup>11</sup> However, without a comparison group, the unique benefit of service integration independent of the benefits of housing alone remains unknown.<sup>11</sup> In addition, current research and evaluation of PSH models tend to focus on outcomes related to cost saving.<sup>3,12,13</sup> Although this is valuable, it is also important to consider the impact on quality of life.<sup>14</sup> In recognition of the need for this data, the National Academies of Sciences, Engineering, and Medicine released a report highlighting the need for more data on the health benefits and best practices for service delivery within PSH.<sup>15</sup>

## THE PRESENT STUDY

The current study assessed the impact of collaborative care on the health-related quality of life (HRQOL) of individuals in PSH. To establish the unique contribution of the service delivery model separate from the benefits of housing alone, we compared 2 PSH collaborative care models. Both models were offered through federally qualified health centers (FQHCs) and each included onsite coordinated care teams with (1) clinical case managers to conduct regular assessments of the client's well-being and implement behavioral health interventions (e.g., substance use counseling), (2) community health workers to address identified health needs and navigate care (e.g., appointments, benefits), and (3) onsite registered nurses who worked to assess immediate health care and care coordination needs.

The intervention service delivery model was designed and implemented in partnership with a social service organization charged with clinical case management. The key difference between the models was the degree of integration between the clinic and the coordinated care team. In the intervention group, all clients were navigated to the partnering FQHC for physical or behavioral health needs as appropriate. Consistent with the highest level of care integration, all team members at the FQHC and the coordinated care team worked collaboratively toward a single coordinated plan of care with a shared electronic health record (EHR).<sup>16,17</sup> The registered nurse translated needs to medical

professionals at the FQHC and worked with other members of the coordinated care team including the community health worker and clinical case manager to implement clinical recommendations. This was consistent with the description by Henwood et al. of embedded partnership models in which a full-time nurse is embedded within the coordinated care team.<sup>18</sup>

By contrast, participants in the comparison group were not directed to a single FQHC, preventing the possibility of a single coordinated plan of care. Thus, the aim of the present study was to investigate whether an integrated service delivery model with a single coordinated plan of care (the intervention) would significantly and meaningfully increase the HRQOL of enrolled participants relative to participants enrolled in a similar service delivery model without a single, coordinated plan of care (the comparison).

## METHODS

The present study was a natural experiment comparing the self-reported HRQOL of individuals enrolled in 1 of 2 PSH service delivery models in Houston, Texas, between 2014 and 2017.

### Procedure

Individuals who met the US Department of Housing and Urban Development's criteria for chronic homelessness,<sup>19</sup> including having a qualifying disability, and those with 3 self-reported emergency department (ED) visits in the 2 years before enrollment were eligible to participate in the program. Individuals were screened for eligibility and assigned to 1 of the 2 service delivery models (each associated with an FQHC) by the regional homeless Continuum of Care's Coordinated Access/Entry program. Coordinated Access/Entry is required by the US Department of Housing and Urban Development for all Continuum of Care and was unrelated to this study.<sup>20</sup> Consistent with a natural experiment, group placement was not randomized, but both models shared inclusion criteria and assignment was done arbitrarily by the Continuum of Care.<sup>21</sup> Baseline assessments were collected before or during the first day of housing, with follow-up assessments collected by members

of the coordinated care team (e.g., clinical case managers) approximately every 6 months after baseline. Participants received an incentive at each assessment.<sup>22</sup>

## Measures

### *Sociodemographic, housing, and health data.*

We attained sociodemographic (gender, age, and race/ethnicity) and health data through the participant's EHR and Homeless Management Information System.<sup>23</sup> We assessed insurance according to the participants' most recent insurance status. Severe mental illness included all individuals who had a diagnosis of bipolar disorder, major depressive disorder, posttraumatic stress disorder, or psychotic disorder. The date of service and housing exit was recorded by the coordinated care team and classified as positive (e.g., move to permanent housing) or negative (e.g., move to a place not meant for human habitation or jail or prison) according to criteria established by the US Department of Housing and Urban Development.<sup>24</sup> Emergency department use and service utilization was not available from the comparison group, prohibiting between-group comparisons. For the intervention group, we extracted data from the EHR. For ED data, the intervention FQHC shares an EHR with the local public health system, which allows for good exchange of data within that system, but would miss any ED visits to hospitals or clinics that do not report health data into the shared EHR system.

*Health-related quality of life.* The 36-item Short Form Survey (SF-36), version 2, is a validated tool<sup>25</sup> with demonstrated reliability ( $\alpha = 0.78-0.93$ ) and validity among a variety of diverse populations,<sup>26</sup> including those with chronic illness<sup>27</sup> and substance use disorder.<sup>28,29</sup> The SF-36 contains 8 subscales: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health. In the present study, the combined subscale Physical Component Summary (PCS) and the Mental Component Summary (MCS) scores are reported, with higher scores indicating increased HRQOL. Raw scores are transformed to norm-based scores, accounting for age and gender, on a scale of 0 to 100 by using a T-score transformation to allow for comparisons with nationally representative samples.<sup>25</sup> We compared mean changes in

scores over time with predetermined cut-off points as established through the literature to indicate minimally important differences (MIDs).<sup>25,30</sup> As opposed to relying on statistical significance scores, which may not indicate a meaningful change in the participant's experience, MIDs indicate a clinically relevant change in the participant's score such that the participant would likely make note of the change and their clinical plan may be altered as a result.

**Depression.** Depression was screened with the 9-item version of the Patient Health Questionnaire (PHQ-9).<sup>31</sup> The PHQ-9 is a widely used measure that has been used effectively with older, homeless adults<sup>32</sup> with good internal consistency in this sample ( $\alpha = 0.86$ ). Each item is scored from 0 to 3, with higher scores indicating greater depression. Because the scale is additive, missing items were replaced with mean scale scores collected at that time point.

We used data collected from 2014 through 2017 for the evaluation of this model.

**Analysis.** First, we assessed bivariate differences between groups. We assessed sociodemographic differences between groups with the  $\chi^2$  test, and we assessed mean differences on outcomes as a function of sociodemographic characteristics by using analyses of variance. To assess mean differences in outcomes at 6-month intervals (not accounting for group differences), we stratified the data by group and within-person differences at each time point and compared them with the baseline scores with a repeated measures analyses of variance. This was conducted to provide data on the length of time required to detect significant and meaningful changes. We controlled for the False Discovery Rate by using Benjamini and Hochberg's method to retain power.<sup>33</sup>

To assess whether changes in HRQOL significantly differed for the intervention and comparison groups, we investigated changes in the outcomes over time by using hierarchical linear growth models. Growth curve modeling has advantages over traditional methods for analysis of repeated measures data, including allowance for missing data and unequal time intervals.<sup>34</sup> Analysis of the unconditional model suggested that there was significant variability between participants in MCS ( $P < .001$ ; intraclass correlation [ICC] = 0.50), PCS ( $P < .001$ ; ICC = 0.58), and

PHQ-9 scores ( $P < .001$ ; ICC = 0.39), supporting the use of hierarchical linear modeling.

Time-varying growth (MCS, PCS, and PHQ-9 scores) are repeated measures at level 1 nested within individuals at level 2. Level 2 variables (i.e., individual differences and group assignment) were considered as predictors of time-varying growth of level 1 outcomes variables. We entered time as days from baseline, with the baseline set to 0 days. As with other interventions, we included both linear and quadratic functional forms in the present analyses as we hypothesized HRQOL to increase over time with the greatest change anticipated immediately after introduction of the intervention.<sup>34</sup> Therefore, at level 1, the linear factor (time) assessed linear change in the outcomes over time relative to zero, and the quadratic factor (time<sup>2</sup>) assessed changes related to the rate of change over time. We included insurance, age, and mental illness in the model given baseline relationships to the outcome variable. In the final model, at level 2, we entered group, age (group-centered), mental illness, and insurance. The time  $\times$  group interaction assessed differences between groups in their linear rate of change, and the time<sup>2</sup>  $\times$  group interaction assessed whether the rate of change differed between groups. We conducted analyses with HLM version 6.0 (SSI, Skokie, IL).

To assess change in ED use over 2 years, we included individuals who were actively enrolled in the intervention group for 2 or more years at the time of data extraction from the EHR in the analyses.

## RESULTS

At baseline, the mean age of the participants in the comparison group ( $n = 113$ ; mean = 49.98; SD = 9.86) did not significantly differ from the intervention group ( $n = 210$ ; mean = 50.68; SD = 10.62). The majority of participants were male (69.04%;  $n = 223$ ), Black (64.91%;  $n = 209$ ), and had a serious mental illness (71.52%;  $n = 231$ ). There were no significant differences between groups with the exception of insurance status ( $P < .05$ ; Table 1). Among those with service data, 83.22% ( $n = 88$ ) of the participants in the intervention had received medical

care 2 or more times from members of the coordinated care team or affiliated FQHC. Outcomes significantly differed ( $P < .05$ ) by age, insurance status, and serious mental illness (Table 1).

Of the 323 participants, 58.20% ( $n = 188$ ) were still enrolled at the time of data collection. Overall, participants in the intervention group were more likely to exit housing earlier relative to the comparison group ( $P < .05$ ). Of those who exited housing, 46.30% ( $n = 44$ ) from the intervention group exited for negative reasons relative to 65.00% ( $n = 26$ ) of those who exited the comparison group for negative reasons.

## Health-Related Quality of Life

At 6 months, participants in neither group surpassed the MID on any SF-36 domain. At 1 year, both groups had exceeded the MID for MCS (Table 2). For the intervention group, this improvement was sustained with participants reporting a MCS score that exceeded their baseline MCS score at each time point up to 30 months. For the comparison group, the MCS score only exceeded the MID at 12 months and then dropped below the MID in subsequent months. The PCS score did not exceed the MID for either group until 30 months. At 30 months, the intervention group had exceeded the MID for the PCS score. Change in PHQ-9 scores over time were similar, with significant reductions in depression for only those in the intervention group.

To investigate whether there was a difference in HRQOL between participants in service delivery models, we assessed change in outcomes across time as a function of service delivery model. We entered level 2 predictors significantly related to the outcomes at the bivariate level (age, mental illness, and insurance; Table 1) into a multivariate model. All were significantly related to the intercept but not the linear or quadratic slope. Retaining the significant level-2 predictors, we added group status (comparison or intervention) to the mixed effects model to test whether group differences would explain significant variance in HRQOL. As in the earlier model, sociodemographic characteristics were significantly related to the intercept but not the linear or quadratic slope, suggesting that the change in outcomes over time

**TABLE 1—Sociodemographic Characteristics of Individuals With Experiences of Chronic Homelessness by the Service Delivery Model They Received While Living in Permanent Supportive Housing and Baseline Health Related Quality of Life (n = 323): Houston, TX, 2014–2017**

Sample Characteristics	Total Sample, % (No.)	Differences Between Groups			Differences on PCS		Differences on MCS		Differences on PHQ-9	
		Comparison, % (No.)	Intervention, % (No.)	<i>P</i>	Mean (SD)	<i>P</i>	Mean (SD)	<i>P</i>	Mean (SD)	<i>P</i>
<b>Gender</b>										
Cis woman	30.34 (98)	34.69 (34)	65.31 (64)		42.78 (10.05)		38.25 (12.16)		9.38 (7.04)	
Cis man	69.04 (223)	35.43 (79)	64.57 (144)		41.50 (9.93)		39.42 (12.72)		10.11 (6.86)	
Transgender woman	0.62 (2)	...	100.00 (2)		...		...		...	
<b>Age at entry, y</b>										
18–19	0.31 (1)	100.00 (1)	...			< .001		< .005		
20–29	4.95 (16)	25.00 (4)	75.00 (12)		49.07 (11.26)		38.87 (13.07)		9.81 (8.15)	
30–39	10.84 (35)	37.14 (13)	62.86 (22)		48.57 (10.36)		33.72 (12.63)		11.15 (7.40)	
40–49	24.46 (79)	34.18 (27)	65.82 (52)		42.69 (9.34)		36.53 (11.19)		10.80 (6.69)	
50–59	44.89 (145)	36.55 (53)	63.45 (92)		40.15 (9.19)		39.95 (12.88)		9.65 (7.06)	
60–69	13.31 (43)	32.56 (14)	67.44 (29)		38.12 (9.24)		43.28 (11.63)		7.95 (5.75)	
≥70	1.24 (4)	25.00 (1)	75.00 (3)		37.97 (10.27)		51.32 (12.58)		14.00 (7.79)	
<b>Race/ethnicity</b>										
White	26.71 (86)	36.05 (31)	63.95 (55)		42.92 (10.90)		38.23 (13.21)		9.96 (6.92)	
Black	64.91 (209)	35.89 (75)	64.11 (134)		41.27 (9.40)		39.52 (12.16)		9.92 (6.96)	
Hispanic	5.28 (17)	29.41 (5)	70.59 (12)		42.25 (11.26)		37.64 (11.83)		10.24 (6.65)	
Other	3.11 (10)	10.00 (1)	90.00 (9)		43.74 (11.79)		35.08 (16.81)		8.80 (7.47)	
<b>Insurance</b>										
Medicaid	29.41 (95)	27.37 (26)	72.63 (69)	< .05	39.63 (9.21)	< .005	41.98 (12.31)	< .01	8.63 (5.98)	< .05
Medicare	9.29 (30)	20.00 (6)	80.00 (24)		39.41 (11.45)		40.19 (11.64)		7.73 (6.63)	
Dual Medicare–Medicaid	8.05 (26)	38.46 (10)	61.54 (16)		38.83 (7.05)		41.24 (10.82)		10.58 (7.37)	
Uninsured	52.01 (168)	42.26 (71)	57.74 (97)		43.88 (10.13)		36.93 (12.51)		10.89 (7.25)	
Other	1.24 (4)	...	100.00 (4)		45.85 (7.26)		29.75 (22.20)		14.50 (7.59)	
<b>Serious mental illness</b>										
No	28.48 (92)	39.13 (36)	60.87 (56)		39.61 (9.61)	< .01	43.43 (12.49)	< .001	8.02 (6.43)	< .005
Yes	71.52 (231)	33.33 (77)	66.67 (154)		42.72 (9.98)		37.20 (12.17)		10.71 (6.99)	

Note. MCS = Mental Component Summary; PCS = Physical Component Summary; PHQ = Patient Health Questionnaire. “Cis” indicates that the participants identify with the gender that they were assigned at birth.

was not a function of the sociodemographic characteristics. In the model, there were no significant initial group differences on the MCS, PCS, or PHQ-9, indicating that the groups did not differ on the outcome variables at baseline. Group status did, however, significantly predict linear growth in both MCS and PCS scores (represented in Table 3), with the intervention group reporting an increase in MCS ( $P < .01$ ) and PCS scores ( $P < .01$ ) with a slower rate of deceleration over time for both MCS ( $P < .05$ ) and PCS scores ( $P < .05$ ). Group status was related to a linear decrease in PHQ-9 scores ( $P < .01$ ), with the intervention group reporting greater reductions in PHQ-9 scores over time relative to the comparison. Considered

together, results indicate that the HRQOL and PHQ-9 scores for the intervention group significantly improved over time relative to the comparison group.

### Emergency Department Use in Intervention Group Only

Relative to ED use in the 2 years before program enrollment (data not shown—no comparison), there was a 71.05% reduction in total ED use across participants enrolled in the intervention for 2 or more years (165 vs 570 ED visits). After 2 years in the program, the median ED use decreased from 5 to 2 visits and the mode decreased from 3 to 0 visits. The mean number of visits significantly decreased

from a mean of 10.00 (SD = 18.86) visits to 2.89 (SD = 4.13) visits after 2 years ( $P < .01$ ).

### DISCUSSION

There has been a shift in recommended approaches to homelessness over the past decade with increased investment in PSH and a corresponding need for data on best practices within PSH.<sup>35</sup> Consistent with the National Academies of Sciences, Engineering, and Medicine recommendations,<sup>15</sup> the current study provides data on the HRQOL of individuals in PSH, with a longitudinal comparison of 2 service delivery models. Overall, in the current study, the HRQOL of

**TABLE 2—Within-Person Changes on Health-Related Quality of Life and Depression Measures of Individuals Living in Permanent Supportive Housing in Houston, TX, From 2014 to 2017, by Service Delivery Model**

Outcome Measure	Baseline (n = 323), Mean (SD)	18 Months (n = 180)			30 Months (n = 104)		
		Mean (SD)	Mdiff	MID <sup>a</sup>	Mean (SD)	Mdiff	MID <sup>a</sup>
<b>SF-36</b>							
<b>Mental Component Summary</b>							
Comparison group	38.47 (11.86)	39.71 (11.90)	(1.41)		40.29 (13.06)	(1.63)	
Intervention group	39.25 (12.94)	45.19* (12.73)	(6.44)	+	44.93* (9.94)	(7.01)	+
<b>Physical Component Summary</b>							
Comparison group	42.91 (9.54)	41.40 (9.81)	(-2.57)	-	39.90* (8.16)	(-4.12)	-
Intervention group	41.25 (10.16)	41.70 (9.55)	(1.26)		43.70 (11.05)	(2.69)	+
<b>Patient Health Questionnaire-9</b>							
Comparison group	9.68 (6.87)	9.80 (6.87)	(0.24)		9.17 (6.53)	(-0.37)	
Intervention group	10.09 (6.98)	8.05* (6.10)	(-2.47)		7.25* (4.78)	(-2.65)	

Note. MDiff = mean difference between score at time point and baseline score; MID = minimally important difference; n = number of participants who responded within +/- 90 d of each timepoint.

\*P value is statistically significant after we controlled for false discovery rate. Patient Health Questionnaire-9 does not have a MID. Higher scores on the 36-item Short Form Survey indicate better health-related quality of life, and lower scores on the Patient Health Questionnaire-9 indicate less depression.

<sup>a</sup> "+" indicates that MDiff exceeded the MID score per established literature and "-" indicates that MDiff fell below MID score per established literature.

participants improved over time, adding to the current literature suggesting that the health and well-being of formerly chronically homeless individuals with a disabling condition may improve in PSH. In a comparison of both service delivery models, participants in the intervention group with a single, coordinated plan of care reported greater improvements in HRQOL relative to a comparison group.

The majority of participants were still in PSH at the most recent point of data collection. In the intervention group, the majority of participants exited for positive reasons. Although PSH provides a permanent

residency option, tenants may have different housing goals, and a positive exit of a tenant has the benefit of providing housing with services to another chronically homeless individual.

### Health-Related Quality of Life

The baseline normed mean MCS (38–39) and PCS (41–43) score indicated a substantial departure from the national average for age and gender (50), suggesting that their baseline HRQOL was lower than that of the average person but within range of similar populations, including opioid-dependent

patients.<sup>29</sup> Overall, participants reported an increase in HRQOL and a decrease in depressive symptoms. The HRQOL rate of change was greatest at enrollment as they adjusted to new housing and services, with a slower rate of change over time as individuals adapted to their new surroundings and systems of care. Service delivery model (intervention or comparison) accounted for a significant amount of variance in change of both PCS and MCS scores over time, indicating that the intervention HRQOL showed greater improvements over time relative to the comparison group. This result highlights the importance of coordinated service delivery for those in PSH, suggesting that a single, coordinated plan of care between medical providers and coordinated care teams may improve the HRQOL for those in PSH relative to those without a single plan of care.

In addition to increasing HRQOL, the current study found a reduction in ED use. After 2 years, the total number of ED visits for the intervention group decreased by more than 70%. Given that participants were required to report 3 ED visits in the 2 years before enrollment, it is possible that individuals were enrolled in a year of high ED use and that they would have reduced ED use over time regardless of the intervention. The impact of service delivery separate from housing could not be determined without comparison group data. Still, when one considers the cost of each ED visit, the reduction in expensive visits may indicate potential for cost-saving from a societal perspective.

### Limitations

This study had several limitations. An intent-to-treat analysis was not possible because data were not available from participants who discontinued housing. There were also limited data on characteristics that may be related to the outcomes of interest (e.g., substance use and comorbidities) and no ED data was available from the comparison group. Furthermore, the comparison group was arbitrarily determined and not randomized as this was an observational study. As such, it was not possible to account for naturally occurring organizational or team member differences. In addition, the researchers did not assess program fidelity. Finally, a larger sample

**TABLE 3—Hierarchical Linear Growth Models Assessing Change in Time on Mental Component Summary (MCS), Physical Component Summary (PCS), and Patient Health Questionnaire-9 (PHQ-9) Scores by Service Delivery Model Among Those Formerly Chronically Homeless Living in Permanent Supportive Housing: Houston, TX, 2014 to 2017**

	MCS, Coefficient (SE)	PCS, Coefficient (SE)	PHQ-9, Coefficient (SE)
Initial status: service delivery model	0.12 (1.25)	-1.33 (0.96)	0.05 (0.77)
Linear slope (time): service delivery model	2.40** (0.84)	1.92** (0.65)	-1.41** (0.54)
Quadratic slope (time <sup>2</sup> ): service delivery model	-0.29* (0.14)	-0.22* (0.11)	0.13 (0.09)

Note. Service delivery model compares comparison service delivery model to intervention (shared plan of care). Models include random effects and age, insurance, and mental illness. Coefficient indicates direction of linear and quadratic slope.

\*P ≤ .05; \*\*P ≤ .01.



would have allowed for the investigation of areas in which the model needs to be modified to meet the unique needs of the diverse population that is being served.

## Public Health Implications

Evidence of the success of PSH coordinated service delivery models in enhancing the HRQOL of the individuals who receive care will be necessary in advocating for support of such models. As in the current study, service delivery models may be funded through a Medicaid Section 1115 demonstration waiver, which allows for the otherwise prohibited use of Medicaid to pay for benefits (e.g., care coordination).<sup>4</sup> For those eligible for Medicaid, another way to sustain funding to support similar models is through partnerships with Medicaid managed care organizations, which may be able to cover the cost of services for Medicaid members if there is a demonstration of cost-saving.<sup>4</sup> Innovative service delivery models could also be supported through other value-based purchasing models that support payment for outcomes as opposed to traditional fee-for-service payment models. The Centers for Medicare and Medicaid Services Quality Strategy aims to provide better care, promote healthier people and communities, and support smarter spending. Evidence supporting service delivery models that contribute to cost saving and better patient outcomes may encourage managed care organizations and other insurance providers to consider alternative payment models that support these strategies.

## Conclusions

Individuals in PSH receiving services through an innovative integrated care model with a single, coordinated plan of care reported significant and meaningful increases in their HRQOL with potential societal cost saving through a reduction in ED use. The potential for health and cost-saving benefits supports a financial and humanitarian justification for the continued investment in service delivery models that provide collaborative care to formerly chronically homeless individuals with complex medical, mental, and behavioral health needs. **AJPH**

## CONTRIBUTORS

V. Schick conceptualized, designed, and performed the analysis; interpreted the data; drafted the article; and edited the article. L. Wiginton assisted in the concept, the review

of the literature and Discussion, and the interpretation of the findings; and reviewed and edited the article. C. Crouch and F. Isbell assisted in the concept and design, the review of the literature and Discussion, and the interpretation of the findings; and reviewed and edited the article. A. Haider assisted with interpretation of the findings and reviewed and edited the article. All authors approved the final version.

## ACKNOWLEDGMENTS

The service delivery and collection of evaluation data were funded through a Section 1115 Medicaid Demonstration Waiver and the City of Houston Health Department. The first author (V.S.) was funded by Healthcare for the Homeless-Houston to evaluate their service delivery model.

An evaluation of the service delivery models was previously presented at conferences and in internal reports.

We are thankful for the collaboration of New Hope Housing and, also, to the service delivery team members who provided high-quality services and collected data. We would like to express particular gratitude to the City of Houston Health Department for sharing data and helping with the interpretation of the various service delivery models.

## CONFLICTS OF INTEREST

The authors have no conflicts of interest.

## HUMAN PARTICIPANT PROTECTION

The secondary analysis of de-identified data was approved by the University of Texas Health Science Center institutional review board.

## REFERENCES

- Henry M, Watt R, Rosenthal L, Shivji A. The 2017 Annual Homeless Assessment Report (AHAR) to Congress: December 2017. 2017. Available at: <https://www.hudexchange.info/resources/documents/2017-AHAR-Part-1.pdf>. Accessed December 12, 2018.
- Homelessness DC. *A Technical Guide for HUD Programs*. Washington, DC: Office of Community Planning and Development, Office of Special Needs Assistance Programs, US Department of Housing and Urban Development; 2007.
- Rog DJ, Marshall T, Dougherty RH, et al. Permanent supportive housing: assessing the evidence. *Psychiatr Serv*. 2014;65(3):287–294.
- Wilkins C. Connecting permanent supportive housing to health care delivery and payment systems: opportunities and challenges. *Am J Psychiatr Rehabil*. 2015;18(1):65–86.
- Henwood BF, Weinstein LC, Tsemberis S. Creating a medical home for homeless persons with serious mental illness. *Psychiatr Serv*. 2011;62(5):561–562.
- US Department of Housing and Urban Development, Office of Policy Development and Research, Pearson CL. The applicability of Housing First models to homeless persons with serious mental illness: final report. 2007. Available at: <https://www.huduser.gov/portal/publications/hsgfirst.pdf>. Accessed December 12, 2018.
- Horvitz-Lennon M, Kilbourne AM, Pincus HA. From silos to bridges: meeting the general health care needs of adults with severe mental illnesses. *Health Aff (Millwood)*. 2006;25(3):659–669.
- Doherty WJ, McDaniel SH, Baird MA. Five levels of primary care/behavioral healthcare collaboration. *Behav Healthc Tomorrow*. 1996;5(5):25–27.
- Rosenheck R, Morrissey J, Lam J, et al. Service delivery and community: social capital, service systems integration,

and outcomes among homeless persons with severe mental illness. *Health Serv Res*. 2001;36(4):691–710.

- McHugo CJ, Bebout RR, Harris M, et al. A randomized controlled trial of integrated versus parallel housing services for homeless adults with severe mental illness. *Schizophr Bull*. 2004;30(4):969–982.
- Parsell C, ten Have C, Denton M, Walter Z. Self-management of health care: multimethod study of using integrated health care and supportive housing to address systematic barriers for people experiencing homelessness. *Aust Health Rev*. 2018;42(3):303–308.
- Rosenheck R, Kaspro W, Frisman L, Liu-Mares W. Cost-effectiveness of supported housing for homeless persons with mental illness. *Arch Gen Psychiatry*. 2003;60(9):940–951.
- Larimer ME, Malone DK, Gamer MD, et al. Health care and public service use and costs before and after provision of housing for chronically homeless persons with severe alcohol problems. *JAMA*. 2009;301(13):1349–1357.
- Kertesz SG, Baggett TP, O'Connell JJ, Buck DS, Kushel MB. Permanent supportive housing for homeless people—reframing the debate. *N Engl J Med*. 2016;375(22):2115–2117.
- The National Academies of Sciences, Engineering, and Medicine. Permanent supportive housing evaluating the evidence for improving health outcomes among people experiencing chronic homelessness. 2018. Available at: <https://www.nap.edu/catalog/25133/permanent-supportive-housing-evaluating-the-evidence-for-improving-health-outcomes>. Accessed December 12, 2018.
- Heath B, Wise Romero P, Reynolds K. A standard framework for levels of integrated healthcare. Washington, DC: Substance Abuse and Mental Health Services Administration, Health Resources and Services Administration, Center for Integrated Health Solutions; 2013.
- Waxmonsky J, Auxier A, Romero PW, Heath B. Integrated practice assessment tool. 2014. Available at: [https://www.integration.samhsa.gov/operations-administration/IPAT\\_v\\_2.0\\_FINAL.pdf](https://www.integration.samhsa.gov/operations-administration/IPAT_v_2.0_FINAL.pdf). Accessed December 12, 2018.
- Henwood BF, Siantz E, Hrouda DR, Innes-Gomberg D, Gilmer TP. Integrated primary care in assertive community treatment. *Psychiatr Serv*. 2018;69(2):133–135.
- Homeless emergency assistance and rapid transition to housing: defining “chronically homeless.” *Fed Regist*. 2015;80(233):75791–75804.
- US Department of Housing and Urban Development Office of Community Planning and Development. Notice establishing additional requirements for a continuum of care centralized or coordinated assessment system. 2017. Available at: <https://www.hudexchange.info/resource/5208/notice-establishing-additional-requirements-for-a-continuum-of-care-centralized-or-coordinated-assessment-system>. Accessed December 12, 2018.
- Remler DK, Van Ryzin GG. *Research Methods in Practice: Strategies for Description and Causation*. Thousand Oaks, CA: Sage Publications; 2010.
- O'Connell M, Rosenheck R, Kaspro W, Frisman L. An examination of fulfilled housing preferences and quality of life among homeless persons with mental illness and/or substance use disorders. *J Behav Health Serv Res*. 2006;33(3):354–365.

23. Poulin SR, Mettraux S, Culhane DP. The history and future of homeless management information systems. *Homelessness in America*. 2008;3:171–180.
24. US Department of Housing and Urban Development. HMIS Data Standards Manual. 2017. Available at: <https://www.hudexchange.info/resources/documents/HMIS-Data-Standards-Manual-2017.pdf>. Accessed December 12, 2018.
25. Ware JE Jr, Kosinski M. *SF-36 Physical & Mental Health Summary Scales: A Manual for Users of Version 1*. 2nd ed. Lincoln, RI: Quality Metric; 2001.
26. McHorney CA, Ware JE Jr, Lu JR, Sherbourne CD. The MOS 36-item Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. *Med Care*. 1994; 32(1):40–66.
27. Failde I, Ramos I. Validity and reliability of the SF-36 health survey questionnaire in patients with coronary artery disease. *J Clin Epidemiol*. 2000;53(4):359–365.
28. Falck RS, Wang J, Carlson RG, Siegal HA. Crack-cocaine use and health status as defined by the SF-36. *Addict Behav*. 2000;25(4):579–584.
29. Griffin ML, Bennett HE, Fitzmaurice GM, Hill KP, Provost SE, Weiss RD. Health-related quality of life among prescription opioid-dependent patients: results from a multi-site study. *Am J Addict*. 2015;24(4):308–314.
30. Ware J, Kosinski M, Bjorner J, Turner-Bowker D, Gandek B, Maruish M. *Determining Important Differences in Scores. User's Manual for the SF-36v2 Health Survey*. Lincoln, RI: QualityMetric; 2007.
31. Kroenke K, Spitzer RL, Williams JB. The PHQ-9. *J Gen Intern Med*. 2001;16(9):606–613.
32. Brown RT, Kiely DK, Bharel M, Mitchell SL. Geriatric syndromes in older homeless adults. *J Gen Intern Med*. 2012;27(1):16–22.
33. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J R Stat Soc B*. 1995;57(1):289–300.
34. Anderson D. Hierarchical linear modeling (HLM): an introduction to key concepts within cross-sectional and growth modeling frameworks. Technical report# 1308. Behavioral Research and Teaching of Oregon. 2012. Available at: <http://www.brtprojects.org/wp-content/uploads/2016/05/TechRpt1308.pdf>. Accessed December 12, 2018.
35. Henry M, Watt R, Rosenthal L, Shivji A, Khadduri J, Culhane DP. The 2016 Annual Homeless Assessment Report (AHAR) to Congress: Part 1, point in time estimates. US Department of Housing and Urban Development. 2016. Available at: <https://www.hudexchange.info/resources/documents/2016-AHAR-Part-1.pdf>. Accessed December 12, 2018.