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SPECIAL ISSUE: BRIDGING THE GAP BETWEEN RESEARCH AND HEALTH POLICY-INSIGHTS FROM THE ROBERT WOOD JOHNSON FOUNDATION CLINICAL SCHOLARS PROGRAM

# Comparative Cost Analysis of Housing and Case Management Program for Chronically Ill Homeless Adults Compared to Usual Care

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**Objective.** To assess the costs of a housing and case management program in a novel sample—homeless adults with chronic medical illnesses.

**Data Source.** The study used data from multiple sources: (1) electronic medical records for hospital, emergency room, and ambulatory medical and mental health visits; (2) institutional and regional databases for days in respite centers, jails, or prisons; and (3) interviews for days in nursing homes, shelters, substance abuse treatment centers, and case manager visits. Total costs were estimated using unit costs for each service.

**Study Design.** Randomized controlled trial of 407 homeless adults with chronic medical illnesses enrolled at two hospitals in Chicago, Illinois, and followed for 18 months.

**Principal Findings.** Compared to usual care, the intervention group generated an average annual cost savings of (–)\$6,307 per person (95 percent CI: –16,616, 4,002;  $p = .23$ ). Subgroup analyses of chronically homeless and those with HIV showed higher per person, annual cost savings of (–)\$9,809 and (–)\$6,622, respectively. Results were robust to sensitivity analysis using unit costs.

**Conclusion.** The findings of this comprehensive, comparative cost analyses demonstrated an important average annual savings, though in this underpowered study these savings did not achieve statistical significance.

**Key Words.** Homeless, housing and case management, chronic illnesses, randomized, costs

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Throughout the United States, several cities, counties, and states face a growing number of individuals and families who are homeless, largely uninsured or publicly insured, and disproportionately consume costly public health, social, and legal services. Nearly 1 percent of the U.S. population experience homelessness each year. Federal and local efforts have focused resources to programs serving those who are chronically homeless with the

anticipation that higher potential cost savings per person can be realized with these programs in this population compared to the general homeless population. However, the population of chronically homeless represents less than 20 percent of the homeless population (US Department of Housing and Urban Development Office of Community Planning and Development, 2008). The rates of chronic medical illness, mortality, and use of emergency health services are high even among adults who are not chronically homeless as they face numerous barriers to accessible nonurgent, primary care, and medication (Fleischman and Farnham 1992; O'Connell 1999, 2005; Hwang 2000; Kushel, Vittinghoff, and Haas 2001; Kushel et al. 2002). As the United States faces record home foreclosures, the newly homeless are increasing. A 2009 national survey of 178 organizations providing services to those who are homeless estimated 10–19 percent had become homeless in the past year due to foreclosure (National Coalition for the Homeless 2009). Therefore, programs and services that cater to a broader segment of the homeless population may be highly beneficial, though the associated costs of providing such services remain uncertain.

The literature on the health and costs related to individuals who are homeless is extensive, yet these studies have limited generalizability as the samples are highly selective subgroups, individuals who are homeless with additional characteristics, such as severe mental illness, substance abuse disorders, HIV infection, veterans, or are frequent users of health care or legal services. Nearly all are exclusively samples of the chronically homeless. All have been observational studies, except for two trials (Tsemberis, Gulcur, and Nakae 2004; Hwang et al. 2005; Leaver et al. 2007; Larimer et al. 2009; Sadowski et al. 2009). One trial was of individuals who were chronically homeless, severely mentally ill, and also had concomitant substance abuse disorders (Larimer et al. 2009); the other trial is the parent study for this paper (Sadowski et al. 2009).

Facing similar limitations of highly selected subgroups, most commonly those with severe mental illness, along with a paucity of controlled trials, the peer-reviewed cost literature frequently lacks important components of cost and describes inconsistent findings. Studies suggesting cost savings or cost neutrality of services are scarce and outnumbered by studies that suggest costs

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outweigh benefits (Salit et al. 1998; Culhane, Metraux, and Hadley 2002; Rosenheck et al. 2003; Stefancic and Tsemberis 2007; Gilmer, Manning, and Ettner 2009; Larimer et al. 2009).

We recently published the results of the first prospective, randomized controlled trial of adults who were homeless for 30 days or more and had any chronic medical illness. In contrast to previous studies in this field, the majority of the participants in this trial were not severely mentally ill, substance abusers, HIV infected, veterans, or frequent users of the health care system. Using an intention-to-treat analysis, this trial reported a significant reduction in emergency room visits and hospitalizations after 18 months (24 and 29 percent, respectively) and a nonstatistically significant increase in quality of life (Sadowski et al. 2009). The reduction in hospital and emergency room services led to the hypothesis driving this cost analyses, that is, whether offering housing and case management to homeless adults with chronic medical illness will lead to an overall cost savings. Answering such questions is a critical step in the translation of research findings into decision making at the public policy level, which is an increasing priority in homelessness research (Hwang and Henderson 2010). Using a societal perspective (Gold et al. 1996), this paper is a comprehensive cost analysis of the medical/health, legal, housing, and social service costs consumed and saved over 18 months among homeless adults with chronic medical illnesses.

## METHODS

### *Setting and Sample*

We conducted a two-arm randomized controlled trial enrolling inpatients at a public hospital and a private, nonprofit hospital in Chicago from September 2003 to December 2007. The study methods are fully described in a previous publication (Sadowski et al. 2009), and the study protocol was approved by the Institutional Review Boards at both study hospitals.

The housing and case management intervention was based on the Housing First model and offered three components: interim housing at a respite center after hospital discharge, stable housing after recovery from hospitalization, and case management based in study hospital, respite, and housing sites.

Patients were eligible for inclusion if they were at least 18 years of age, fluent in English or Spanish, without stable housing during the 30 days prior to hospitalization, were not the guardian of minor children needing housing, and had at least one of 15 chronic medical illnesses documented in the medical

record (Sadowski et al. 2009). Patients were ineligible if their hospital physician found them incapable of self-care upon hospital discharge.

Hospital social workers referred inpatients who were homeless and trained research assistants verified eligibility within 24 hours of the referral from the hospital social worker. After the baseline interview, patients were randomized in a 1 : 1 allocation to the intervention group or the usual care group. Patients assigned to the intervention group received case management services from the on-site intervention social worker, including plans for discharge to a respite care facility for transitional care between hospitalization and stable housing. Patients assigned to the usual care group were referred back to the original hospital social worker and received the usual discharge planning services with no continued relationship after hospital discharge. As there are no standard services available to homeless adults with chronic medical illnesses in the setting of this study, those in usual care would need to initiate and maintain contact with community-based resources to receive services. We assessed the services used by each participant during the 18-month study period.

### *Study Variables*

At baseline, we used the medical record and interviews to assess sociodemographic and health care variables. Alcohol and illicit drug use were assessed using the alcohol and drugs module of the Addiction Severity Index. Symptoms of mood and anxiety disorders were assessed using the Brief Patient Health Questionnaire of the Primary Care Evaluation of Mental Health Disorders and classified into its four subscales—major depression, other depression, panic disorder, and other anxiety disorder (Spitzer, Kroenke, and Williams 1999). Quality of life was assessed using the Aids Clinical Trial Group SF21 instrument and reported using its component subscales: physical functioning, mental health, general health perception, role functioning, social functioning, pain, energy, and cognitive functioning. These eight subscales were transformed to a 100-point scale, with higher values representing quality of life (ACTG). The duration of homelessness was assessed at the 1-month interview; chronic homelessness was defined as lacking stable housing for 24 or more months.

### *Outcomes*

The primary outcome in this cost analysis is the total annual cost of services used per homeless adult. The medical/health, legal, housing, and

social services include (1) hospital days, (2) emergency room visits, (3) outpatient visits to community clinics, hospital clinics, mental health clinics, and substance abuse treatment centers, (4) days in residential substance abuse treatments, (5) nursing home stays, (6) legal services, including days detained in jails and prisons, (7) days in respite, shelter, and other housing, and (8) case management. Mortality was similar in both groups (Intervention  $n = 25$ , 12 percent, Usual Care  $n = 23$ , 11 percent) and not included in the cost analysis. Unit costs are described in Table 1.

The dates of service for each hospitalization and emergency room visit were verified with medical records. Electronic medical record surveillance at the two enrolling hospitals was supplemented by requesting medical records from outside hospitals and emergency rooms. We received 89 percent of the medical records requested from outside hospitals. The number of outpatient medical and mental health visits, substance abuse treatment encounters (residential and outpatient), and case management contacts were identified at each follow-up interview using the modules of the HIV cost study (ACTG). Nursing home stays were identified during follow-up interviews. The number of arrests and the number of days in jail or prison were assessed using public access websites for local jails and state prisons. Days in respite (interim housing) were assessed using the institution's database. Stable housing days (type and duration) were assessed during the follow-up interviews at 1, 3, 6, 9, 12, and 18 months following the discharge from the enrolling hospitalization.

### *Statistical Analysis*

Our sample size of 200 in each group was based on the hypotheses of the parent trial to detect differences in hospitalizations and emergency room visits. This sample size provided the ability to detect a difference of at least 30 percent for emergency room visits at 90 percent power and a two-tailed  $\alpha$  of 0.05 (*Arcus Quick-Stat*, Biomedical version 1.0, 1997, Cambridge, UK).

We performed a comparative cost analysis between the intervention (i.e., offering of the housing and case management program) and the usual care group following an intention-to-treat approach. We followed a societal perspective that was recommended by the U.S. panel on cost-effectiveness research (Gold et al. 1996). Under a societal perspective, all impacts on costs due to an intervention are accounted for irrespective of who bears

Table 1: Unit Costs

<i>Items</i>	<i>Unit Costs</i>	<i>Year</i>	<i>2010 Dollars</i>	<i>Reference</i>
Medical services				
Hospitalization, daily costs	0 night: \$4,857; 1 night: \$7,131; 2 nights: \$6,880; 3 nights: \$9,326; 4 nights: \$10,652; 5 + nights: \$2,023/ night	2007	0 night: \$5,098; 1 night: \$7,485; 2 nights: \$7,221; 3 nights: \$9,789; 4 nights: \$1,1181; 5 + nights: \$2,123/ night	Brown and Beaugard (2004)
ER visits	\$560	2003	\$662.36	Machlin (2006)
Community clinics	\$25	2007	\$26.24	Coalitionclincs.org/ncnm.html
Hospital clinics	\$145	2007	\$152.20	Brown and Beaugard (2004)
Mental health clinics	\$106	2004	\$122.12	Brown and Beaugard (2004)
Substance abuse treatment visits	\$26	2002	\$31.45	Substance Abuse and Mental Health Services Administration, Office of Applied Studies (2003)
Residential substance abuse treatment (per day)	\$76	2002	\$91.94	Substance Abuse and Mental Health Services Administration, Office of Applied Studies (2003)
Nursing home days	\$143	2010	\$143.62	Huskamp, Stevenson, and Chernew (2010)
Legal services				
Legal costs of making an arrest	\$120	1995	\$171.36	Hirschel and Dean (1995)
A jail day per inmate	\$60	2007	\$62.98	Sullivan (2010)
Judicial costs of a conviction			\$5,000.00	Legislative Analyst's Office, California
A prison day per inmate	\$129	2008	\$130.39	Legislative Analyst's Office, California

*continued*

Table 1. *Continued*

<i>Items</i>	<i>Unit Costs</i>	<i>Year</i>	<i>2010 Dollars</i>	<i>Reference</i>
Residential services—daily costs per person				
Respite housing	\$30	2010	\$30.13	Spellman et al. (2010)
Shelter	\$25	2010	\$25.11	Spellman et al. (2010)
Stable housing	\$30	2010	\$30.13	Spellman et al. (2010)
Case management services				
Face-to-face encounters			1 hour @ \$15/hour	
Telephone encounters			15 min @ \$15/hour + \$0.15	

them. Analyses were conducted on all services accumulated over the 18-month follow-up period, and results are reported in annualized form. Differences in each specific component of costs between the two groups were also reported. Total cost was assessed by accumulating several types of services and utilizations and weighting them by national unit cost estimates obtained from various national datasets and reports (Table 1) (Gold et al. 1996; Rosenheck et al. 2003). We performed *t*-tests to compare study groups for each utilization and cost outcome, without assuming equal variance.

To adjust for slight imbalances in baseline-level covariates across randomized arms of the study, we first estimated a propensity score for treatment assignment using a logistic regression model after controlling for all the baseline characteristics and interactions between them. To ascertain that the estimated propensity score appropriately balanced all baseline covariates across treatment group, we ran a series of linear regressions where each of the baseline covariates was regressed on the treatment indicator weighted by the inverse propensity of treatment assignment (Rosenbaum and Rubin 1985; Hirano, Imbens, and Ridder 2003). We expected that if proper balancing was achieved, then the coefficients on the treatment indicators would not be significantly different from zero (balancing test) and also the absolute coefficient divided by the standard deviation of that baseline variable (balancing ratio) would be small (we used  $<0.5$  as a threshold) (Rosenbaum and Rubin 1985; Rosenbaum 1998).

For our main cost analyses, we calculated adjusted costs for each group using inverse propensity weighted estimators and studied the incremental total annual costs per person between the intervention and the usual care (Hirano, Imbens, and Ridder 2003). We studied sensitivity of the incremental total costs to variation in unit prices for different types of utilization. We varied each unit price from 50 percent of its baseline value (Table 1) to 150 percent and studied the effect of such variation on the incremental total costs. In a post hoc analysis, similar methods for cost analysis were repeated separately for each subgroup: HIV, chronically homeless, and any illicit drug use in 30 days prior to study enrollment.

There were no missing values in the analyses except for duration of homelessness, which was missing in 12 percent of the sample. Standard errors for adjusted analyses were obtained using 1,000 bootstrap replicates. All *p*-values were based on two-tailed tests. Statistical analysis was performed using *Stata* version 11.0 (StataCorp, College Station, TX, USA).

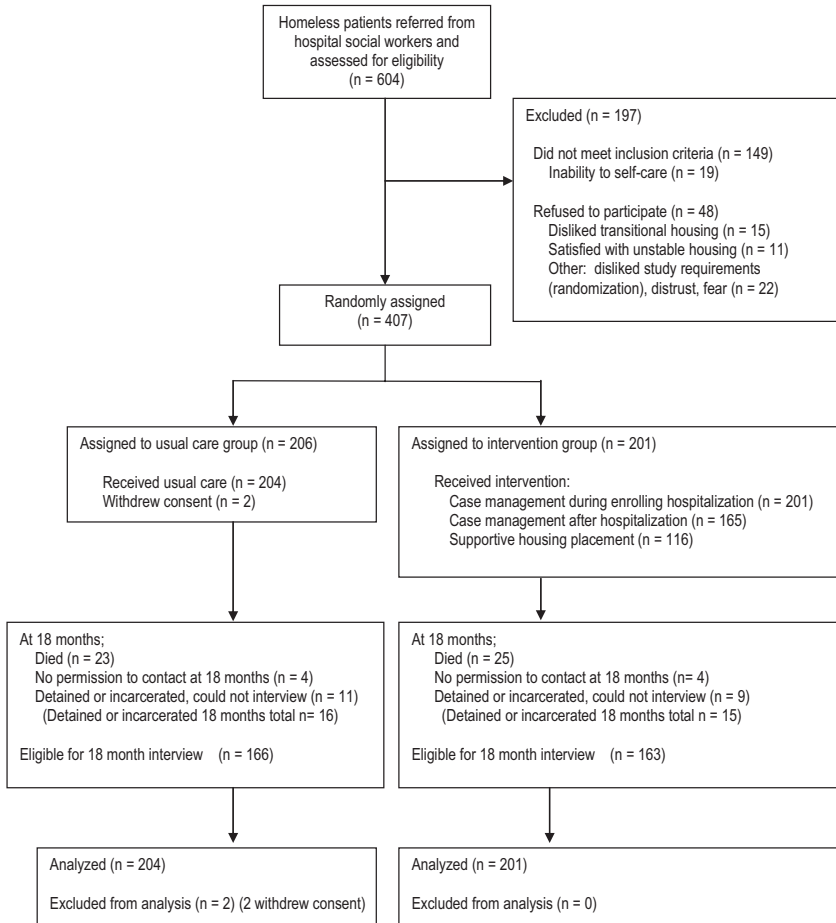


## RESULTS

Of the 455 eligible inpatients, 407 (89 percent) agreed to participate and were randomized; 201 were assigned to the intervention group, and 206 were assigned to the usual care group (see Figure 1). Two usual care participants withdrew their consent after randomization. See original paper for further details (Sadowski et al. 2009).

Baseline characteristics between the two study groups were similar except that more intervention participants had been hospitalized at the two

Figure 1: Study Diagram



enrolling hospitals during the year preceding enrollment ( $p = .05$ ) (Table 2). Of the 405 trial participants, 45 percent had insurance (37 percent Medicaid, 8 percent Medicare) and 36 percent were HIV seropositive. During the 30 days preceding the enrolling hospitalization, 27 percent lived on the streets, 43 percent stayed in shelters, and 50 percent were temporarily staying with family or friends. The median duration of homelessness was 30 months (interquartile range: 11–105 months).

### *Comparison of Medical, Legal, Housing, and Case Management Service Use*

Table 3 shows the unadjusted, annualized comparison of medical, legal, housing, and case management service use between the intervention and usual care group. Those in the intervention group incurred 2.6 fewer hospitalized days ( $p = .08$ ), 1.2 fewer emergency room visits ( $p = .04$ ), 7.5 fewer days in residential substance abuse treatment ( $p = .004$ ), 9.8 fewer nursing home days ( $p = .08$ ), and 3.8 more outpatient visits each year ( $p = .01$ ) annually compared with those in the usual care group. Those in the intervention group had 7.7 fewer prison days during the study period ( $p = .07$ ). Those in the intervention group had 62 more days in stable housing ( $p = .001$ ) and 12 more days in respite care ( $p = .002$ ) than those in the usual care group. Those in the intervention group used case management services (i.e., telephone calls and face-to-face meetings) more frequently than those in the usual care group, having on average 18 more encounters per year ( $p < .001$ ).

### *Comparative Costs*

The estimated propensity scores were able to balance each of the baseline covariates across treatment groups. The balancing ratios ranged from 0.0005 to 0.13, indicating good substantive balance when adjusted for the propensity scores.

Adjusting for all baseline covariates, the annual mean incremental effect (per person) of the intervention compared to usual care was estimated to be  $-\$6,307$  (95 percent CI:  $-16,616, 4,002$ ;  $p = .23$ ) (see Table 4). The negative value indicates cost savings. In Table 4, we show the components of the overall cost by study group. As expected, the intervention group had lower costs compared with those in the usual care group in five components—with annual mean cost savings (we use the ‘(–)’ notation to convey that cost savings means a negative incremental mean costs between intervention and usual care): (1)

Table 2: Baseline Characteristics

<i>Characteristic</i>	<i>Intervention N = 201</i>	<i>Usual Care N = 204</i>	<i>p-Value</i>
<b>Sociodemographic characteristics</b>			
Age, years, mean (SD)	47 (8.2)	46 (9.1)	.30
Male gender, no. (%)	149 (74)	161 (79)	.26
Race or ethnic group, no. (%)			
African American	162 (81)	154 (76)	.64
Hispanic	17 (8)	17 (8)	
White	13 (7)	21 (10)	
Mixed or other	9 (4)	12 (6)	
Education, highest level attained, no. (%)			
Less than high school graduation	97 (48)	91 (44)	.73
High school graduation	59 (29)	62 (30)	
Education beyond high school	45 (22)	51 (25)	
Marital status, no. (%)			
Never married	116 (57)	102 (51)	.38
Divorced/separated	65 (32)	80 (40)	
Widowed	15 (7)	11 (5)	
Currently married	8 (4)	8 (4)	
Veteran, no. (%)	18 (9)	21 (10)	.68
No medical insurance, no. (%)	101 (50)	122 (60)	.05
<b>Health care and health characteristics</b>			
Emergency room visits at study hospitals in prior 12 months, mean (SD)	2.2 (3.3)	2.5 (4.9)	.49
Hospitalizations at study hospitals in prior 12 months, mean (SD)	1.2 (2.0)	0.9 (1.5)	.05
HIV seropositive, no. (%)	75 (37)	71 (35)	.60
Mental health symptoms, no. (%)			
Major depression	80 (40)	92 (45)	.28
Other depression	66 (33)	68 (33)	.92
Panic disorder	30 (15)	36 (18)	.46
Other anxiety disorder	80 (40)	91 (45)	.33
ACTG SF-21 quality-of-life subscales, mean (SD)*			
Physical functioning	45.9 (29)	45.7 (28)	.95
Mental health	42.3 (26)	39.6 (26)	.29
General health perceptions	19.5 (19)	21.2 (22)	.42
Role functioning	38.7 (34)	36.0 (32)	.42
Social functioning	57.6 (32)	53.1 (31)	.15
Bodily pain	48.0 (30)	45.6 (29)	.43
Energy	44.0 (28)	39.0 (26)	.06
Cognitive functioning	61.6 (27)	58.9 (27)	.31
Alcohol and drug use, number of days consumed in past 30 days consumed, mean (SD)			
Alcohol to intoxication	5.4 (9)	4.3 (8)	.19
Cocaine	4.7 (9)	4.8 (9)	.92

*continued*

Table 2. *Continued*

<i>Characteristic</i>	<i>Intervention N = 201</i>	<i>Usual Care N = 204</i>	<i>p-Value</i>
Heroin	4.3 (9)	5.4 (10)	.26
Opiates	0.2 (2)	0.1 (1)	.52
Sedatives	0.2 (2)	0.03 (0.4)	.38
Cannabis	1.0 (4)	0.8 (3)	.55

\*Subscales transformed to achieve a range of possible scores of 0–100.

ACTG-21, AIDS Clinical Trials Group 21-Item Short Form Instrument; HIV, human immunodeficiency virus.

(–)\$6,786 for hospitalizations (95 percent CI: –16,208, 2,636;  $p = .16$ ); (2) (–)\$704 for emergency room visits (95 percent CI: –1,517, 109;  $p = .09$ ); (3) (–)\$897 for residential substance abuse treatment (95 percent CI: –1,648, 146;  $p = .02$ ); (4) (–)\$895 for nursing home days (95 percent CI: –1,077, 2,869;  $p = .37$ ); and (5) (–)\$1,051 for legal costs (95 percent CI: –2,944, 842;  $p = .28$ ). As expected, the intervention group had higher costs compared with those in the usual care group in three components—with incremental annual mean higher costs of: (1) \$689 for outpatient visits (95 percent CI: 15, 1,363;  $p = .05$ ); (2) \$3,154 for housing and respite costs (95 percent CI: 2,321, 3,987;  $p < .001$ ); and (3) \$183 for case management (95 percent CI: 112, 254;  $p < .001$ ).

Sensitivity analyses based on variation in unit prices revealed that the point estimates for the incremental effect on total costs were most sensitive to hospitalization costs and cost of public housing (Figure 2). However, neither reduction of hospitalization costs to 50 percent of its baseline value nor increase in public housing costs to 150 percent of its baseline value changed the sign (negative) of the total incremental effect. All estimates remained nonsignificant at the 5 percent level.

### *Secondary Subgroup Analysis*

We conducted a secondary analysis of three subgroups selected using characteristics that represent samples in the homeless literature, namely HIV or AIDS, chronic homelessness, and illicit drug users. Though not achieving statistical significance, the incremental effect of intervention group compared to usual care resulted in an overall cost savings ranging from (–)\$3,484 to (–)\$9,809 per person per year across the three subgroups (Table 5). Similar to the findings from the full study sample, the findings

Table 3: Annualized Effects of Housing and Case Management Program for Chronically Ill Homeless Adults (Unadjusted)

<i>Service Use</i>	<i>Intervention</i> <i>N = 201</i> <i>Mean (SD)</i>	<i>Usual Care</i> <i>N = 204</i> <i>Mean (SD)</i>	<i>Mean Difference</i> <sup>†</sup> <i>Mean (SE)</i>
<b>Medical services</b>			
Number of hospitalizations	1.95 (3.5)	2.4 (3.6)	-0.47 (0.4)
Hospitalized days	8.75 (13.7)	11.39 (16)	-2.64 (1.5)**
Emergency room visits	2.59 (5.1)	3.84 (7)	-1.27 (0.6)*
Total outpatient visits	8.8 (20)	5 (10)	3.84 (1.6)*
Community clinics	3.0 (12)	2.0 (6)	1.07 (0.9)
Hospital clinics	2.4 (12)	0.0 (3)	1.46 (0.9)**
Mental health clinics	3.5 (9)	2.2 (6.4)	1.31 (0.8)**
Substance abuse treatment visits	20.2 (58)	7.9 (33)	12.24 (4.7)*
Number of days in residential SAT	3.5 (11)	11.1 (36)	-7.51 (2.6)*
Nursing home days	13.3 (47)	23.1 (64)	-9.77 (5.6)**
<b>Legal</b>			
Number of arrests <sup>‡</sup>	0.21 (0.4)	0.26 (0.5)	-0.05 (0.04)
Number of days in jail	17.9 (50)	13.9 (40)	4.06 (4.5)
Number of convictions <sup>§</sup>	0.03 (0.2)	0.07 (0.2)	-0.03 (0.01)**
Number of days in prison	6.0 (32)	13.8 (50)	-7.73 (4.2)**
<b>Residence</b>			
Days in respite	14.4 (29)	6.3 (25)	8.13 (2.7)*
Days in shelter	28.8 (51)	28.9 (64)	-0.07 (5.7)
Days with family/friends	51.0 (83)	80.7 (106)	-29.66 (9.4)*
Days in paid housing	112 (122)	1.9 (18)	109.9 (8.7)*
Days homeless	121 (120)	183.5 (130)	-62.3 (12.4)*
<b>Case management</b>			
Face-to-face meetings	18.7 (20)	5.9 (12)	12.75 (1.7)*
Telephone meetings	5.8 (10)	0.5 (2)	5.32 (0.7)*

\* $p < .05$ .

\*\* $p < .10$ .

<sup>†</sup>Mean difference = Mean service use of Intervention group—mean service use of Usual Care group, *t*-test, unequal variance assumed.

<sup>‡</sup>Arrests were determined by the number of times a subject was sent to jail.

<sup>§</sup>Number of convictions were determined by the number of times a subject was sent to prison from jail.

SAT, substance abuse treatment; SD, standard deviation; SE, standard error.

from each subgroup analyses were consistent; the costs of providing housing and case management services and the outpatient visits were higher for those in the intervention group, whereas the costs of hospitalizations, emergency room visits, nursing home stays, residential substance abuse treatment stays, and legal costs were higher for those in the usual care group.

Table 4: Annualized Total Expenditures and Expenditures by Category (Adjusted†)

Costs (in U.S. Dollars)	Intervention N = 201		Usual Care N = 204		Mean Difference* N = 204 Mean SE
	Mean	SD	Mean	SD	
Hospitalization	18,231	3,091	25,017	3,907	-6,786 (4,807)
Emergency visit	1,755	295	2,458	343	-704 (415)**
Outpatient	1,997	307	1,308	165	689 (344)*
Residential SAT	283	97	1,181	363	-897 (383)*
Nursing home	2,377	616	3,272	789	-895 (1,006)
Legal	2,010	474	3,060	847	-1051 (966)
Housing	4,260	380	1,106	192	3,154 (425)*
Case management	287	32	104	18	183 (36)*
Total	31,199	3,295	37,506	4,328	-6,307 (5,260)

\* $p < .05$ .

\*\* $p < .10$ .

†Propensities for alternative treatment assignments were estimated using study variables that included sex, race/ethnicity, age, education, insurance, veteran, marital status, enrolling hospital site, prior year’s hospital and emergency room use, baseline quality-of-life subscale scores on physical functioning, mental health, general health perception, role functioning, social functioning, bodily pain, energy, cognitive functioning, mental health symptoms of major depression, other depression, panic disorder and other anxiety disorders, human immunodeficiency virus status, housing status at 30 days prior to enrollment, and baseline alcohol and other drug use. Adjusted group-level costs and the treatment effects were estimated using inverse propensity score weighted estimators.

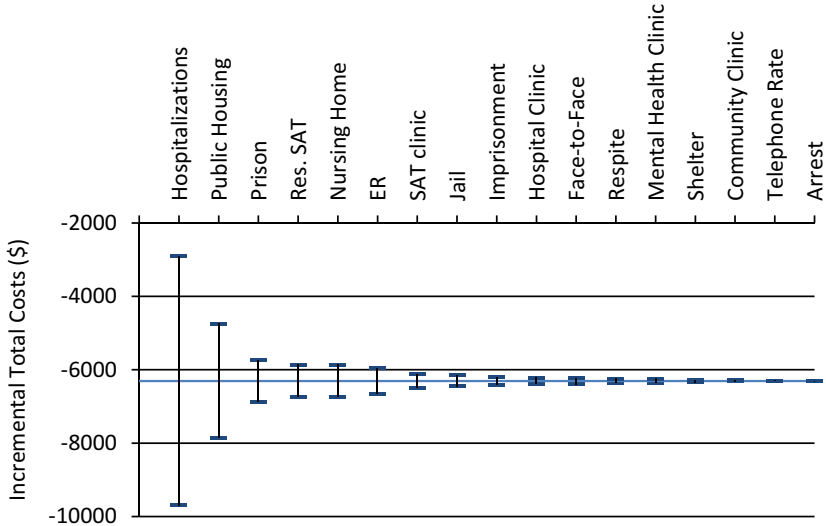
‡Mean difference = Mean service use of intervention group – mean service use of usual care group, *t*-test, unequal variance assumed.

SAT, substance abuse treatment; SD, standard deviation; SE, standard error.

## COMMENT

The findings from this comprehensive cost analysis using data from a randomized controlled trial demonstrated an estimated overall annual cost savings of (–)\$6,307 per homeless adult with a chronic medical illness offered housing and case management. The findings of this study are particularly important in two respects: (1) this is the first cost analyses from a randomized controlled trial of homeless adults with chronic medical illness; and (2) the findings from this study pertain to a broad spectrum of adults who experience homelessness. Nearly all of the literature is based on studies of people who experience chronic homelessness, representing 18 percent of the homeless population. Our inclusion criteria was a minimum duration of homelessness of 30 days to better mirror the current population experiencing homelessness; 58 percent were homeless for 2 years or more, 76 percent were homeless for 1 year or

Figure 2: Sensitivity Analyses of Variation in Unit Prices on Mean Incremental Effect on Total Annual Costs. For Each Utilization Category, Unit Prices Are Varied from 50 to 150 percent



more, and 24 percent were homeless for less than 1 year. Additionally, prior studies use samples selected on the basis of characteristics associated with the highest use of costly health and social services, characteristics such as having severe mental illness, HIV/AIDS, or substance abuse disorders (Culhane, Metraux, and Hadley 2002; Rosenheck et al. 2003; Hwang et al. 2005; Leaver et al. 2007; Larimer et al. 2009). These characteristics were present in a minority of our study sample; our corresponding inclusion criterion was the presence of at least one chronic medical illness.

At the population level, based on our point estimate, the housing and case management intervention may have the potential to save \$5.5 billion over next 10 years, with 100,000 incident homeless cases with at least one chronic medical condition each year (Zerger 2002; Garibaldi and Conde-Martel 2005) at a discount rate of 3 percent.

As expected, we found that those in the intervention group had higher costs in outpatient visits, housing, and case management compared with those in usual care group. Also, those who experienced chronic homelessness had the highest cost savings (\$9,809 annually per person).

Table 5: Annualized Expenditures for Selected Subgroups (Adjusted<sup>†</sup>)

	<i>Differences in Mean Costs (Intervention—Usual Care in U.S. Dollars)</i>		
	<i>HIV</i> ( <i>N</i> = 146) <i>Mean (SE)</i>	<i>Chronically Homeless</i> ( <i>N</i> = 208) <i>Mean (SE)</i>	<i>Any Drug Use in Past 30 days</i> ( <i>N</i> = 238) <i>Mean (SE)</i>
Hospitalization	−8,311 (7,023)	−8,329 (7,178)	−2,857 (5,910)
Emergency visit	−239 (516)	−818 (715)	−1,336 (536)*
Outpatient	1,001 (616)	653 (439)	836 (334)*
Residential SAT	−986 (443)*	−1,087 (563)**	−1,201 (583)*
Nursing home	−873 (754)	−2,933 (1,541)**	−1,949 (915)*
Legal	−1,435 (1,667)	−485 (1,163)	−1,268 (1,477)
Housing	4,022 (554)*	3,030 (593)*	4,047 (522)*
Case management	199 (47)*	161 (45)*	243 (51)*
Total	−6,622 (7,046)	−9,809 (7,862)	−3,484 (6,418)

\* $p < .05$ ;\*\* $p < .10$ .

<sup>†</sup>Propensities for alternative treatment assignments were estimated using study variables that included sex, race/ethnicity, age, education, insurance, veteran, marital status, enrolling hospital site, prior year's hospital and emergency room use, baseline quality-of-life subscale scores on physical functioning, mental health, general health perception, role functioning, social functioning, bodily pain, energy, cognitive functioning, mental health symptoms of major depression, other depression, panic disorder and other anxiety disorders, human immunodeficiency virus status, housing status at 30 days prior to enrollment, and baseline alcohol and other drug use. Adjusted group-level costs and the treatment effects were estimated using inverse propensity score weighted estimators.

HIV, human immunodeficiency virus; SAT, substance abuse treatment; SE, standard error.

The incremental effect that we observed is driven primarily due to cost savings in hospitalizations, emergency room visits, residential substance abuse treatment, and nursing home use. The latter two costs are frequently missing from cost studies.

Our cost estimations are conservative. We excluded the costs of any emergency room visit leading to a hospitalization as well as the costs incurred during the enrolling hospitalization. We used a societal perspective in our analysis and presented each of the components of overall costs so that a subset of these components can be accumulated under a different perspective. For this population, the societal perspective comes very close to a public-dollar perspective. The exception would be found under circumstances in which medical service use and housing costs may be borne by private payers. We did not have reliable information on the productivity changes with the housing program. We expect that neglecting this component of cost (income) will make our cost savings estimates conservative.



The strengths of our study include its rigorous design and the use of an intention-to-treat approach to all analyses, excellent participation and 18 month follow-up rates, the use of broad inclusion criteria, nonreliance on self-report for many costs (i.e., hospitals, emergency rooms, jails, and prisons), inclusion of a novel and important outcome, nursing home stays, and the consistency of cost findings in the primary and subgroup analyses.

Our study had several limitations as well. Although we included a broad spectrum of homelessness, our findings should be applied to those who have interacted with the medical care system, that is, at least one hospitalization in a 2.5-year period. We did not have ambulance service use data for the cost analysis. Our sample size was underpowered to detect a statistically significant cost difference, especially relevant for a cost outcome that was skewed. Lastly, our study setting was a single metropolitan city.

Changing state and national policy affecting those who are homeless is daunting. Recent work by AHRQ has shown that impending expansion of health insurance coverage for low-income homeless individuals who will receive Medicaid may not be sufficient to reduce health care costs for homeless individuals (Hwang and Henderson 2010). Solutions would seemingly entail policy makers and leaders from the housing and health care sectors collaborating in novel ways and sharing in the challenging decisions of resource allocation. We are encouraged by the remarks of Secretary of Housing and Urban Development (HUD)—Donovan acknowledging the need for HUD to work closely with the Department of Health and Human Services (HHS) to link HUD and HHS programs (Donovan 2009). Our findings support the incorporation of housing and case management services into health care delivery policies for homeless populations similar to ours as, at worst, a cost-neutral measure of targeted support. We also hope that physicians and medical service organizations find this cost evidence compelling and use these findings to drive the development of programs coordinating services at the local level to improve their patients, and communities, health.

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## NOTE

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Appendix SA1: Author Matrix.

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