Effect of a Housing and Case Management Program on Emergency Department Visits and Hospitalizations Among Chronically Ill Homeless Adults
A Randomized Trial

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ADDRESSING THE HEALTH NEEDS of the homeless population is a challenge to physicians, health institutions, and federal, state, and local governments. Homelessness is pervasive in the United States, and an estimated 3.5 million individuals are likely to experience homelessness in a given year.[1] To address this problem, 860 cities and counties have enacted 10-year plans to end homelessness, and 49 states have created Interagency Councils on Homelessness.[2]

Rates of chronic medical illness are high among homeless adults. With the exception of obesity, stroke, and cancer, homeless adults are far more likely to have a chronic medical illness such as human immunodeficiency virus (HIV), hypertension, and diabetes mellitus and more likely to experience a complication from the illness because they lack adequate housing and regular, uninterrupted treatment.[3-6] Homeless adults are frequent users of costly emergency department and hospital services, largely paid for by public dollars.[7-14] The combination of chronic medical illnesses and poor access to primary health care has sub-

Context Homeless adults, especially those with chronic medical illnesses, are frequent users of costly medical services, especially emergency department and hospital services.

Objective To assess the effectiveness of a case management and housing program in reducing use of urgent medical services among homeless adults with chronic medical illnesses.

Design, Setting, and Participants Randomized controlled trial conducted at a public teaching hospital and a private, nonprofit hospital in Chicago, Illinois. Participants were 407 social worker–referred homeless adults with chronic medical illnesses (89% of referrals) from September 2003 until May 2006, with follow-up through December 2007. Analysis was by intention-to-treat.

Intervention Housing offered as transitional housing after hospitalization discharge, followed by placement in long-term housing; case management offered on-site at primary study sites, transitional housing, and stable housing sites. Usual care participants received standard discharge planning from hospital social workers.

Main Outcome Measures Hospitalizations, hospital days, and emergency department visits measured using electronic surveillance, medical records, and interviews. Models were adjusted for baseline differences in demographics, insurance status, prior hospitalization or emergency department visit, human immunodeficiency virus infection, current use of alcohol or other drugs, mental health symptoms, and other factors.

Results The analytic sample (n=405 [n=201 for the intervention group, n=204 for the usual care group]) was 78% men and 78% African American, with a median duration of homelessness of 30 months. After 18 months, 73% of participants had at least 1 hospitalization or emergency department visit. Compared with the usual care group, the intervention group had unadjusted annualized mean reductions of 0.5 hospitalizations (95% confidence interval [CI], −1.2 to 0.2), 2.7 fewer hospital days (95% CI, −5.6 to 0.2), and 1.2 fewer emergency department visits (95% CI, −2.4 to 0.03). Adjusting for baseline covariates, compared with the usual care group, the intervention group had a relative reduction of 29% in hospitalizations (95% CI, 10% to 44%), 29% in hospital days (95% CI, 8% to 45%), and 24% in emergency department visits (95% CI, 3% to 40%).

Conclusion After adjustment, offering housing and case management to a population of homeless adults with chronic medical illnesses resulted in fewer hospital days and emergency department visits, compared with usual care.

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stantial health and economic consequences.

Prior intervention research has focused on subgroups of the homeless

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population, particularly those with severe mental illness, substance abuse disorders, veterans, or those with HIV. Few studies of these subgroups have found any positive effect of housing and case management on health or health service use,[14,15] although most compared 2 active interventions without a comparison group receiving usual care.[16,17] Missing are intervention studies of homeless individuals with any chronic medical illness. Our study sought to determine whether an intervention that provided housing and case management for homeless adults with chronic medical illness would reduce hospitalizations and visits to the emergency department.

METHODS

Design and Setting

We conducted a randomized controlled trial at 2 primary study sites (a public teaching hospital and a private, nonprofit hospital) in Chicago, Illinois. Participants were enrolled from September 2003 until May 2006, with follow-up provided through December 2007. The housing and case management intervention was administered at the primary study sites, 2 respite sites, and 10 housing agencies. The study protocol was approved by the institutional review boards at the primary study sites.

Sample

Hospital social workers referred any inpatient who did not have housing to the study team on weekdays between 8 AM and 4 PM. Patients were eligible for inclusion if they were referred at least 24 hours before hospital discharge, were at least 18 years of age, were fluent in English or Spanish, were without stable housing (housing for which a person has adequate resources and for which there are no time limits) during the 30 days prior to hospitalization, were not the guardian of minor children needing housing, and had at least 1 of the following chronic medical illnesses documented in the medical record: hypertension or diabetes requiring medication, thromboembolic disease, renal

failure, cirrhosis, congestive heart failure, myocardial infarction, atrial or ventricular arrhythmias, seizures within the past year or requiring medication for control, asthma or emphysema requiring at least 1 emergency department visit or hospitalization in the past 3 years, cancer, gastrointestinal tract bleeding (other than from peptic ulcer disease), chronic pancreatitis, and HIV. These illnesses were selected because of the increased mortality risk they pose in homeless individuals.[18] Patients were ineligible if their hospital physician judged them incapable of self-care on hospital discharge.

Study Variables

At baseline, we used the medical record to assess sociodemographic and health care variables (sex, age, insurance status, number of hospitalizations, and emergency department visits at the 2 primary study sites during the prior year) and interviewed participants to determine their self-classified race and ethnicity, education, and veteran status. Race and ethnicity options were defined by the participants. Details of alcohol and illicit drug use were assessed using the alcohol and drugs module of the Addiction Severity Index.[19] Consumption of alcohol to intoxication was defined as 5 or more alcoholic drinks of any type during a single 24-hour period during the previous 30 days. Any illicit drug use was defined as any use of heroin, cocaine, cannabis, or amphetamines (or of nonprescribed barbiturates, methadone, or opiates) during the 30 days preceding the enrollment hospitalization.

Symptoms of mood and anxiety disorders were assessed using the Brief Patient Health Questionnaire of the Primary Care Evaluation of Mental Health Disorders, a screening instrument that classifies symptoms into 4 disorders: major depression, other depression, panic attack, and other anxiety. A positive screen result for major depression is defined as having little interest in doing things or feeling down, depressed, or hopeless at any time in the preceding 2 weeks and also having 5 or more

depression symptoms that occur more than half of the days or nearly every day. A positive screen result for panic syndrome is defined as having a recurrent, sudden anxiety attack in the previous 4 weeks resulting in worry as well as having 4 of 11 additional anxiety symptoms. The prevalence of major depression detected with this instrument in the general population ranges from 5% to 13%; the prevalence of panic disorder ranges from 2% to 9%.[20]

Quality of life was assessed at baseline and at 18 months using the physical functioning and mental health subscales from the AIDS Clinical Trials Group 21-Item Short Form instrument.[21] These subscales were transformed to a 100-point scale, with higher values representing higher quality of life. Representative subscale mean scores from HIV-infected persons receiving care were 69.08 for physical functioning and 57.55 for mental health.[22] The quality-of-life subscales were used to characterize the sample at baseline and as a secondary outcome. Duration of homelessness was assessed at the 1-month interview.

Outcomes

Outcomes were the number of hospitalizations, total hospital days, and number of emergency department visits during the 18-month follow-up period. Emergency department visits that led to hospital admission were excluded, because the 2 primary study sites seek reimbursement only for the hospital admission; essentially all (>95%) inpatients are admitted to the hospital via the emergency department in the 2 primary study sites.

At the primary sites, the outcomes were assessed using electronic surveillance of the medical records for all trial participants. At the other study hospitals, these outcomes were initially identified during the follow-up interviews using the health service screening modules of the HIV/AIDS Treatment Adherence, Health Outcomes and Cost Study[23] and then verified after reviewing the requested medical records. We received medical records from 66 other

study hospitals, of which 58 were in Illinois, 33 were within Chicago city limits, and 8 were out of state.

The sum of data from the primary study sites and the other study hospitals produced the total number of hospitalizations, hospital days, and number of emergency department visits at all hospitals. All clinicians caring for the study participants on the wards and in the emergency departments and clinics were blinded to study group assignment.

Data Collection

Trained research associates verified eligibility within 24 hours of the referral from the hospital social worker. The associates explained the study, obtained written informed consent, and performed the baseline interview at the participant's bedside.

Participants were interviewed at 1, 3, 6, 9, 12, and 18 months following enrollment and compensated $20 after each interview. At all interviews we assessed housing status, quality of life, and health service use, and we updated tracking information. Mental health symptom assessment ended with the 12-month interview. Follow-up interviews were conducted at sites convenient for the participant and conducive to privacy (eg, clinic areas, hospital chapels, participant homes, the Cook County Jail, restaurants, and public spaces such as parks). We tracked participants using a multifaceted approach, with ongoing updates of contact information and active surveillance of electronic sources (eg, primary study site encounters and city jail and state prison Web sites) as well as searching parks, street corners, and other locations that participants were known to frequent.

Research personnel who collected outcome data from medical records were blinded to study group assignment. Collection of medical records from other study hospitals ended June 30, 2008; we received 89% of the medical records requested.

Randomization

Prior to implementation of the study, the randomization strategy was deter-mined by an outside statistician using Stata version 7.0 (StataCorp, College Station, Texas) to generate the starting point for randomization. Using a random-numbers table, one investigator (L.S.S.) placed each group assignment into a sealed opaque envelope and stored it until needed for enrollment. Participants were randomized in a 1:1 allocation to the intervention group or the usual care group using numbered envelopes opened by the participant after the baseline interview, thus concealing allocation assignment from participants and research personnel until after enrollment. Randomization was stratified by study hospital.

Intervention

Participants randomized 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.

The intervention, developed by a consortium of 14 hospitals, respite care centers, and housing agencies in Chicago, had 3 integrated components: provision of transitional housing at respite care centers, subsequent placement in stable housing, and case management. Case management for the intervention was provided on-site at the primary study sites, the respite care facilities, and the stable housing sites. The case managers had master's-level training and case loads of 20 or fewer active participants. Participants were defined as inactive if they lost contact with the case manager for 3 months or more. The program allowed reengagement at any time. Hospital case managers facilitated discharge planning during subsequent hospitalizations and placement in respite care or back in stable housing sites. Respite and housing case managers facilitated the participant's housing placement and coordinated appropriate medical care, with substance abuse and mental health treatment referrals coordinated as needed. Each intervention participant had contact, at least biweekly, with his or her on-site case manager. The intervention case managers had weekly team meetings to coordinate the housing, social service, and medical care needs of participants.

The housing intervention was based on the Housing First model, which encourages early placement in stable housing following a short transitional stay in respite care after hospitalization.[15] The stable housing options were provided by 10 community agencies offering group living arrangements as well as apartments at single and scattered sites. Housing decisions were based on availability, sex, sobriety, HIV status, and participants' geographic preferences.

Usual Care

Participants randomized 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. Typically patients would be provided transportation to an overnight shelter if no other accommodation could be arranged before discharge. Participants with HIV had access to case management after hospital discharge through a Ryan White program, while those without HIV had access to general case management services. Access to any respite or stable housing site for usual care participants was unaffected by the intervention or participation in the study.

Statistical Analysis

Our sample size of 200 in each group was based on funding limits. Using prevalence estimates and hospitalizations from a prior study in our setting,[12] we had the ability to detect a difference of at least 30% for emergency department visits and 33% for hospitalizations, with 90% power and 2-tailed $\alpha = .05$ (Arcus Quick-Stat, Biomedical Version 1.0, Cambridge, United Kingdom).

We conducted an intention-to-treat analysis for each of the outcomes (emergency department visits, hospitalizations, and total hospital days) at all hospitals (primary outcome) and also at primary study sites only. Emer-

Figure. Flow of Participants Through the Trial
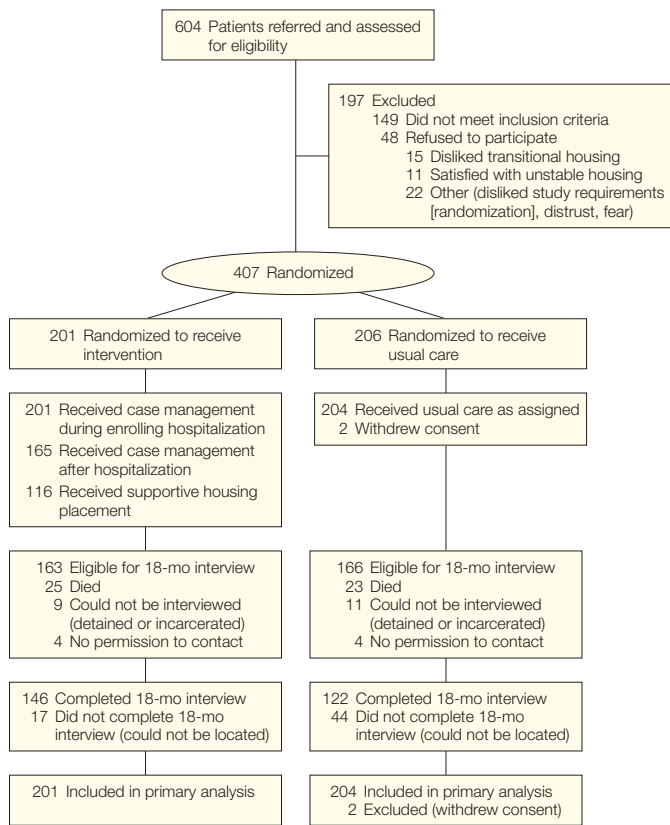
gency department visits and hospitalization outcomes were categorized as 0, 1, 2, and 3 or more events to address the high degree of skewness in the data; exact tests were used to compare the categorized outcome distributions. We also performed *t* tests to compare study groups for each outcome, without assuming equal variance. Although the count data were nonnormal and highly skewed, with a large number of zeros for each outcome, the sample size was sufficiently large to potentially allow *t* tests. Annualized rate differences per person and per 100 persons were calculated.

To better model the underlying distribution of the count data and increase statistical efficiency, the analysis plan prespecified that regression models would be used for each outcome. Likelihood ratio tests and the Vuong test[24] suggested that zero-inflated negative binomial regression models better fit the data than zero-inflated Poisson models or regular negative binomial models, owing to the data dispersion and the preponderance of zeros. The models adjusted for all baseline covariates; the zero-inflation factor was modeled with an intercept and indicators for an emergency department visit in the prior year and for hospitalization in the prior year.

Incidence rate ratios were produced by exponentiating the study group regression coefficients. We report rate reduction statistics equal to 1 minus the incident rate ratio. In a separate analysis, inverse probability weighting using all baseline covariates was used to adjust for differential follow-up for the all-hospital outcomes.[22] Confidence intervals were calculated with robust standard errors.

We used *t* tests to compare groups on quality of life at follow-up. To handle missing quality-of-life data (83 participants in the usual care group and 55 in

the intervention group were missing such data at the 18-month interview), we used inverse probability weighting, using the baseline covariates.[25]

All *P* values were based on 2-tailed tests; values less than .05 were considered statistically significant. Statistical analysis was performed using Stata version 10.0.

RESULTS

Of the 604 referrals from hospital social workers, 455 inpatients were eligible, of whom 407 (89%) agreed to participate and were randomized; of these, 201 were assigned to the intervention group and 206 were assigned to the usual care group (**FIGURE**). Two usual care participants withdrew their consent after randomization because they did not want to participate in the follow-up interviews and were excluded from analyses. After 18 months of follow-up, 25 participants had died in the intervention group and 23 had died in the usual care group. Of the 176 intervention participants alive at 18 months, 116 reached stable housing and 15 were incarcerated. Of the 181 usual care participants alive at 18 months, 19 reached stable housing and 16 were incarcerated. Of those eligible for the 18-month follow-up, 146 of 163 intervention participants (90%) and 122 of 166 usual care participants (73%) were interviewed. Excluding death, no adverse events were reported in either study group.

Baseline characteristics between the 2 study groups were similar, except that more intervention participants had been hospitalized at the primary study sites during the year preceding enrollment (*P* = .05) (**TABLE 1**). The 25th, 50th, and 75th percentiles for hospitalizations at the primary study sites in the prior year were 0, 1, and 2, respectively, for the intervention group but 0, 0, and 1, respectively, for the usual care group. The 25th, 50th, and 75th percentiles for emergency department visits at the primary study sites in the prior year were 0, 1, and 3, respectively, for both groups. Of the 405 trial participants, 45% had insurance (37% Medicaid, 8%

Medicare). Among trial participants, 36% were HIV seropositive, and nearly 60% reported drug use in the 30 days preceding the enrolling hospitalization (Table 1). During the 30 days preceding the enrolling hospitalization, 27% of participants had lived on the streets, 43% had stayed in shelters, and 50% were temporarily staying with family or friends. The median duration of homelessness was 30 months (interquartile range, 11-105 months).

Primary Outcomes

When the unadjusted primary outcomes (hospitalizations, hospital days, and emergency department visits) were treated as continuous measures, over 18 months there were 583 hospitalizations in the intervention group (1.93 hospitalizations/person per year [n=201]) and 743 in the usual care group (2.43 hospitalizations/person per year [n=204]); however, the reduction of –0.5 hospitalizations/person per year (95% confidence interval [CI], –1.2 to 0.2) in the intervention group as compared with the usual care group was not statistically significant ($P=.16$) (**TABLE 2**). Over 18 months, there were 2635 hospital days at all hospitals in the intervention group (8.74 days/person per year) and 3500 in the usual care group (11.44 days/person per year); the reduction of –2.7 hospital days/person per year (95% CI, –5.6 to 0.2) in the intervention group was not statistically significant ($P=.07$). Over 18 months, there were 787 emergency department visits at all hospitals in the intervention group (2.61 visits/person per year) and 1154 in the usual care group (3.77 visits/person per year); the reduction of –1.2 emergency department visits/person per year (95% CI, –2.4 to 0.03) in the intervention group was not statistically significant ($P=.06$).

Thus, for every 100 homeless adults offered the intervention, the expected benefits over the next year would be 49 (95% CI, –20 to 119) fewer hospitalizations, 270 (95% CI, –23 to 563) fewer hospital days, and 116 (95% CI, –3 to 235) fewer emergency department visits.

When we assessed outcomes at all hospitals using zero-inflated negative binomial models adjusted for all baseline variables, the intervention group had lower rates of hospitalizations, hospital days, and emergency department

Table 1. Baseline Characteristics

	No. (%)		
Characteristic	Intervention (n = 201)	Usual Care (n = 204)	P Value
Sociodemographic characteristics			
Age, mean (SD), y	47 (8.2)	46 (9.1)	.30
Men	149 (74)	161 (79)	.26
Race or ethnic group			
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			
Less than high school graduation	97 (48)	91 (44)	.73
High school graduation	59 (29)	62 (30)	
Beyond high school	45 (22)	51 (25)	
Veteran	18 (9)	21 (10)	.68
No medical insurance	101 (50)	122 (60)	.05
Housing location 30 d prior to enrollment			
Streets, abandoned buildings, parks	83 (41)	98 (48)	.17
Shelters	50 (25)	64 (31)	.15
Doubled up with family or friends	106 (53)	102 (50)	.58
Transient hotel	13 (7)	16 (8)	.70
Other[a]	20 (10)	18 (9)	.70
Health care and health characteristics			
Hospitalizations at primary study sites in prior 12 mo, mean (SD)	1.24 (2.0)	0.89 (1.5)	.05
Emergency department visits at primary study sites in prior 12 mo, mean (SD)	2.23 (3.3)	2.52 (4.9)	.49
HIV seropositive	75 (37)	71 (35)	.60
Alcohol intoxication in prior 30 d	114 (43)	128 (37)	.22
Any illicit drug use in prior 30 d	120 (60)	118 (58)	.70
Mental health symptoms			
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)[b]			
Physical functioning	45.9 (28.6)	45.7 (28.0)	.95
Mental health	42.3 (25.6)	39.6 (25.9)	.29

Abbreviations: ACTG SF-21, AIDS Clinical Trials Group 21-Item Short Form instrument; HIV, human immunodeficiency virus.
[a] Participant spent 1 or more of last 30 days in residential treatment for substance use, detained in jail or prison, group home, public housing, or rental unit which the participant did not have sufficient resources to maintain.
[b] Subscales transformed to achieve a range of possible scores of 0-100.

Table 2. Unadjusted Study Outcomes: Hospitalizations, Hospital Days, and Emergency Department Visits, by Study Group

	Mean (25th, 50th, 75th Percentiles) at 18 mo		Mean Difference (95% CI)		
Outcomes (All Hospitals)	Intervention	Usual Care	18-mo Follow-up	12-mo Annualized	P Value
Hospitalizations	2.9 (0, 1, 3)	3.6 (0, 2, 5)	–0.7 (–1.8 to 0.3)	–0.5 (–1.2 to 0.2)	.16
Hospital days	13.1 (0, 6, 16)	17.2 (0, 7.5, 24)	–4.1 (–8.4 to 0.3)	–2.7 (–5.6 to 0.2)	.07
Emergency department visits	3.9 (0, 1, 4)	5.7 (0, 2, 6)	–1.7 (–3.5 to 0.04)	–1.2 (–2.4 to 0.03)	.06

Abbreviation: CI, confidence interval.

Table 3. Rate Reduction of Study Outcomes in the Intervention Group Compared With the Usual Care Group, Adjusting for Baseline Characteristics[a]

Outcome (All Hospitals)	Rate Reduction (95% CI)	P Value
Hospitalizations	29 (10 to 44)	.005
Hospital days	29 (8 to 45)	.01
Emergency department visits	24 (3 to 40)	.03

Abbreviation: CI, confidence interval.
[a] Zero-inflated negative binomial models were used for each outcome because of the count data and the large number of zero values. Incident rate ratios were calculated for the negative binomial component of the model; the rate reduction figures reported are equal to 1 minus the incident rate ratio. Baseline variables used for adjustment included sex, race, age, education, insurance, veteran, prior hospitalization or emergency department visit, human immunodeficiency virus status, enrolling primary study site, current alcohol and other drug use, physical function quality of life, mental health quality of life, and mental health disorders.

Table 4. Unadjusted Categorical Outcomes: Hospitalizations, Hospital Days, and Emergency Department Visits, by Study Group

Outcomes (All Hospitals)	Intervention	Usual Care	P Value
Hospitalizations			
0	58	58	
1	47	26	.03
2	31	33	
≥3	65	87	
Hospital days			
0	58	58	
1	8	2	.10
2	9	4	
≥3	126	140	
Emergency department visits			
0	65	54	
1	36	30	.007
2	33	19	
≥3	67	101	

visits (rate reductions of 29% (*P* = .005), 29% (*P* = .01), and 24% (*P* = .03), respectively) (TABLE 3). After adjusting for differential follow-up, the rate reductions at all hospitals became 34% for hospitalizations (*P* = .003), 42% for hospital days (*P* = .001), and 18% for emergency department visits (*P* = .13).

After 18 months, 73% of the sample had at least 1 hospitalization or emergency department visit. When outcomes at all hospitals (hospitalizations, hospital days, emergency department visits) after 18 months were categorized as 0, 1, 2, and 3 or more events, the unadjusted differences between the study groups were statistically significant for the number of hospitalizations and emergency department visits. The intervention participants had fewer hospitalizations (*P* = .03) and fewer emergency department visits (*P* = .007); the difference for the unadjusted categorized outcome for hospital days was not statistically significant (*P* = .10) (TABLE 4).

Secondary Analysis

Hospitalizations and Emergency Department Visits at Primary Study Sites. We had 100% of the outcome data occurring at the primary study sites and conducted a secondary analysis for this subgroup. When the primary study site outcomes (hospitalizations, hospital days, and emergency department visits) were categorized as 0, 1, 2, and 3 or more events, the unadjusted differences between the study groups were statistically significant; the intervention group had fewer hospitalizations (*P* = .002), fewer hospital days (*P* = .03), and fewer emergency department visits (*P* = .004).

When the unadjusted outcomes were treated as continuous measures, during the 18-month follow-up period there were 271 hospitalizations at primary study sites in the intervention group (0.93 hospitalizations/person per year [n = 201]) and 462 at primary study sites in the usual care group (1.53 hospitalizations/person per year [n = 204]). Thus, there was a reduction of –0.6 hospitalizations/person per year (95% CI, –1.0 to –0.3) in the intervention group compared with the usual care group (*P* < .001). Over 18 months, there were 1259 hospital days at primary study sites in the intervention group (4.18 days/person per year) and 2312 in the usual care group (7.56 days/person per year), for a reduction of –3.4 hospital days/person per year (95% CI, –5.3 to –1.4) in the intervention group (*P* < .001). Over 18 months, there were 546 emergency department visits at primary study sites in the intervention group (1.8 visits/person per year) and

942 in the usual care group (3.1 visits/person per year), for a reduction of –1.3 emergency department visits/person per year (95% CI, –2.3 to –0.2) in the intervention group (*P* = .02).

When we assessed each outcome using the zero-inflated negative binomial model adjusted for all baseline variables, the intervention group had lower rates of hospitalizations, hospital days, and emergency department visits, with rate reductions of 46% (*P* < .001), 46% (*P* < .001), and 36% (*P* = .001), respectively.

Quality of Life. Compared with baseline, both groups reported improvement in physical functioning and mental health at the 18-month interview. The mean physical functioning score was 53.6 (95% CI, 49.2 to 60.0) in the intervention group and 52.2 (95% CI, 46.9 to 57.4) in the usual care group; the difference was not statistically significant (*P* = .68). The mean mental health score was 57.0 (95% CI, 52.8 to 61.3) in the intervention group and 54.0 (95% CI, 49.1 to 58.9) in the usual care group; the difference was not statistically significant (*P* = .35). When we adjusted for missing data using inverse probability weighting, the differences in physical functioning and mental health outcomes remained statistically nonsignificant.

COMMENT

The findings of this randomized controlled trial demonstrate that a housing and case management program for chronically ill homeless adults reduced hospitalizations and emergency department visits. The magnitude of benefit was large: our most conservative analyses suggest a 29% reduction in hospital days and a 24% reduction in emergency department visits. This translates into substantial health care impact. For every 100 homeless adults (similar to those included in our study) offered the intervention, the expected benefits over the next year would be 49 fewer hospitalizations, 270 fewer hospital days, and 116 fewer emergency department visits.

Our findings apply to adults who lack stable housing, have been hospitalized at least once, and have 1 or more chronic medical illnesses. Despite these high-risk characteristics, 27% of our sample had no hospitalization or emergency department visit during the 18-month study period. However, other study participants used the health care system extensively, demonstrating the heterogeneity of the homeless population. We do not know the effect of housing assignment on where emergent hospital care was received, although we anticipated that participants with medical insurance limitations would seek care at the primary study sites. Although our intervention provided novel case management, the housing units were provided through routinely available federal housing funds.

Although our study outcomes differed from those reported in the review by Hwang et al,[16] similar to many of those studies our results did not show an improvement in health. We found no significant mortality difference between groups. For both groups, we found an improvement in quality of life (physical functioning and mental health from baseline), likely owing, in part, to low baseline values assessed during the enrolling hospitalization.

Several factors could account for the success of our intervention. First, our case management program was linked to the medical system and provided coordinated services across the full spectrum of settings—hospitals, respite care centers, and stable and unstable community housing. Second, our intervention recognized the heterogeneity within the homeless population and tried to tailor the supportive housing to the participant's needs and characteristics. Third, our intervention represented a city-wide consortium of clinicians, social workers, and housing and other advocacy groups, which facilitated a comprehensive and coordinated effort to obtain case management and housing for every intervention participant.

The strengths of our study were the rigorous design and analysis plan, the sample characteristics (broad inclusion criteria, including chronic medical illness; few individuals refusing to participate), the length of follow-up, and the blinded collection of outcome data. We had complete data for 100% of the sample from the 2 primary study sites. Because we lacked electronic access to the medical records of the other study hospitals, we had to rely on participant interviews to identify these outcomes, which probably biased results for all hospitals against the intervention group. We had opportunity to identify hospitalizations and emergency department visits at other study hospitals for 17% more of the intervention participants at the 18-month interview. After adjusting for the differential follow-up in our analyses, large rate reductions for all hospitals remained.

Our study has limitations. We did not measure the types of services provided or their costs. For example, we did not assess whether an emergency department visit was for refilling prescriptions (common when individuals have poor access to primary care) or for life-threatening health problems. We did not have complete follow-up of our outcomes at the other study hospitals. We did not have records of other medical services, such as primary care visits and mental health service encounters. Severity of illness was not measured at baseline, although participants were randomized to study groups, and the groups had similar physical and mental health functioning as assessed in our quality-of-life measurement as well as similar numbers of emergency department visits at the primary study sites during the year preceding enrollment. The study did not have the power to distinguish the independent effects of the case management and housing components of the intervention. Our community-wide intervention was tested in only a single setting, urban Chicago, Illinois.

In summary, an intervention comprising housing and case management greatly reduced emergency department and hospital use among homeless adults with chronic medical illnesses. These results provide a rationale and a blueprint for programs that address the needs of this vulnerable population.

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