The Cost-Effectiveness of Independent Housing for the Chronically Mentally Ill: Do Housing and Neighborhood Features Matter?

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Objective. To determine the effects of housing and neighborhood features on residential instability and the costs of mental health services for individuals with chronic mental illness (CMI).

Data Sources. Medicaid and service provider data on the mental health service utilization of 670 individuals with CMI between 1988 and 1993 were combined with primary data on housing attributes and costs, as well as census data on neighborhood characteristics. Study participants were living in independent housing units developed under the Robert Wood Johnson Foundation Program on Chronic Mental Illness in four of nine demonstration cities between 1988 and 1993.

Study Design. Participants were assigned on a first-come, first-served basis to housing units as they became available for occupancy after renovation by the housing providers. Multivariate statistical models are used to examine the relationship between features of the residential environment and three outcomes that were measured during the participant's occupancy in a study property: residential instability, community-based service costs, and hospital-based service costs. To assess cost-effectiveness, the mental health care cost savings associated with some residential features are compared with the cost of providing housing with these features.

Data Collection/Extraction Methods. Health service utilization data were obtained from Medicaid and from state and local departments of mental health. Non-mental-health services, substance abuse services, and pharmaceuticals were screened out.

Principal Findings. Study participants living in newer and properly maintained buildings had lower mental health care costs and residential instability. Buildings with a richer set of amenity features, neighborhoods with no outward signs of physical deterioration, and neighborhoods with newer housing stock were also associated with reduced mental health care costs. Study participants were more residentially stable in buildings with fewer units and where a greater proportion of tenants were other individuals with CMI. Mental health care costs and residential instability tend to be reduced in neighborhoods with many nonresidential land uses and a higher proportion of renters. Mixed-race neighborhoods are associated with reduced probability of mental health hospitalization, but they also are associated with much higher hospitalization costs if hospitalized. The degree of income mixing in the neighborhood has no effect.

Conclusions. Several of the key findings are consistent with theoretical expectations that higher-quality housing and neighborhoods lead to better mental health outcomes among individuals with CMI. The mental health care cost savings associated with these favorable features far outweigh the costs of developing and operating properties with them. Support for the hypothesis that “diverse-disorganized” neighborhoods are more accepting of individuals with CMI and, hence, associated with better mental health outcomes, is mixed.

Key Words: Mental illness, housing, neighborhoods

Housing has long been a neglected area in research on persons with chronic mental illness (CMI). As a result, there is little reliable information to guide important resource allocation decisions by both the public and private sectors. There are compelling reasons for closing this information gap: the estimated 4.6 million individuals with CMI who now live most of their lives in the community; the plight of the homeless; the high cost of mental health service use by the CMI (Frank, Goldman, and McGuire 1996); attention to community-based care options in proposals to reform the health care system; research findings suggesting that housing may contribute in a significant way to a number of individual mental health outcomes (Baker and Douglas 1990; Hanrahan et al. 2001; Nagy, Fisher, and Tessler 1988; Earls and Nelson 1988); and the increased involvement of states and localities in funding housing for persons with CMI (Frank, Lave, and Goldman 1988).

This article examines the mental health service costs and residential instability of 670 persons with CMI living in alternative types of independent housing in the community (i.e., different housing structure, tenantry, and neighborhood). It also assesses whether residential features associated with lower mental health service costs are cost-effective in the sense that the mental

This research was supported by the Robert Wood Johnson Foundation (grant no. 027105). The authors gratefully acknowledge the outstanding research assistance of Amy Robie, the programming assistance of David Kantor, the production assistance of Laura Vernon-Russell, and the invaluable aid of numerous staff members in the nonprofit housing development corporations, local mental health agencies, and state Medicaid offices in the study sites of the Robert Wood Johnson Foundation Program on Chronic Mental Illness that are the focus of this research.

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health cost savings outweigh the cost of purchasing housing with these features. The next section provides a brief review of the literature on housing and mental illness. This is followed by a description of the approach taken in this study, the data and research methods. We then present the results, followed by a discussion of their implications for mental health services, housing policy, and research.

LITERATURE REVIEW

The past 15 years have witnessed a growing emphasis on independent housing for persons with CMI (e.g., Carling 1984; Ohio Department of Mental Health [ODMH] 1988; Hough et al. 1995; Lehman et al. 1997). Those who favor independent housing believe that housing should be viewed “as a place to live, not a place to be treated” (Ohio Department of Mental Health 1988). Two basic principles underlie this perspective. First, the need for housing remains constant over a person’s lifetime, while the need for services varies. Second, only by disentangling housing from services will it be possible to create a system in which services are designed to support the person in housing instead of developing housing programs to facilitate treatment or services (Ohio Department of Mental Health 1988).

Although the pros and cons of independent housing for persons with CMI have been debated for more than two decades, rigorous research on the nature and effects of this approach to housing is extremely limited (Newman 2001). Much of the mental health literature that addresses housing issues focuses on housing with on-site services, such as sheltered care or board-and-care, rather than on independent apartment units in the housing market at large (e.g., Bond et al. 1989; Hodgins, Cyr, and Gaston 1990; Drake et al. 1997). Other studies that examine mental health outcomes of individuals with CMI living “in the community” provide little information about these community settings, making it difficult to judge whether they are, in fact, independent (e.g., Earls and Nelson 1988). Additionally, many of these studies do not control for specific attributes of the housing setting, such as its physical characteristics (e.g., structure type, number of units), whether all dwellings in the structure are occupied by persons with CMI, or the attributes of the surrounding neighborhood. Without such controls, it is impossible to distinguish the effects of a range of potentially relevant factors, such as service utilization, from the effects of housing per se (Newman 1992, 2001). Much past research has also been based on very small samples. Finally, past

benefit-cost and cost-effectiveness analyses pertaining to persons with mental illness have focused mainly on different modes of treatment—not different types of housing (e.g., Jerrell and Hu 1989; Dickey et al. 1997; Rosenheck, Frisman, and Gallup 1995). Thus, while previous research suggests that independent housing has salutary effects on individuals with mental illness, it has not examined what housing features have the most important effects. Nor has it explored how the mental health outcomes associated with different configurations of housing compare to their costs.

CONCEPTUAL FRAMEWORK

The conceptual foundation for the relationship between housing configuration and mental health outcomes stems from the work of Earls and Nelson (1988), who build on the motivation-hygiene theory of Herzberg et al. (1974) and Bradburn (1969). According to this theory, long-term psychiatric patients struggle to satisfy “pain-avoidance needs,” which range on a continuum from pain to relief. Failure to satisfy these needs results in worse mental health, poorer functioning, and psychiatric symptomatology. Earls and Nelson suggest that quality of housing may be one way individuals with CMI can move toward the “relief” end of the continuum.

Although there are no empirical studies that examine the effects of physical quality, there is some suggestion in the literature that individuals with CMI react differently to buildings of different size. Persons with mental illness appear to fare better when they live in smaller-scale housing developments (e.g., Nagy, Fisher, and Tessler 1988; Nelson, Hall, and Walsh-Bowers 1998). Possible explanations include the more homelike and less institutional atmosphere in buildings with fewer units, the greater likelihood that fewer units fosters a sense of community among tenants, and the less threatening atmosphere in smaller buildings.

Other literature (e.g., Trute and Segal 1976; Segal, Silverman, and Baumohl 1989; Segal and Aviram 1978; Hall, Nelson, and Fowler 1987; Newman et al. 1994) suggests that the neighborhood surrounding the dwelling may also affect where an individual with CMI is located on the pain-avoidance continuum. Contrary to expectations, these empirical studies indicate that “diverse-disorganized” neighborhoods—those with socioeconomically and demographically diverse populations, with a mix of commercial and residential land uses, and not physically pristine—are associated with better mental

health outcomes for the CMI, perhaps because they are more tolerant and less rejecting of residents with mental illness.

An even less well-developed literature addresses the effects of tenantry characteristics on mental health outcomes (Hodgins, Cyr, and Gaston 1990; Nagy, Fisher, and Tessler 1988; Newman et al. 2001). This limited body of research offers two opposing speculations. To the extent that living among others with similar characteristics is comfortable and secure, then individuals living in properties devoted exclusively or largely to occupants with CMI would be expected to experience the most positive mental health outcomes. But if anonymity about one's illness increases one's sense of self-esteem and well-being, or possible disruptions by neighbors with CMI increase stress, then living in properties where persons with CMI do not predominate would be associated with the most beneficial effects. The empirical findings of Newman et al. (2001) are consistent with the first speculation, while those of Hodgins, Cyr, and Gaston (1990) and Nagy, Fisher, and Tessler (1988) comport with the second scenario.

BACKGROUND

The 1986–1991 Robert Wood Johnson Foundation Program on Chronic Mental Illness (RWJF-PCMI) was a national demonstration program designed to test the benefits of centralizing the organization and financing of mental health and related services in local mental health authorities. A distinctive feature of the RWJF-PCMI was the inclusion of a significant housing intervention alongside the organizational and financing intervention. As part of the demonstration program, each of the nine participating sites established a nonprofit housing development corporation devoted to the development, ownership, and management of independent housing for persons with chronic mental illness (Cohen and Somers 1990; Newman and Ridgely 1994). The RWJF-PCMI provided a \$1 million loan at 4 percent interest and a 10-year term to each corporation.

Eligible tenants were those suffering from chronic mental illness, which was defined by three criteria: diagnosis, disability, and duration. Tenants had diagnoses that produced persistent dysfunction, including schizophrenia, major depression, bipolar disorder, and organic brain syndrome (excluding dementia), were functionally impaired, and had been suffering from mental illness for one year or more. All nonprofit development corporations focused on housing the chronically mentally ill with severe disabilities, though they

excluded active substance abusers and those with recent histories of fire-setting, assaultive behavior, or suicidal behavior. Prior living arrangements included group homes, with family, in institutions, or being homeless.

This study focuses on the mental health impacts of housing developed under the RWJF-PCMI in four of the nine demonstration sites. (Because the housing development corporations asked for confidentiality, their locations and identities are suppressed.) These four sites were the focus of the national evaluation of the demonstration (e.g., Goldman, Morrissey, and Ridgely 1994). Specifically, we examine how the costs of mental health services and residential instability are affected by features of the buildings and the surrounding neighborhoods, and how these costs compare to the property costs associated with these features.

Housing units were acquired and renovated over time. Each site maintained a waiting list of prospective tenants, who were allocated to housing units on a first-come, first-served basis as they became available. Interviews with directors of the housing development corporations and mental health agencies revealed no systematic effort to assign individuals with particular types of psychiatric diagnosis, symptoms, or functioning to particular residential settings. Indeed, there would have been no strong grounds for undertaking such assignment because all of the newly acquired properties were renovated to roughly similar quality standards and none were linked to any particular service package. This view is supported by statistical tests of the relationship between residential features and Global Assessment of Functioning (GAF) scores when participants moved into their housing units, which found no statistically significant link. These considerations suggest that the statistical results for building and neighborhood features may be relatively unaffected by confounding from unmeasured participant characteristics that have not been controlled for in the models. It may be noted, however, that across all sites, black participants tended to locate in neighborhoods with a higher proportion of black residents than white participants, most likely a result of participant choice.

DATA

This study combines data on the characteristics and mental health service utilization of 670 individuals with CMI with the characteristics and costs of the 150 multi-unit apartment buildings developed under the RWJF-PCMI where these individuals lived. Data cover the period 1988 through 1993. Characteristics of the study participants include: age, race, sex, and GAF score measured

when the tenant moved into the dwelling unit, drawn primarily from case files. Residence period in a study property was extracted from monthly rent rolls. The mental health service utilization of participants was tracked from the time they moved into their dwellings until they moved out or December 31, 1993, when data collection ended. Tracking of services ended upon move-out because data were not available on subsequent residential settings. Mental health service utilization data were obtained from Medicaid and from state and local departments of mental health. (The authors may be contacted for details on the preparation of these data.) Hospital and community-based services were included in the analysis. Substance abuse services and pharmaceutical costs were not examined because they comprised only a small fraction of total mental health care costs.

We use costs as the common metric to capture the broad range of hospital and community-based services (e.g., counseling, case management, partial hospitalization), and frequency of utilization (e.g., daily, half-day, hourly). Data on housing characteristics, neighborhood features and costs, including acquisition, rehabilitation, and operation, were collected as part of an earlier study of the costs of independent housing for the individuals with CMI (Harkness et al. 1997; Newman et al. 2001). These data were obtained from administrative records, interviews, and onsite observations of dwellings and neighborhoods.

OUTCOME MEASURES

Multivariate statistical methods are used to estimate the effects of features of the residential environment on community-based mental health service costs (CMTY), hospital-based mental health service costs (HOSP), and residential instability. Hospitalization and residential instability are two participant outcomes that have been relied upon in numerous studies as indicators of the mental health status of persons with severe mental illness (e.g., Bond et al. 1989; Hodgins, Cyr, and Gaston 1990). Furthermore, over roughly the last decade, research has suggested a relationship between inpatient hospitalization and quality of life. For example, Lehman, Possidente, and Hawker (1986) found that persons with serious mental illness who become rehospitalized report significantly lower quality of life along several dimensions including leisure activities, social relations, finances, and global satisfaction.

Other data collected in this study confirm that residential moves by participants were typically associated with negative results, supporting our use of

residential instability as a relevant “negative” outcome indicator. Of those who moved out, many were evicted for nonpayment of rent, disruptive or destructive behavior, or substance abuse problems. Others moved because they were unable to cope with independent living and were transferred to a more structured environment, such as a residential treatment facility or hospital.

Building attributes that promote better mental health may impact community-based treatment costs in a variety of ways. To the extent that these features reduce institutionalization and increase time spent in the community, they will increase community-based costs (e.g., rehabilitation services, individual and group therapy, case management). On the other hand, a positive impact on mental health may also translate into lower community-based costs if building features reduce the need for high-intensity services (e.g., partial hospitalization) to deal with acute flare-ups, or reduce the frequency of ongoing services (e.g., reduce therapy visits from weekly to biweekly).

Explanatory Variables

All models estimated outcomes as a function of demographic characteristics (race, age, sex), initial functioning level (as measured by the GAF score), building and neighborhood features, characteristics of other CMI tenants living in the same building, and supplementary control variables (site, missing data indicators, and time in study).

Building features include the number of units in the building, the number of amenity features (e.g., air conditioning, garbage disposal, off-street parking), the average size (in square footage) of units in the building, the building age, and repair needs (based on an exterior inspection by at least two members of the research team). Tenant composition variables include the percentage of other units in the building occupied by a mentally ill tenant, and the average GAF score of the other mentally ill tenants.

The neighborhood variables included in this analysis emerged from a factor analysis of an array of neighborhood features, including 1990 census tract attributes and characteristics collected by the research team through onsite observation. Four census tract variables were used: percent white population; percent of housing units built before 1940; poverty rate; and homeownership rate. The percent white population was specified as a quadratic form to capture effects of racial mix. A neighborhood problems variable was constructed by combining census data on boarded up buildings with onsite observational data on the presence of bars or grates on windows or doors, or junk or trash on the streets. Various forms of the neighborhood problems

variable were tested, but a dummy variable indicating the presence of any of the three components proved to be the most parsimonious specification. A final neighborhood variable measures the number of nonresidential land uses (e.g., retail stores, industrial establishments, churches, schools) on the block, collected through onsite observation. Following the diverse-disorganized neighborhood hypothesis of Segal and his colleagues (e.g., Segal and Aviram 1978), neighborhoods that are racially mixed, have relatively little homeownership, and exhibit mixed land uses were expected to be associated with better mental health outcomes. We also tested a variety of income diversity measures but none had any effect on outcomes. Therefore, we simply included the tract poverty rate as an indicator of the tract's income level. The binary neighborhood problems indicator is used as a measure of neighborhood quality, and the proportion of housing units built before 1940 captures the vintage of the neighborhood's physical capital.

Psychiatric hospitalization in this sample occurred in both private and state hospitals. Treatment patterns typically differ markedly between these two types of hospitals, and national data show that costs per day in private hospitals are higher while inpatient length of stay is much shorter relative to state hospitals (Salkever et al. 1999). To capture these differences in settings, the model for hospital-based mental health costs (conditional on inpatient service use) included a control for the fraction of mental health hospitalizations in a private hospital.

MODEL SPECIFICATION AND ESTIMATION TECHNIQUES

Community-based Services

Ordinary least squares regression was used to estimate the model for CMTY costs. The dependent variable was specified as dollars per month during the 1988–1993 study period, which was logged because it was highly skewed. This resulted in a loss of 34 observations (6 percent of the sample) with zero costs. Regression results indicated that a missing GAF score was the only significant predictor of observations with zero CMTY costs. Two-thirds of these observations were missing GAF scores, compared to 8 percent of those with positive costs. The discrepancy suggests that the group with no CMTY costs may be unusual, and that little is lost by excluding them from the analysis.

Hospital-based Services

The dependent variable in the HOSP cost model is also expressed as dollars per month during the study period. Although this variable is also highly

skewed among those who experienced some mental health hospitalization costs, a log transformation would have been inappropriate because only 21 percent of the sample, or 138 cases, received hospital-based mental health treatment at some point during their residency in a study property. Using a log transformation would have eliminated the 79 percent of the sample with no hospitalization costs.

Instead, we estimated a two-part model, the first predicting whether a study member received any hospital-based services, and the second predicting the cost of services received, conditional on receipt. That is, given hospitalization costs y and dependent variables x , we first estimate $y^* = \pi(x)$ using logit, where $y^* = 1$, if $y > 0$ and zero otherwise. For the second part, we followed Mullahy (1998) by using nonlinear least squares, with $y - \exp(x\beta)$ as the residual function.

A difficulty with modeling the effects of building and neighborhood features on mental health hospitalization costs is that, because of the natural course of mental illness, a sample member's probability of being hospitalized is likely to depend on how long he or she remained in the study. Since hospitalization costs were relatively rare but were large for those who incurred them, individuals who remained in a study property for a longer period of time could appear to have higher monthly hospitalization costs simply because they were observed over a longer period of time—not because their mental health had deteriorated as a result of some adverse building feature. Thus, property features that reduced residential instability could erroneously appear to increase mental health hospitalization costs. Therefore, we need to control for the length of time an individual remained in the study, but inclusion of that variable directly raises concerns about endogeneity, because unmeasured property characteristics could influence both hospitalization and residential instability, causing simultaneity bias in the estimates of our hospitalization model.

We use an instrumental variable approach to deal with this problem. The two-equation model is: $y^* = \pi(t, x)$, $t = \tau(z, x)$, where π is the logit model for hospitalization and t is the length of the residence period in a study property. For z , the instrument for t , we use the maximum *potential* length of the residence period; that is, the number of days between the sample member's date of initial residence and December 31, 1993, when data collection stopped. Among the many alternative functional forms for τ tested, OLS had the best predictive ability. Since $\mathcal{Y}$ can, therefore, be modeled as a linear function, the second equation can be substituted without complication into the first, yielding the reduced form, which is the model we estimate. Use of the reduced form is appropriate because the reduced form coefficients on x will capture both the

effects on hospitalization that operate independently of t and those that operate through t , and for our purposes it is not necessary to distinguish them.

Because the group of sample members who experienced a mental health hospitalization was so small, estimation of the second part (costs if hospitalized) of the two-part HOSP cost model with the full set of covariates may be inappropriate. Although we present results obtained using the full set of covariates, we focus the discussion of regression results on estimates obtained using a limited set of covariates that proved to be statistically significant under extensive testing of alternative model specifications.

Two measures of hospital-based mental health service use were tested—costs and days—both expressed as an average over the time in the study. Because these measures were highly correlated ($p = .94$), producing nearly identical statistical results, we present only the hospitalization cost results.

Residential Instability

We used the Cox proportional hazards model to analyze impacts on residential instability. The dependent variable in this model is the number of elapsed days between moving into and out of a sample property; it is censored for the 61 percent of the sample members who were still living in their apartments at the end of the study period. The proportional hazards model produces estimates of the proportional effects of the independent variables on the probability of moving out of the study dwelling unit in a particular month.

SAMPLE CHARACTERISTICS

Descriptive statistics for the sample are shown in Table 1. Individuals in the sample ranged in age from 17 to 85, with a mean of 37, when they moved into a sample property. About half were women; 38 percent were African American. On average, participants scored 50 on the 100-point GAF scale, indicating moderate to serious impairment in social, occupational, or school functioning. Nearly a fifth scored below 40, which reflects major impairment in several areas or some impairment in reality testing or communication, and a sixth scored above 60, signifying mild symptoms.

Nearly all (94 percent) of the sample members used CMTY services during their residence in a study property. Case management absorbed 59 percent of CMTY costs, the largest share. There were 138 sample members (21 percent) who had a mental health hospitalization. Sixty percent of these cases had one mental health hospitalization, 22 percent had two, 9 percent had

Table 1: Sample Univariates

	<i>Mean</i>	<i>SD</i>
Mental health service costs (\$/month)		
Community-based	523	542
Hospital-based	164	512
Hospital-based excl. zeros	796	880
Total	687	833
Client characteristics		
GAF	50	14
Age	37	10
Black	0.38	0.49
Female	0.51	0.50
Buildings characteristics		
No. units	6.4	4.3
No. amenities	3.2	0.9
Avg. unit size	672	177
Age of building	42	20
Building needs repairs	0.14	0.35
% other tenants MI	56	32
Neighborhood characteristics		
% white	73	28
% built < 1940	35	23
Poverty rate	18	13
% owner occupied	52	20
Physical deterioration	0.50	0.50
Nonresidential (index)	0.80	0.77
Site		
1	0.04	0.19
2	0.25	0.43
3	0.38	0.49
4	0.34	0.47
GAF unknown	0.11	0.32
% hospitalizations in private facility	0.40	0.46

N = 670.

three, and 9 percent had more than three. As expected, the hospitalization rate was higher for participants who remained in the study longer.

Residential instability was low. Sixty-two percent of sample members remained in their sample dwellings for the entire period from the time they moved in until the end of the study. The six-month "survival rate," the proportion of those who remained in their units for six months among those who moved in six months before the end of the study period, was 93 percent. The one-year survival rate declined to 78 percent, and the two-year survival rate was 55 percent. Among those who moved out of a sample property during the

study period, the median residence period was 12 months, and only 10 percent moved out before four months.

REGRESSION RESULTS

Individual Characteristics

Few individual characteristics significantly affect outcomes, as shown in Table 2. Older individuals are more residentially stable, with every 10 years reducing the move-out rate by 22 percent, but other outcomes are unaffected by age. In the strongest result, being female or African American is associated with a 60 percent reduction in mental health hospitalization costs, conditional on use. Higher-level functioning is weakly associated with reduced use of CMTY ($p = .11$) and, somewhat more strongly, with reduced probability of hospitalization ($p = .08$), but has no effect on residential instability or hospitalization cost, conditional on use. It was earlier noted that the effect of improvements in mental health on CMTY costs could be either positive or negative. Here, the result that higher base functioning level is associated with both reduced CMTY costs and reduced probability of hospitalization suggests that lower CMTY costs may be indicative of improved mental health. This pattern is repeated throughout the results that follow: variables associated with lower CMTY costs are also linked with either a lower probability of hospitalization, lower hospitalization costs, or less residential instability. The consistency of this pattern suggests that, in this sample, improvements in mental health result in lower CMTY costs. Accordingly, this interpretation is adopted in the following discussion.

Building Features

The results support the hypothesis that better quality buildings convey mental health benefits. Buildings in need of repair were associated with a 58 percent increase in residential instability ($p = .01$) and a 28 percent increase in CMTY costs ($p = .06$). Older properties, which, all else equal, are likely to be in worse condition, were also associated with worse outcomes; every additional 10 years of a property's age raised the probability of a mental health hospitalization by 16 percent ($p = .05$) and increased residential instability by 13 percent ($p = .01$). Finally, each additional amenity feature was associated with an 11 percent reduction in CMTY costs ($p = .06$). There is also evidence that individuals with CMI fare better in smaller-scale residential settings, as

Table 2: Regression Results

	Community-based Mental Health Service Costs		Any Mental Health Hospitalizations		Residential Mobility		Hospital Costs All Covariates		Hospital Costs Reduced Covariates	
	Coef.	p	Coef.	p	Coef.	p	Coef.	p	Coef.	p
Individual										
GAF (in 10s)	-5.5	0.11	-13.8	0.08	+0.6	0.91	+0.2	0.98		
Age (in decades)	+4.3	0.36	+2.7	0.79	-21.8	0.00	+15.2	0.17		
Black	-7.2	0.44	-9.9	0.64	-12.6	0.34	-51.2	0.00	-59.9	0.00
Female	+4.2	0.64	-12.6	0.52	-17.5	0.14	-63.3	0.00	-64.1	0.00
Building										
No. units	+1.9	0.24	+4.4	0.29	+9.7	0.00	-1.4	0.79		
No. amenities	-10.7	0.06	-14.5	0.31	+0.3	0.97	-4.4	0.81		
Ave. unit size (100 sq. ft)	-5.3	0.16	-7.8	0.38	-2.9	0.60	-5.3	0.56		
Age of building (in decades)	+3.5	0.29	+16.2	0.05	+12.5	0.01	-5.9	0.37		
Building needs repairs	+28.2	0.06	+44.4	0.22	+57.5	0.01	-7.6	0.77		
% other tenants MI (deciles)	+2.3	0.14	+5.5	0.13	-5.5	0.02	-4.3	0.24		
Neighborhood (percents in deciles)										
% white	-6.1	0.42	-34.0	0.03	+4.4	0.70	+58.5	0.02	+103.5	0.00
% white squared	+0.8	0.25	+3.3	0.06	-1.0	0.34	-4.3	0.02	-6.2	0.00
% built < 1940	+4.9	0.08	+9.2	0.21	+1.9	0.66	+12.8	0.09		
Poverty rate	+5.6	0.37	-10.9	0.44	+7.7	0.41	+7.2	0.68		
% owner occupied	+5.0	0.17	+1.7	0.84	+7.5	0.19	+9.3	0.35		
Physical problems	+26.0	0.04	-8.2	0.75	+17.2	0.34	+56.9	0.06	+79.1	0.00
Nonresidential (index)	-14.7	0.02	-20.5	0.16	-0.4	0.97	-26.3	0.10		
Site										
1	-43.1	0.05	-47.2	0.46	-17.2	0.69	+283.5	0.11	+592.7	0.01
2	+3.6	0.81	+79.2	0.09	+35.7	0.17	-29.0	0.21		
3 - excluded										
4	-50.5	0.00	-16.2	0.64	-31.1	0.12	-35.0	0.28		
GAF unknown	-71.3	0.00	-71.9	0.03	+70.5	0.14	+193.7	0.05	+173.9	0.00
Max possible months in study			+3.9	0.00						
% private hosp.							-72.4	0.00	-70.8	0.00
Constant	\$ 400	0.00	0.16	0.50			\$ 2,127	0.00	\$ 2,051	0.00

Note: All coefficients except the constant have been transformed to indicate percentage effects. The constant represents the baseline with continuous variables set to their means and dummy variables set to zero.

expected, with each additional apartment in a multi-unit dwelling increasing residential instability by 10 percent ($p < .01$).

The effects of the presence of other tenants with CMI in the building were mixed but tending toward the beneficial. On one hand, every 10 percentage point increase in the proportion of tenants with CMI decreased residential instability by 5.5 percent ($p = .02$), which indicates favorable effects. On the other hand, a higher proportion of tenants with CMI was weakly associated with higher CMTY costs ($p = .14$) and a higher probability of a mental health hospitalization ($p = .13$).

These results do not necessarily conflict. For example, buildings with a higher proportion of tenants with CMI may be more frequently visited by case managers, who may share information about their participants with each other, potentially resulting in a more rapid response to developing psychiatric problems. More prompt delivery of services could contribute to higher costs, but could also reduce residential instability.

Neighborhood Features

In contrast to past research, the results offer only weak support for the hypothesis that individuals with mental illness fare better in diverse-disorganized neighborhoods. Although each nonresidential land use on a block is associated with a 15 percent reduction in CMTY costs ($p = .02$), the point estimates for the effects of nonresidential land uses on the likelihood of mental health hospitalization, and costs if hospitalized, are not statistically significant (p -values around .20), though they are negative. The point estimates on the effects of homeownership are all positive, consistent with the hypothesis, but, again, none are statistically significant. The neighborhood poverty rate has no effect on any outcome.

The quadratic of percent white population suggests that the mental health hospitalization rate is lowest for individuals living in racially mixed neighborhoods, but the opposite holds for costs if hospitalized. When the two parts are combined, the second part (costs if hospitalized) dominates, which undermines the diverse-disorganized neighborhood hypothesis. The validity of this result is questionable, however, because further examination shows that the link between living in a mixed-race neighborhood and hospitalization costs held for white men, but not blacks or women. This is problematic not only because there is no strong theoretical reason to expect white men, in particular, to be affected by the racial composition of their neighborhoods, but also because there were relatively few white participants that lived in mixed or

predominantly black neighborhoods: three-fourths of whites lived in neighborhoods where at least 76 of the population was also white. The relative rarity of cases raises the possibility these results may be a statistical anomaly.

There is strong evidence that the physical quality of a neighborhood has a salutary impact on mental health outcomes. Neighborhood problems are associated with 26 percent higher CMTY costs ($p = .04$) and a 79 percent increase in hospital-based mental health service costs if hospitalized ($p < .01$). Mental health service utilization may also be affected by the age of the housing stock: a 10 percentage-point increase in the fraction of housing units in a neighborhood that were built before 1940 is associated with a 5 percent rise in CMTY costs ($p = .08$).

COST-EFFECTIVENESS ANALYSIS

The cost-effectiveness of building and neighborhood features that were associated with reductions in mental health service costs was assessed by comparing the marginal effect of the feature in question on the combined costs of community-based and hospital-based mental health services with its marginal effect on building costs. Residential instability effects are not monetized, but their implications for the cost-effectiveness of building and neighborhood features are described. (Details of these computations are available from the authors.)

Results of this analysis demonstrate that the mental health care cost savings associated with certain building features dwarfed their impact on building costs, typically by an order of magnitude. With one exception—the neighborhood poverty rate—building and neighborhood features that reduce mental health service costs and residential instability are cost-effective irrespective of their effects on building costs.

The poverty rate had a statistically significant negative effect on the purchase price, resulting in reduced building costs, but it did not attain even a modest level of statistical significance for any mental health outcome. It thus appears that building cost savings could be achieved by siting properties for individuals with CMI in higher-poverty neighborhoods without running the risk of incurring substantially higher mental health care costs. Even then, however, the poverty rate is only a marginal factor.

The building cost models indicate that costs per unit fall with a rising proportion of tenants with CMI. Since a higher proportion of tenants with CMI was also associated with greater residential stability, buildings 100

percent occupied by tenants with CMI appear to be a cost-effective option. Further research on this question may be warranted, however, because mental health service costs were higher in buildings where a greater proportion of tenants were individuals with CMI, although this result achieved only marginal statistical significance. It may be particularly worth examining whether living in a building with a high proportion of tenants with CMI affects the quantity and quality of service delivery.

DISCUSSION

Individuals with CMI living in newer and properly maintained buildings were found to have reduced mental health care costs and less residential instability. Buildings with a richer set of amenity features, neighborhoods with no outward signs of physical deterioration, and neighborhoods with newer housing stock are also associated with reduced mental health care costs. All of these statistically significant results support Earls and Nelson's (1988) suggestion that higher quality of housing may lead to better mental health outcomes among individuals with CMI. Without even counting the benefits of reduced residential instability, the mental health care cost savings associated with these features far outweigh the costs of developing and operating properties that have these features. Since study participants were assigned to units on a first-come, first-served basis, there is little reason to suspect that these findings can be attributed to unmeasured mental or physical attributes of participants.

Less residential instability was also found in buildings with fewer units, consistent with the findings of Linn, Klett, and Caffey (1980), Nagy, Fisher, and Tessler (1988), and Nelson, Hall, and Walsh-Bowers (1998), and in buildings where a greater proportion of units are occupied by other individuals with CMI. These results suggest that individuals with CMI may feel more comfortable and secure living in smaller-scale residential settings with others like themselves. An alternative interpretation is that it may be easier for case managers to monitor their participants' status in such settings. How building configuration and location affect the quantity and quality of mental health service delivery is an important topic for future research.

Beyond the strong relationship between neighborhood physical problems and mental health care costs, the implications of the results for neighborhood features are less clear. There is some suggestive evidence that mental health care costs and residential instability may be reduced in neighborhoods with many nonresidential land uses and a higher proportion of renters,

consistent with the theory of Segal and Aviram (1978). These diverse neighborhoods may have a more active street life and a more fluid population, allowing residents with CMI to remain anonymous and avoid stigmatization. But the lack of effect of neighborhood income diversity undercuts this interpretation. How individuals with CMI interact with other people living in their buildings or neighborhoods—which may be an important determinant of mental health outcomes—deserves further study.

REFERENCES

- Baker, F., and C. Douglas. 1990. "Housing Environments and Community Adjustment of Severely Mentally Ill Persons." *Community Mental Health Journal* 26 (6): 497–505.
- Bond, G., T. Witheridge, D. Wasmer, J. Dincin, S. McRae, J. Mayes, and R. Ward. 1989. "A Comparison of Two Crisis Housing Alternatives to Psychiatric Hospitalization." *Hospital and Community Psychiatry* 40 (2): 177–83.
- Bradburn, N. 1969. *The Structure of Psychological Well-Being*. Chicago: Aldine.
- Carling, P. 1984. *Meeting the Housing and Residential Service Needs of Persons with Severe Psychiatric Disabilities: An Overview of Principles, Services*. Burlington, VT: University of Vermont, Department of Psychology.
- Cohen, M., and S. Somers. 1990. "Supported Housing: Insights from the Robert Wood Johnson Foundation Program on Chronic Mental Illness." *Psychological Rehabilitation Journal* 13 (4): 43–50.
- Dickey, B., E. Latimer, K. Powers, R. Schutt, and S. Goldfinger. 1997. "Housing Costs for Adults Who Are Mentally Ill and Formerly Homeless." *Journal of Mental Health Administration* 24 (3): 291–305.
- Drake, R., N. Yovetich, R. Bebout, M. Harris, and G. McHugo. 1997. "Integrated Treatment for Dually Diagnosed Homeless Adults." *Journal of Nervous and Mental Disease* 186 (5): 298–305.
- Earls, M., and G. Nelson. 1988. "The Relationship between Long-Term Psychiatric Clients' Psychological Well-Being and Their Perceptions of Housing and Social Support." *American Journal of Community Psychology* 16 (2): 279–93.
- Frank, R. G., H. H. Goldman, and T. G. McGuire. 1996. "Insuring Severe Mental Disorders: A Comparison of Approaches." In *The Economics of Schizophrenia*, edited by M. Moscarelli, A. Rupp, and N. Sartorius, pp. 411–22. New York: Wiley.
- Frank, R. G., J. R. Lave, and H. H. Goldman. 1988. "Financing of Care for the Chronically Mentally Ill in the U.S.: A Patchwork of Policies." In *Cost-Effective Care for the Chronically Mentally Ill*, edited by D. Schwefel, pp. 76–87. Berlin: Springer-Verlag.
- Goldman, H., J. Morrissey, and M. S. Ridgely. 1994. "Evaluating the Robert Wood Johnson Foundation Program on Chronic Mental Illness." *Milbank Quarterly* 72 (1): 37–47.

- Hall, G., G. Nelson, and H. Fowler. 1987. "Housing for the Chronically Mentally Disabled: Part I—Conceptual Framework and Social Context." *Canadian Journal of Community Mental Health* 6 (2): 65–78.
- Hanrahan, P., D. J. Luchins, C. Savage, and H. H. Goldman. 2001. "Housing Satisfaction and Service Use by Mentally Ill Persons in Community Integrated Living Arrangements." *Psychiatric Services* 52 (9): 1206–9.
- Harkness, J., S. Newman, G. Galster, and J. Reschovsky. 1997. "Life-Cycle Costs of Housing for the Mentally Ill." *Journal of Housing Economics* 6 (3): 223–47.
- Herzberg, F., J. Mathapo, Y. Weiner, and L. Weisen. 1974. "Motivation-Hygiene Correlates of Mental Health: An Examination of Motivation Inversion in a Clinical Population." *Journal of Consulting and Clinic Psychology* 42 (3): 411–9.
- Hodgins, S., M. Cyr, and L. Gaston. 1990. "Impact of Supervised Apartments on the Functioning of Mentally Disordered Adults." *Community Mental Health Journal* 26 (6): 507–15.
- Hough, R., P. Wood, M. Hurlburt, R. Quinlivan, H. Tarke, and S. Yamashiro. 1995. *Using Independent Housing and Supportive Services with the Homeless Mentally Ill: An Eighteen-Month Outcome Study*. Mimeo. San Diego: University of California at San Diego.
- Jerrell, J., and T. Hu. 1989. "Cost-Effectiveness of Intensive Clinical and Case Management Compared with an Existing System of Care." *Inquiry* 26 (2): 224–34.
- Lehman, A., L. Dixon, E. Kernan, B. DeForge, and L. Postrado. 1997. "A Randomized Trial of Assertive Community Treatment for Homeless Persons with Severe Mental Illness." *Archives of General Psychiatry* 54 (11): 1038–43.
- Lehman, A., S. Possidente, and F. Hawker. 1986. "The Quality of Life of Chronic Patients in a State Hospital and in Community Residences." *Hospital and Community Psychiatry* 37 (9): 901–7.
- Linn, M., C. Klett, and E. Caffey. 1980. "Foster Home Characteristics and Psychiatric Patient Outcome." *Archives of General Psychiatry* 37 (2): 129–32.
- Mullahy, J. 1998. "Much Ado about Two: Reconsidering Retransformation and the Two-part Model in Health Econometrics." *Journal of Health Economics* 17 (3): 247–81.
- Nagy, M., G. Fisher, and R. Tessler. 1988. "Effects of Facility Characteristics on the Social Adjustment of Mentally Ill Residents of Board-and-Care Homes." *Hospital and Community Psychiatry* 39 (12): 1281–6.
- Nelson, G., G. B. Hall, and R. Walsh-Bowers. 1998. "The Relationship between Housing Characteristics, Emotional Well-being and the Personal Empowerment of Psychiatric Consumer/Survivors." *Community Mental Health Journal* 34 (1): 57–69.
- Newman, S. 1992. "The Severely Mentally Ill Homeless: Housing Needs and Housing Policy." *Occasional Paper No. 12*. Baltimore, MD: Johns Hopkins University Institute for Policy Studies.
- . 2001. *The Living Conditions of America's Disabled*. Mimeo. Baltimore, MD: Johns Hopkins University Institute for Policy Studies.
- Newman, S., and S. Ridgely. 1994. "Independent Housing for Persons with Chronic Mental Illness." *Administration and Policy in Mental Health* 21 (3): 199–215.

- Newman, S., J. Harkness, G. Galster, and J. Reschovsky. 2001. "Bricks and Behavior: The Development and Operating Costs of Housing for Persons with Mental Illness." *Real Estate Economics* 29 (2): 277-304.
- Newman, S., J. Reschovsky, K. Kaneda, and A. Hendrick. 1994. "The Effects of Independent Living on Persons with Chronic Mental Illness: An Assessment of the Section 8 Certificate Program." *Milbank Quarterly* 72 (1): 171-98.
- Ohio Department of Mental Health. 1988. *Housing-as-Housing*. Discussion paper. Columbus: Ohio Department of Mental Health.
- Rosenheck, R., L. Frisman, and P. Gallup. 1995. "Effectiveness and Cost of Specific Treatment Elements in a Program for Homeless Mentally Ill Veterans." *Psychiatric Services* 46 (11): 1131-9.
- Salkever, D., M. Domino, B. Burns, A. Santos, P. Deci, J. Dias, H. Wagner, R. Faldowski, and J. Paolone. 1999. "Assertive Community Treatment for People with Severe Mental Illness: The Effect on Hospital Use and Costs." *Health Services Research* 34 (2): 577-601.
- Segal, S., and U. Aviram. 1978. "Toward a Better System of Sheltered Care." In *The Mentally Ill in Community Based Sheltered Care: A Study of Community Care and Social Integration*, pp. 277-87. New York: Wiley.
- Segal, S., C. Silverman, and J. Baumohl. 1989. "Seeking Person-Environment Fit in Community Care Placement." *Journal of Social Issues* 45 (3): 49-64.
- Trute, B., and S. Segal. 1976. "Census Tract Predictors and the Social Integration of Sheltered Care Residents." *Social Psychiatry* 11 (4): 153-61.