Affordable Senior Housing Plus Services: What's the Value?

EXAMINING THE ASSOCIATION BETWEEN AVAILABLE ONSITE SERVICES AND HEALTH CARE USE AND SPENDING

LeadingAge™
Center for Housing Plus Services

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MacArthur Foundation

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The LeadingAge Center for Affordable Housing Plus Services serves as a national catalyst for the development, adoption and support of innovative affordable housing solutions that enable low- and modest-income seniors to age safely and successfully in their homes and communities.

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Executive Summary

Multiple initiatives are underway at the federal and state level to reform the nation's health and long-term services and support (LTSS) systems. Key goals of these efforts include:

- Improving health outcomes.
- Increasing opportunities to receive LTSS in the home and other community-based settings, rather than institutional settings.
- Slowing spending growth in the Medicare and Medicaid programs.

Health and LTSS reform efforts are focused particularly on vulnerable populations that have complex health situations and are at higher risk for excessive use of costly health and LTSS. One potential approach that could help facilitate these reform efforts for the elderly population involves linking affordable senior housing communities with health and/or supportive services.

This study is one of the first to examine the association between the availability of onsite services in affordable senior housing properties and residents' health care utilization and spending.

Over two million low-income older adults live in thousands of affordable senior housing properties across the country. Due to their advanced ages, low-income status and other demographic characteristics, many residents are coping with multiple chronic illnesses and/or functional impairments. These conditions put residents at risk for poor health outcomes and make it more likely that they will use costly Medicare and Medicaid-funded services such as emergency departments (ED), hospitals, and nursing homes.

Evidence on the impact of housing plus services strategies is limited, but growing. Early studies suggest that service-enriched housing interventions hold promise for helping improve health and quality of life for vulnerable older adults.

Study Overview

This study—conducted by the LeadingAge Center for Housing Plus Services and The Lewin Group, and funded by the John D. and Catherine T. MacArthur Foundation—was designed to shed further light on the value of linking affordable senior housing settings with health and supportive services to help address resident needs.

The research team created a dataset that includes:

- 2008 Medicare and Medicaid utilization and expenditure data for individuals living in senior housing communities subsidized by HUD in 12 geographic areas.
- Information about the types of onsite services available in those properties.

Controlling for demographic characteristics, residents' physical health status, and key geographic variables, the team explored whether patterns of resident health care use and spending differed in HUD-assisted housing properties with onsite services available compared to properties without onsite services. Specifically, researchers were interested in discovering whether the availability of services could be associated with several outcomes of interest, including:

- Number of Medicare ED visits without an admission.
- Odds of at least one Medicare ED visit without admission.
- Number of Medicare acute inpatient admissions.
- Odds of at least one Medicare acute inpatient admission.

- Number of Medicare physician office visits.
- Medicare medical payments.
- Medicare Part D payments.
- Medicaid payments.

The research team only had data on the *availability* of services at the properties and not on individual resident *use* of those services. Therefore, this analysis examines the association between the *presence* of onsite services and resident health care use and spending.

Key Findings

The availability of health education, exercise, primary care, mental health, medication management service, and the presence of a service coordinator were found to be associated with the study's outcomes of interest. Other services, including the availability of transportation and health screening services, and the presence of a nurse, were not found to have an association with the outcomes of interest.

Residents living in housing with on-site service coordinators had significantly lower hospitalization rates than those without this position. This key finding supports previous research indicating positive effects associated with service coordination.

Helping individuals better navigate the complex health care system and improve access to needed services is a primary component of many health reform efforts. The study's findings suggest that service coordinators could play a valuable role in helping health care providers and payers improve access to and coordination of health services for their vulnerable elderly patients who live in affordable senior housing communities.

The availability of mental health services was associated with a significantly increased likelihood of a resident having at least one inpatient hospital stay. Since the study's dataset did not include information on resident mental illnesses (other than depression), it is possible that this finding simply reflects utilization patterns of residents with mental health problems. It could also indicate that the presence of onsite mental health services led to more appropriate hospitalization.

The analysis indicates that the availability of health education increases the odds of ED use without a hospital admission. This finding could be viewed as counterintuitive. One potential explanation is that health educators working with people who have conditions like diabetes or congestive heart failure may identify early warning signs that need immediate attention.

The availability of health education was also associated with lower Medicare Part D payments, while onsite exercise was associated with higher Medicare drug costs.

Finally, on-site medication management services were associated with lower Medicaid payments, which could reflect better overall monitoring of resident prescription drug use.

Conclusion

This study provides some important new insights into the relationship between service-enriched senior housing and resident health care use and spending. The findings indicate differences in utilization patterns among low-income older adults with access to various onsite services. However, interpretation is difficult, given the data limitations.

Further research focusing specifically on the actual use of these services over time will be needed to help policy makers, providers, and others better understand the value of linking affordable senior housing with services.

Background

Multiple initiatives are underway at the federal and state level to reform the nation's health and long-term services and support (LTSS) systems. Health reform efforts are reshaping delivery and payment mechanisms to drive improved health outcomes, particularly among vulnerable populations. Efforts to transform the LTSS system are designed to shift services away from institutional settings and expand opportunities for individuals to receive care in the community. These two areas of reform share the common goal of slowing the growth in both Medicare and Medicaid spending.

One potential approach that could help facilitate reform efforts involves linking independent, affordable senior housing communities with health and/or supportive services.[1] Over two million low-income older adults live in thousands of affordable senior housing properties across the country (Wilden and Redfoot, 2002) Due to their advanced ages, low-income status and other demographic characteristics, many residents are coping with multiple chronic illnesses and/or functional impairments (Redfoot & Kochera, 2004; Haley & Gray, 2008; Gibler, 2003; Kochera, 2002; The Lewin Group, 2014). These conditions put residents at risk for poor health outcomes and make it more likely that they will use costly health and long-term care services.

Linking affordable senior housing properties with health and/or supportive services offers a number of potential benefits. Community-based health and service providers partnering with housing communities receive access to a concentrated population of vulnerable older adults, including many who are dually eligible for Medicare and Medicaid. Many reform efforts are attempting to better address the needs of this dually eligible population, which has a complex health and functional status and a high rate of service use. This concentration of vulnerable individuals in a common location offers a number of operating efficiencies, including:

- *More cost-effective delivery*. Health care and service providers can reach multiple individuals at one location at the same time.
- *Improved client follow-through and compliance.* Residents, particularly those with functional limitations or transportation barriers, have easier access to services. Trusted housing staff have the ability to remind and encourage individuals to participate in service programs.
- *More complete knowledge about individuals.* This knowledge comes either from observing residents in their home environments or obtaining information from the housing staff.
- *The potential for affordable senior housing properties to serve as a hub* for serving older adults in the surrounding communities.

Health and LTSS reform efforts have drawn attention to the role of housing in achieving desired outcomes and costs savings.

Increased attention is being given to the role that social determinants of health—including quality, affordable, and accessible housing—play in achieving and maintaining good health (Braveman & Gottlieb, 2014; Taylor et. al., 2015). Lack of affordable and accessible housing is also a primary barrier to efforts that support individuals to move out of institutional settings and back into the community (Reinhard, 2010; Stone, 2011).

[1] Affordable senior housing refers to apartment buildings where rents are affordable to lower-income older adults, generally through some form of federal- or state-funded capital and/or rent subsidy. Examples of these properties include, but are not limited to, Section 202, Section 515, public housing, and low-income housing tax credit properties. Affordable senior housing with services involves an intentional linkage through which services are delivered onsite at the housing property, either by the housing property or an outside organization.

Attention to the potential value of housing as a platform for the delivery of services and supports to vulnerable populations is also increasing. Programs linking housing properties with health and supportive services have developed on an ad-hoc basis across the country. Primarily, housing providers have driven these linkages in an attempt to help address the growing needs of their aging residents.

Evidence on the impact of housing plus services strategies is limited, but growing. Early studies suggest that service-enriched housing interventions hold promise. Evaluations reveal that residents and staff perceive that housing plus services programs are improving access to services, enhancing health status and quality of life, and supporting residents' ability to age in place (Griffith, Greene, Stewart &Wood, 1996; Ficke & Berkowitz, 2000; Washko, Sanders, Stone & Harahan, 2007; Levine & Robinson Johns, 2008; Sanders & Stone, 2011). A few studies have found that participants in service-enriched housing experience improvements in some health behaviors and indicators (Marek et. al., 2005, Yaggy et. al., 2005; Castle, 2008).

More recent and rigorous studies are showing that housing plus services strategies have an effect on health care utilization and costs. A study by Castle and Resnick (2014) found that residents in affordable senior housing properties offering the Staying-at-Home program were less likely to use the emergency department (ED) and hospital or move to a nursing home, compared to residents in buildings not offering the program. Staying-at-Home participants were also more likely to use health care services (e.g., visit a doctor) and report health improvements. Preliminary results from an evaluation of the Support and Services at Home (SASH) program found that participants had lower growth in annual total Medicare expenditures relative to two comparison groups not participating in the program (RTI International and LeadingAge, 2014).

Incentives and opportunities to leverage the potential value of senior housing plus services strategies are growing. To adopt and support these programs and models on a more formal and broader scale, federal and state policy makers and health care organizations need evidence that these models are a sound investment strategy. Recent and ongoing studies discussed above indicate that housing plus services models can have an impact on the use of health care services and health care costs. The study presented here is intended to shed further light on the value of linking affordable senior housing settings with health and supportive services to meet resident needs.

Study Overview

The purpose of this study was to assess whether the availability of onsite services in affordable senior housing properties has an association with residents' health care utilization and spending.

This study builds on previous research conducted by LeadingAge and The Lewin Group and funded by the U.S. Departments of Health and Human Services (HHS) and Housing and Urban Development (HUD). The initial study created a dataset that linked HUD administrative data for all individuals receiving HUD assistance in 12 geographic areas with the individuals' Medicare and Medicaid claims data. The dataset identifies the population's health care service use and spending patterns in 2008, which was the latest year of both Medicare and Medicaid data available to the research team at the time the dataset was created. This dataset is referred to in this report as the "HHS/HUD dataset."

The HHS/HUD dataset offered a picture of the health conditions, health care use, and health care spending of HUD-assisted residents. The dataset revealed that, in 2008:

- Almost 70% of the HUD-assisted older adults (age 65 and older) who were identified as Medicare beneficiaries were dually eligible for both Medicare and Medicaid.
- More than half (55%) of HUD-assisted older adults who were dual eligibles had five or more chronic conditions, compared to 43% of dual-eligible older adults not receiving HUD assistance.

- HUD-assisted older adults who were dual eligibles had 16% higher fee-for-service (FFS) Medicare costs and 32% higher FFS Medicaid costs than dual-eligible older adults not receiving HUD assistance.

A complete description and results of this project can be found in the project report, *Picture of Housing and Health: Medicare and Medicaid Use Among Older Adults in HUD-Assisted Housing*.

One aim of the initial project was to understand whether offering services onsite at an affordable senior housing property could have an effect on residents' health and LTSS utilization and costs. However, neither HUD nor Medicare/Medicaid data contains any information on services available at the housing properties.

With support from The MacArthur Foundation, the research team surveyed the senior housing properties included in the HHS/HUD dataset about the types of services that were available onsite at the housing properties in 2008.

This services survey revealed new information about affordable senior housing properties, including insights about:

- The availability of onsite services staff.
- Resident needs assessment practices.
- Types of onsite services.
- Frequency of services.
- How services were provided and funded.
- Co-located services.[2]

Detailed results from the services survey can be found in the survey report, *Service Availability in HUD-Assisted Senior Housing: Findings from a Survey on the Availability of Onsite Services in HUD-Assisted Senior Housing*.

In this current analysis, the research team merged the HHS/HUD dataset with the services survey results to explore whether patterns of resident health care use and spending differed in HUD-assisted housing properties with onsite services available compared to properties without onsite services. The initial hope was to examine the effect of using onsite services on resident's health care service use and costs. However, the research team only had data on the availability of services at the properties and not on individual resident use of the services. Therefore, this analysis examines the association between the presence of onsite services and resident health care use and spending.

Study Methodology

This section provides an overview of the study methodology. Full details can be found in Appendix A.

The analysis described in this report is based on two primary datasets:

- The HHS/HUD dataset links tenant-level administrative data from HUD with individual-level administrative Medicare and Medicaid data from the Centers for Medicare and Medicaid Services (CMS) for 12 geographic areas. The HHS/HUD dataset contains data for 2007-2009. This current analysis focuses on 2008, since that was the latest year for both Medicare and Medicaid data in the dataset.

[2] "Co-located" programs or services are operated by an outside organization in a distinct space connected with the housing property.

- The services survey dataset includes responses from a survey of affordable senior housing properties included in the HHS/HUD dataset. The survey focused on the availability of services staff and services onsite at the housing properties in 2008.

The two datasets were merged to create a new data file. Individuals in the HHS/HUD dataset were linked with properties in the services survey dataset using property ID codes in the HUD data files. After applying certain merging criteria, the new data file contained 507 housing properties with 44,373 residents.

Information on the concentration of health care professionals, hospitals, and health care facilities from the 2008 Area Health Resource File was also incorporated into the new data file.

After the datasets were merged, inclusion criteria were applied to the individuals in the sample. Individuals were included in the dataset if the person:

1. Matched with Medicare and/or Medicare data, based on social security number (SSN), sex, and date of birth (DOB).
2. Was enrolled in Medicare for six or more months.
3. Was enrolled in Medicare Part A Hospital and Part B Physician Services for all 12 months of 2008, or up until death.
4. Was not enrolled in Medicare managed care (i.e. Medicare Part C or Medicare Advantage) in 2008.[3]
5. Was age 65 or older in 2008 (calculated as 2008 minus the birth year).

After applying these criteria, the sample was reduced to 23,967 individuals.

To diminish possible bias due to confounding variables, propensity score matching was then conducted. This matching was conducted to create a sample where there was an equally average likelihood of living in a property with a service coordinator across those who actually did live in a property with a service coordinator and those who did not. The service coordinator was chosen as the focus because it is a key staff role underpinning other service offerings.

Propensity scores were created through a multivariable logistic regression model where the dependent variable was whether or not the individual lived in a property with a service coordinator on staff. Independent variables included property type, property size, race/ethnicity, disability status, living alone status, and dual-eligible status. After generating propensity scores for all individuals in the dataset, residents living in a property with and without a service coordinator, and living in the same metropolitan statistical area (MSA), were matched 1:1. The propensity score matching process resulted in a final sample with 4,353 matches representing 8,706 individuals (20% of the 44,373 individuals in the original merged dataset).

Regressions were conducted with the final sample to examine differences in health care utilization and costs as they related to the presence of onsite services staff and services. A generalized linear model was applied using the GENMOD (with Generalized Estimating Equations) method in SAS.

Table 1 details the dependent, independent, and control variables used in the regression model. Control variables were individually selected for inclusion in each model based on a hypothesized relationship with the dependent variable.

[3] Individuals with any managed care enrollment were excluded because CMS administrative data does not contain any claims data (i.e., health care utilization and cost data) for individuals in managed care.

Table 1: Regression Model Variables

Dependent Variables	Independent Variables	Control Variables
• Medicare ED visits without an admission – # per Medicare-enrolled month in 2008 – Odds of any in 2008 • Medicare acute inpatient admissions – # per Medicare-enrolled month in 2008 – Odds of any in 2008 • Medicare physician office visits – # per Medicare-enrolled month in 2008 • Total Medicare medical payments (excluding Part D drugs) – $ per Medicare-enrolled month in 2008 • Total Medicare Part D payments – $ per Medicare-enrolled month in 2008 • Total Medicaid payments – $ per Medicare-enrolled month in 2008	• Availability of onsite services staff in 2008 (Y/N): – Service coordinator – Nurse • Availability of onsite services in 2008 (Y/N): – Transportation – Exercise and fitness – Health education – Health screening – Medication assistance – Primary health care – Mental health care	• Individual characteristics in 2008: – Sex – Race/ethnicity – Age – Living alone – Disability status (based on original reason for Medicare eligibility) – State of residence – Number of chronic conditions – Depression – Any dual-eligible status • Individual's prior health service utilization and payments in the Medicare and Medicaid programs (as relevant) in 2007: – Prior ED outpatient visits – Prior acute inpatient stays – Prior office visits – Prior skilled nursing facility (SNF) visits – Prior Medicare medical payments – Prior Medicare Part D payments – Prior Medicaid payments • Concentration of provider resources in the core-based statistical area in 2008: – Primary Care Physicians (PCP) per 10,000 (65+) – Specialists per 10,000 (65+) – SNF beds per 10,000 (65+) – Hospital beds per 10,000 (65+)

Each model was run with an indicator variable for the frequency with which each available service was provided (i.e. daily, weekly, monthly, and other). No predictive or analytic value was found with these variables so they were removed from the overall analysis.

Study Limitations

While controlling for several possible confounding items in the analysis, this study is not without limitations.

The data sources only contain information on services available at the property and do not have any information on individual utilization of the services. This limitation could potentially weaken the strength of observed relationships between staff/service patterns and individual outcomes.

Limitations in the process of conducting the services survey may affect the current analysis. One limitation is that the survey, administered in 2014, asked respondents to recall the services staff and services that were available at the property in 2008. This request introduces the chance of recall bias. Other limitations of the services survey include the potential for over-representation of certain geographic areas in the completed surveys, and the recoding/filtering of the survey response data that was conducted.

This study is not longitudinal and looks only at outcomes at one point in time. All independent and dependent variables represent information from 2008 overall. However, it is possible that this timing restriction misses multiyear relationships. For example, it is possible that services provided in 2008 were associated with health care utilization and costs beyond 2008.

The data sources do not contain a variable that directly measures frailty. Two disability-related variables were available in the data sources. One variable in the Medicare data indicates the original reason for eligibility for Medicare. This measure uses a limited definition of disability that relates to eligibility for Medicare coverage prior to age 65, and captures only a small proportion of the Medicare beneficiary population. Another variable in the HUD data indicates the presence of disability among residents. However, this variable has no standard definition of "disability" and is inconsistently collected across properties. Although limited in what it captures, the disability variable in the Medicare data was used as a control variable in the regression models because it has greater reliability than the HUD disability variable.

Finally, the presence of chronic conditions, which is used as a control variable, is limited to those conditions available in the Medicare claims data. It is likely the file does not capture all the chronic conditions that individuals might have. For example, the file also does not contain a flag for any types of serious mental illness, which are likely to be present among residents of low-income housing, and which can have an association with increased health care use and spending.

Results

Table 2 describes the characteristics of the final matched sample. The majority of residents in the sample were females (74.2%), non-Hispanic whites (70.7%), and lived alone (82.6%). Half (50.4%) had five or more chronic conditions, and 55.5% were dual eligibles.

Table 2: Final Sample Characteristics (N=8,706)

Gender	
Female	74.2%
Male	25.8%
Race/Ethnicity	
Non-Hispanic white	70.7%
Hispanic	10.5%
Black	10.4%
Asian/Pacific Islander	6.6%
American Indian/Alaska Native	0.1%
Other	1.5%
Unknown	0.2%
Age	
65 to 74	28.3%
75 to 79	21.1%
80 to 84	20.8%
85+	29.9%
Median age	80
Living Arrangement	
Lives alone	82.6%
Lives with spouse	14.8%
Lives with other adults	2.0%
Has minor(s) in household	0.2%
Has live-in aide	0.2%
Other	0.0%
Unknown/declined to report	0.1%
State of Residence	
California	4.3%
Connecticut	7.8%
Massachusetts	31.7%
North Carolina	0.0%
New Hampshire	0.9%
New Jersey	22.4%
New York	15.9%
Ohio	11.5%
Virginia	0.0%
Vermont	3.4%
Wisconsin	2.1%

Housing Property Type	
Public housing	17.9%
Section 202	49.7%
Other multi-family housing	32.4%
Original Reason for Medicare Entitlement	
Old age and survivor's insurance*	82.9%
Disability insurance benefits	17.0%
End Stage Renal Disease (ESRD)	0.0%
Disability Insurance and ESRD	0.1%
# Chronic Conditions	
0 conditions	6.5%
1 conditions	7.4%
2 conditions	9.2%
3 conditions	12.8%
4 conditions	13.7%
5 + conditions	50.4%
Chronic Conditions by Category	
Cardiovascular	52.7%
Cancer	9.9%
Endocrine and renal	48.5%
Alzheimer's-related	15.4%
Depression	16.9%
Musculoskeletal	43.2%
Pulmonary	20.4%
Ophthalmic	36.2%
Anemia	35.4%
Hyperlipidemia	53.4%
Hypertension	73.7%
Benign prostatic hyperplasia	5.1%
Dual-Eligible Status	
Any dual-eligible status	55.5%

*Indicates the individual enrolled in Medicare when he/she turned 65.

Controlling for multiple factors, the regression models examined the association between the availability of certain onsite services or service staff types and eight outcomes of interest.

Table 3 provides a summary of the onsite services staff and services that were found to have an association with the various outcomes. Services with both a significant ($p<.05$) and borderline significant ($p<.10$) association are noted because the analysis was only able to look at the availability of services and services staff at the property and not actual utilization of services or engagement with services staff. Because this limitation results in an overall diluted exposure to services for the resident population at each property (i.e., some residents use the services and others do not), it is believed that borderline significant results still reveal a potential relationship between the independent and dependent variables.

The availability of health education, exercise, primary care, mental health and medication management services and the presence of a service coordinator were found to have a relationship with the outcomes of interest. Other services examined, including the availability of transportation and health screening services and the presence of a nurse, were not found to have an association with the various outcomes.

Table 3: Summary of Results

Outcome	Increase	Decrease
Number of Medicare ED visits without an admission per enrolled month, 2008	Health education: 21% ($p<.05$)	
Odds of at least one Medicare ED visit without admission during 2008	Health education: 31% ($p<.05$) Primary Care: 30% ($p<.10$)	
Number of Medicare acute inpatient admissions per enrolled month, 2008	Mental health: 17% ($p<.10$)	
Odds of at least one Medicare acute inpatient admission in 2008	Mental health: 42% ($p<.05$)	Service coordinator: 18% ($p<.05$)
Number of Medicare physician office visits per enrolled month, 2008		
Medicare medical payments per enrolled month, 2008	Health education: 15% ($p<.10$)	
Medicare Part D payments per enrolled month, 2008	Exercise: 11% ($p<.05$) Medication management: 13% ($p<.10$)	Health education: 8% ($p<.05$)
Medicaid payments per enrolled month, 2008	Service coordinator: 14% ($p<.10$)	Medication management: 21% ($p<.05$)

The full regression results for each outcome can be found in Appendix B.

ED Visits without an Admission

Medicare ED visits without an admission per enrolled month in 2008 were, on average, 21% higher ($p<.05$) in properties with health education services available onsite than in properties without health education services. (Chart 1) The odds of having at least one outpatient ED visit without an admission during 2008 were, on average, 31% higher ($p<.05$) in properties with health education services available and 30% higher ($p<.10$) in properties with primary care services available, when compared to properties without these services available. (Chart 2)

Acute Inpatient Admissions

Medicare acute inpatient admissions per enrolled month in 2008 were, on average, 17% higher (p<.10) in properties with mental health services than in properties without those services available. (Chart 3) The odds of having at least one Medicare acute inpatient admission during 2008 was, on average, 42% higher (p<.05) in properties with mental health services, compared with properties without these services. By contrast, the odds of having at least one acute inpatient admission were 18% lower (p<.05) in properties with an onsite service coordinator. (Chart 4)

Physician Office Visits

None of the services or services staff examined were found to have an association with physician office visits.

Medicare Medical Payments

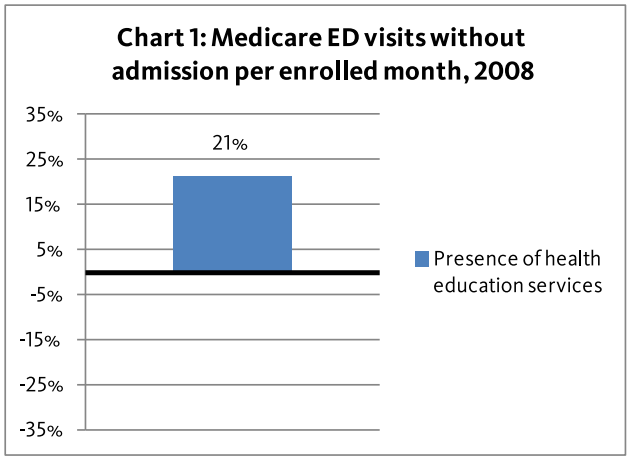
Medicare medical payments (excluding Part D) per enrolled month in 2008 were, on average, 15% higher (p<.10) in properties with health education services available onsite than in properties without health education services. (Chart 5)

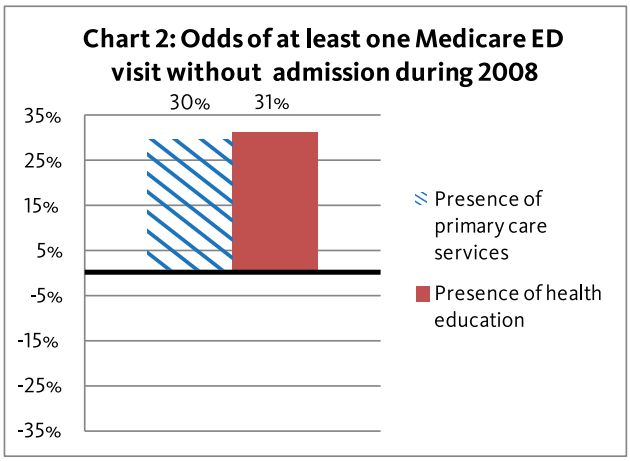
Medicare Part D Payments

Medicare Part D payments per enrolled month were, on average, 8% lower (p<.05) in properties with health education services available onsite than in properties without health education services. By contrast, payments were 11% (p<.05) and 13% (p<.10) higher in properties with exercise services and medication management services, respectively. (Chart 6)

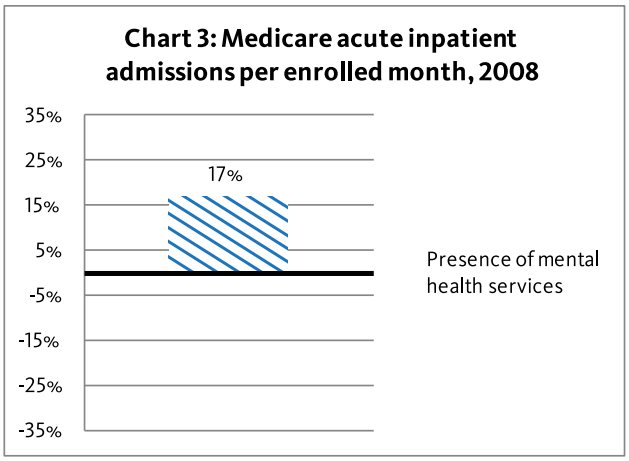
Medicaid Payments[4]

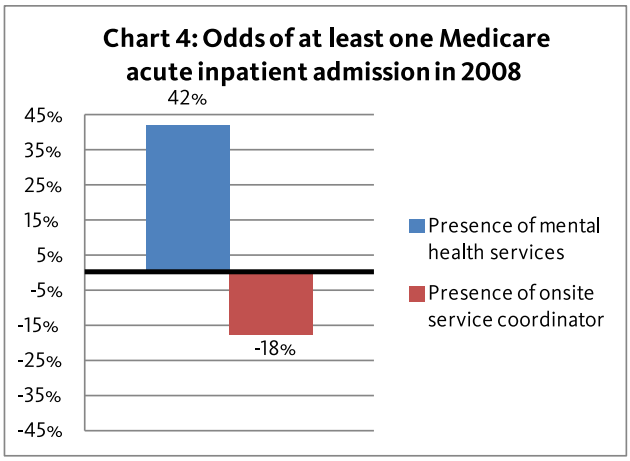
Medicaid payments (among full dual eligibles) per enrolled month were, on average, 21% lower (p<.05) in properties with medication management services compared to properties without these services. In contrast, Medicaid payments were, on average, 14% higher (p<.10) in properties with an onsite service coordinator than in properties without an onsite service coordinator. (Chart 7)

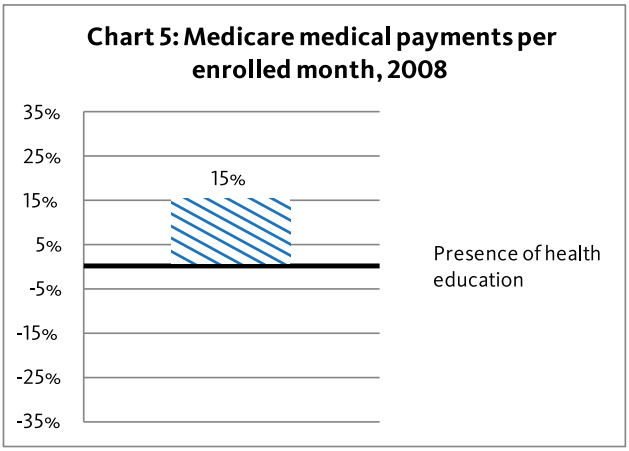


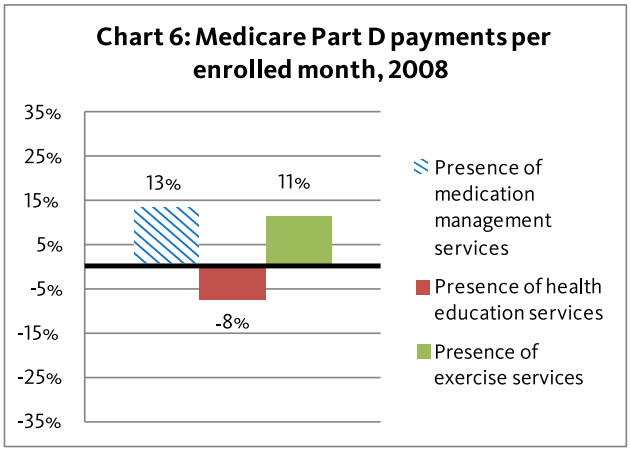


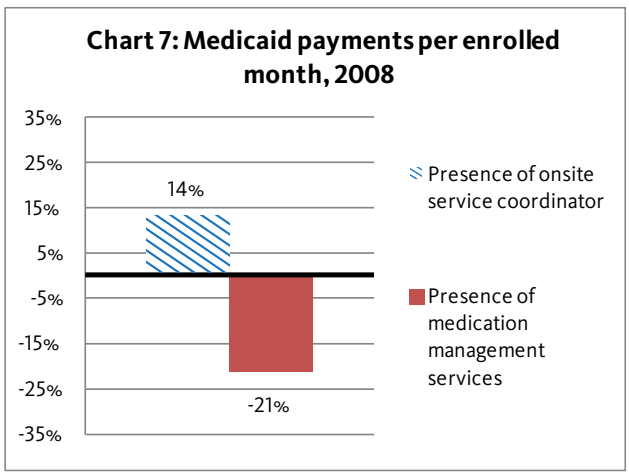
[4] This model only examines the subset of individuals in the sample who are full-benefit dual eligibles. Individuals in Medicaid managed care are also excluded because complete Medicaid use and cost information was not available for these persons.











Note: In all charts, the solid color bars indicate results are significant at $p<.05$. Striped bars indicate results are borderline significant at $p<.10$

Discussion

This study is one of the first to examine the association between the availability of certain onsite services and services staff roles in HUD-assisted senior housing properties and key outcomes of interest, including use of ED and hospital services, and Medicare and Medicaid payments. The analysis cannot specifically identify the nature of the relationship between the use of onsite services/staff and health care use and spending. However, it does provide insight into the relationships between the availability of these services and residents' health care use and spending.

The presence of a service coordinator was found to decrease the odds of having at least one acute inpatient admission (18%, $p<.05$) in 2008. A service coordinator could assist residents in a number of ways that could possibly bear on an individual's ability to better manage his or her health conditions. For example, a service coordinator could:

- Help improve access to primary care physicians by helping to coordinate doctor appointments and transportation to medical appointments.
- Help identify and access resources that help address challenges or barriers to maintaining good health. For example, a service coordinator could help an individual obtain a Medicare Part D plan that helps minimize out-of-pocket expenses and makes medications more affordable. Service coordinators could also help an individual enroll in the Supplemental Nutrition Assistance Program (SNAP, also known as "food stamps") or a meals delivery program as a way to help ensure the individual is receiving proper nutrition.
- Encourage residents to visit their doctors when early warning signs or concerns are identified, rather than waiting until the condition worsens.

The availability of an onsite service coordinator also had a borderline significant association with higher average Medicaid payments (14%, $p<.10$), compared to properties without a coordinator. It is possible that a service coordinator helps residents identify and enroll in Medicaid-funded programs such as Medicaid waiver, personal care option, or adult day health programs. In this instance, increased spending may be viewed as a positive outcome. By utilizing Medicaid-funded home and community-based services, individuals may prolong their ability to remain in their home and community and avoid moving to a higher and more costly level of care, such as a nursing home.

The presence of health education services was found to be associated with an increase in both the number of ED visits without an admission (21%, $p<.05$) and the odds of having an ED visit with an admission during the year (31%, $p<.05$). A health education session could help an individual discover that he/she has a health symptom (e.g. high blood pressure or glucose level) that warrants immediate attention. The individual might then follow a recommendation that he/she go to the ED immediately. In several case studies conducted by LeadingAge, entities providing health education and screening services at affordable senior housing services indicated they have discovered urgent health issues and encouraged individuals to go to the ED. While an ED visit may be considered an undesirable outcome, the entities indicated that the health condition was often caught before it became a bigger health crisis that could have resulted in a more costly hospitalization.

Health education services were also associated with a decrease (8%, $p<.05$) in Medicare Part D payments per enrolled month. Health education sessions might involve a medication review that identifies unnecessary medications. Education might also prompt individuals to have discussions with their doctor about their medication regimens. Those discussions could result in a decrease in the number of medications they take. Additionally, a person could eliminate the need for a prescription after learning how to better control a health condition.

The presence of mental health services at a housing property was associated with increased odds of having at least one acute inpatient admission (42%, $p<.05$). It is possible that mental health services are more likely provided at properties that house a higher number of residents with mental health needs. (The analysis is only able to control for individuals having depression and not other mental illnesses.) Individuals with mental illness often have higher levels of hospital use, which may be reflected here in the higher likelihood of having an acute inpatient admission (Boyd et al., 2010). Higher levels of hospital use may also reflect the fact that onsite mental health treatment might lead to more appropriate hospitalizations for individuals with these conditions.

The presence of medication management was associated with a lower average Medicaid monthly payment (21%, $p<.05$) compared to properties without this service. The relationship between medication management and lower Medicaid payments is unclear. Better medication management could possibly help decrease side effects that might lead to a need for Medicaid-provided LTSS. Or, unnecessary medications might be eliminated, thus shrinking the related costs not covered by Medicare Part D but covered by Medicaid for dual-eligible beneficiaries.

The authors are not able to speculate about possible explanations for the positive relationship between availability of exercise and fitness programs and higher Medicare Part D payments (11%, $p<.05$). This finding underscores the need for additional research that could better control for an array of health and functional problems and would examine the actual effects of use of fitness programs on drug expenditures.

Conclusion

This study provides new information about the association between the availability of onsite services in affordable senior housing properties and residents' health service use and costs.

The observed relationship between the availability of a service coordinator and lower use of inpatient hospital services is perhaps the most important and timely finding for policy makers and practitioners interested in the role of service-enriched housing. This finding complements other studies that have also indicated the positive effects of service coordination (Levine & Robinson, 2008; RTI International and LeadingAge, 2014; Castle & Resnick, 2014).

Helping individuals better navigate the complex health care system and improve access to needed services is a primary component of many health reform efforts. This study suggests that service coordinators could play a valuable role in helping health care providers and payers improve access to and coordination of health services for their patients living in affordable senior housing communities.

As models of housing linked with services continue to be developed at the community and state levels, more longitudinal research is needed to examine:

- How residents' use of service coordinators and other housing-based services affects Medicare and Medicaid utilization and costs, resident health, quality of life, and functional outcomes.
- The value of these service interventions to housing providers.
- The frequency, intensity, and combination of services that will best meet the needs of elderly low-income residents.

This and other research will help health, social services and housing providers attempting to engage in better population health management and assist older adults in successfully aging in their communities.

References

Boyd, C., Leff, B., Weiss, C., Wolff, J., Clark, R., & Richards, T. (December 2010). *Clarifying multimorbidity to improve targeting and delivery of clinical services for Medicaid populations.* Hamilton, NJ: Center for Health Care Strategies, Inc.

Braveman, P. & Gottlieb, L. (2014). The social determinants of health: It's time to consider the causes of the causes. *Public Health Reports*, 129(Supplement 2), 19-31. Accessed at: *http://www.publichealthreports.org/issueopen.cfm?articleID=3078.*

Castle, N. (2008). Service enriched housing and the senior living enhancement program. *Journal of Housing for the Elderly*, 22(3), 263-277.

Castle, N. & Resnick, N. (July 2014). Service-enriched housing: The Staying-at-Home program. *Journal of Applied Gerontology,* published online July 9, 2014.

Centers for Disease Control and Prevention. (1999). *Physical activity and health: A report of the Surgeon General.* Accessed at: *http://www.cdc.gov/nccdphp/sgr/index.htm*.

Ficke, R. & Berkowitz, S. (2000). *Report to congress: Evaluation of the HOPE for Elderly Independence Demonstration Program and the new Congregate Housing Services Program.* Washington, DC: U.S. Department of Housing and Urban Development.

Gibler, K. (2003). Aging subsidized housing residents: A growing problem in U.S. cities. *Journal of Real Estate Research,* 25, 395-420.

Griffith, J., Greene, A., Steward L., & Wood, M. (1996). *Evaluation of the new Congregate Housing Services Program.* Washington, DC: U.S. Department of Housing and Urban Development.

Haley, B. & Gray, R. (2008). *Section 202 Supportive Housing for the Elderly: Program status and performance measurement*. Washington, DC: U.S. Department of Housing and Urban Development.

Kochera, A. (2002). *Developing appropriate rental housing for low-income older persons: A survey of Section 202 and LIHTC property managers.* Washington, DC: AARP Public Policy Institute.

Levine, C. & Robinson Johns, A. (2008). *Multifamily property managers' satisfaction with service coordination.* Washington, DC: U.S. Department of Housing and Urban Development.

The Lewin Group. (2014). *Picture of housing and health: Medicare and Medicaid use among older adults in HUD-assisted housing.* Washington, DC: U.S. Department of Health and Human Services. Available at: *http://aspe.hhs.gov/daltcp/reports/2014/HUDpic.shtml*.

Marek, K., Popejoy, L., Petroski, G., Mehr, D., Rantz, M., & Lin, W. (2005). Clinical outcomes of aging in place. *Nursing Research*, 54, 202-211.

Redfoot, D. and Kochera, A. (2004). Targeting services to those most at risk: Characteristics of residents in federally subsidized housing. *Journal of Housing for the Elderly*, 18, 137-163.

Reinhard, S. (2010). Diversion, transition program target nursing homes' status quo. *HealthAffairs*, 29(1), 44-48.
RTI International and Leading Age. (2014). *Support and Services at Home (SASH) evaluation: First annual report*. Washington, DC. Accessed at: *http://aspe.hhs.gov/daltcp/reports/2014/SASH1.pdf.*

Sanders, A. & Stone, R. (2011). *Supporting aging in place in subsidized housing: An evaluation of the WellElder Program*. Washington DC: LeadingAge Center for Applied Research.

Stone, R. (2011). *Long-term care for the elderly.* Washington, DC: The Urban Institute Press.

Taylor, L., Coyle, C., Ndumele, C., Rogan, E., Canavan, M., Curry, L., et al. (June 2015). The social determinants of health: What works?" New Haven, CT: Yale Global Health Leadership Institute. Accessed at: *http://www.bluecrossfoundation.org/sites/default/files/download/publication/Social_Equity_Report_Final.pdf*.

Washko, M., Sanders, A., Stone, R. & Harahan, M. (2007). Connecting affordable senior housing and services: An in-depth descriptive study of three models. *Seniors Housing & Care Journal*, 15(1), 31-46.

Wilden, R. & Redfoot, D. (2002). *Adding assisted living services to subsidized housing: Serving frail older persons with low incomes.* Washington, DC: American Association of Retired Persons.

Yaggy S., Michener, J., Yaggy, D., Champagne, M., Silberberg, M., Lyn, M., et al. (2005). Just for Us: An academic medical center-community partnership to maintain the health of a frail low-income senior population. *Gerontologist*, 46(2), 271-6.

Appendix A: Study Methodology

This current study builds on two prior interrelated efforts:

1. The development of a dataset on the health condition, and health care use and costs, of residents in affordable senior housing communities assisted by the U.S. Department of Housing and Urban Development (HUD). This dataset, which contains data from HUD and the U.S. Department of Health and Human Services (HHS), is referred to as the "HHS/HUD dataset."
2. A survey of the HUD-assisted senior housing properties included in the HHS/HUD dataset to examine the availability of onsite services and services staff in the properties.

The goal of this analysis is to merge the HHS/HUD dataset with the responses from the services survey to examine whether the availability of onsite services and services staff has any association with residents' health care utilization and costs.

Data Sources

HHS/HUD Dataset

The HHS/HUD dataset links tenant-level administrative data from HUD with individual-level administrative data from the Centers for Medicare and Medicaid Services (CMS). The data sources for each component are described in Table A1. The current analysis is focused only on 2008, as this was the latest year available for both the Medicare and Medicaid data at the time the data was secured.

Table A1: Administrative Data Sources

	HUD tenant-level administrative data	CMS individual-level administrative data
Years	2007, 2008, and 2009	• Medicare: 2007–2009 • Medicaid: 2007–2008
Data Sources	Tenant Rental Assistance Certification System (TRACS)	Medicare Administrative Data from the Medicare Beneficiary Summary File • Parts A, B, and D • Chronic Conditions • Cost & Use
	Public and Indian Housing (PIH) Information Center (PIC)	Medicaid Administrative Data from the Medicaid Analytic eXtract (MAX) Person Summary file

For more details on the data sources in the HHS/HUD Dataset, see Appendix A in *Picture of Housing and Health: Medicare and Medicaid Use Among Older Adults in HUD-Assisted Housing*. This is the report for the project in which the HHS/HUD dataset was created.

The HHS/HUD dataset includes all individuals receiving HUD assistance in the 12 geographic areas listed below. These regions were chosen because they are areas in which the research team had conducted case studies of affordable senior housing plus services models.

- New Haven-Milford, CT
- Bridgeport-Stamford-Norwalk, CT
- Milwaukee-Waukesha-West Allis, WI
- San Francisco-Oakland-Fremont, CA
- Boston-Cambridge-Quincy, MA
- Durham-Chapel Hill, NC
- Richmond, VA
- New York-Northern New Jersey-Long Island
- Columbus, OH
- Akron, OH
- Cleveland, OH
- The State of Vermont

Services Survey Dataset

The services survey dataset includes responses to a survey administered with the senior housing properties in the HHS/HUD dataset. A senior housing property was defined as a property that is either designated by HUD as an elderly property, or a property in which 50% or more of the households had an individual age 62 or older. The properties consisted of all types of HUD-assisted properties, including public housing, Section 202, and all forms of multi-family housing properties. A total of 2,017 senior housing properties were identified. Through a mail survey, the properties were asked about the types of services and services staff available onsite at the property in 2008. A total of 520 surveys were returned. The response data was cleaned to create a final services survey dataset.

For complete details on the survey methodology, see Appendix B in *Service Availability in HUD-Assisted Senior Housing: Findings from a Survey on the Availability of Onsite Services in HUD-Assisted Senior Housing*. This is the report for the project that created the services survey dataset.

Area Health Resource File

Information on the concentration of health care professionals, hospitals, and health care facilities from the 2008 Area Health Resource File (AHRF) was added to the data file. This allowed for the creation of four variables for each individual's core based statistical area (similar to a county), including: primary care physicians per 10,000 (65+), specialists per 10,000 (65+), skilled nursing facility (SNF) beds per 10,000 (65+), and hospital beds per 10,000 (65+).

Data File Creation

The data file for this analysis was created by merging the HHS/HUD dataset and the services survey dataset. Individuals in the HHS/HUD dataset were linked with properties in the services survey dataset using property ID codes from the PIC and TRACS data files.[5] Due to a change in how the property ID codes in the PIC data file were constructed between 2007 and 2008, a conservative matching approach was used that required individuals to be associated with the property in both 2007 (when the original property ID was used) and 2008 (when a new property ID was used). For consistency, individuals in the TRACS data file were also required to match with the same property ID in both 2007 and 2008. If an individual appeared in both the PICS and TRACS data file, one observation was created for the individual, based on the PIC data. Individuals were excluded if their move-out date in a given year occurred prior to the current data year.

[5] See Appendix A of the report on the HHS/HUD dataset project for more information on the property ID codes, found at: *http://aspe.hhs.gov/basic-report/picture-housing-and-health-medicare-and-medicaid-use-among-older-adults-hud-assisted-housing*.

Table A2 details the number of properties included in the final dataset after the HHS/HUD dataset and survey response dataset were merged using the criteria described above.

Table A2: Property Inclusion in Dataset

Property-level surveys returned	520 properties
Surveyed properties that matched to at least one individual in the HUD/HHS dataset	512 properties*
Surveyed properties that matched to at least one individual in the HUD/HHS dataset with duplicate properties removed	507 properties

*Eight properties opened very late in 2007 or early in 2008 and did not have individuals meeting the matching criteria.

Sample

Inclusion Criteria

After the merged data file was created, sample inclusion criteria were applied to the individuals in the file. Individuals were included in the dataset if the person:

1. Matched with Medicare and/or Medicare data, based on social security number (SSN), sex, and date of birth (DOB). This conservative approach was taken to ensure that individuals were, in fact, enrolled in Medicare and/or Medicaid. Medicare and Medicaid data can have duplicate observations for a given SSN due to a variety of reasons (e.g., Medicaid beneficiary who moved to a different state mid-year, data error, etc.).
2. Was enrolled in Medicare enrollment for six or more months.
3. Was enrolled in Medicare Part A Hospital and Part B Physician Services for all 12 months of 2008, or up until death.
4. Was not enrolled in Medicare managed care (i.e. Medicare Part C or Medicare Advantage) in 2008.[6] Individuals with any managed care enrollment were excluded because CMS administrative data does not contain any claims data (i.e., health care utilization and cost data) for individuals in managed care.
5. Was age 65 or older in 2008 (calculated as 2008 minus the birth year).

Table A3 details the application of each inclusion criteria and the resulting number and percentage of individuals retained in the sample.

Table A3: Sample with Inclusion Criteria Applied

	Number of individuals in the dataset (%)
HUD-assisted individuals merged with property-level survey data	44,373 (100%)
Merged with Medicare and/or Medicaid individual-level data	39,102 (88%)
Six or more months of Medicare enrollment	36,371 (82%)
Enrolled in Part A Hospital & Part B Physician Services for entire 12 month in 2008 period or up until death	35,885 (81%)
No Medicare managed care	26,685 (60%)
Age 65 or older	23,967 (54%)

[6] Individuals with any managed care enrollment were excluded because CMS administrative data does not contain any claims data (i.e., health care utilization and cost data) for individuals in managed care.

Propensity Score Application

The ultimate goal of this study was to examine, through multivariate analysis, the relationship between differences in staffing patterns and service offerings across properties and Medicare and Medicaid health care utilization and costs at the individual level. Propensity score matching was employed on the merged dataset described above. This was done to create a sample where there was an equally average likelihood of living in a property in a particular Metropolitan Statistical Area (MSA) with a service coordinator across those who actually did live in a property with a service coordinator and those who did not. The service coordinator was chosen as the focus because it is a key staff role that underpins other service offerings. Individuals were limited to matching within their specific MSA because the prevalence of properties with service coordinators can differ across MSAs. Limiting matches to individuals within MSAs increases the chances that matched individuals had similar opportunity to live in a property with a service coordinator. The likelihood of living in a property in a particular MSA with a service coordinator was, in this approach, called a propensity score. The propensity score was generated from a multivariable logistic regression model where the dependent variable was whether or not the individual lived in a property in a particular MSA with a service coordinator on staff.

The following covariates were used as independent variables in this logistic regression:

- Property type (public housing, Section 202, or other multi-family).
- Property size (number of units in 2007).
- Race/ethnicity.
- Disability status (original reason for Medicare eligibility).
- Living alone status.
- Dual-eligible status (any type of dual eligible versus not a dual eligible).

These variables were chosen based on preliminary mean comparisons of these variables between residents living in properties with and without service coordinators. The comparison suggested that certain kinds of residents were more likely to live in a property with a service coordinator. Using the coefficients from the logistic regression model, a propensity score was created for each individual as the predicted probability of living in a property with service coordinator.

After generating propensity scores for all individuals in the dataset, residents living in the same MSAs in a property with and without a service coordinator were matched 1:1, creating a new matched dataset. An algorithm was used to match individuals using various maximum values for the "score difference" (the maximal allowable absolute difference in propensity scores). The characteristics of the resulting samples were compared. Pairs were assigned by finding the nearest match meeting the maximum allowable score difference requirement. Specifically, differences in the same independent variables used in the logistic regressions between the group of individuals living in a property with a service coordinator and those who did not live in a property with a service coordinator were explored. A maximum allowable score difference of 0.01 was selected as it balanced having similarity across the matched pairs on key variables without pulling in a large number of individuals at the edge of the distribution of each variable. The algorithm also used a matching "without replacement" approach. This is a linear matching algorithm approach that removes the individuals in a matched pair from further consideration after they are matched.

Here is a simplified illustration of the matching approach: Individual A lives in a particular MSA in a property with a service coordinator and has a propensity score of 0.931. An individual living in the same MSA in a property without a service coordinator (Individual B) with the closest possible propensity score to Individual A is found. These two individuals are then flagged for inclusion in a new propensity score matched dataset. The difference between the propensity scores for Individual A and Individual B is called the "score difference."

The propensity score matching process resulted in 4,353 matches representing 8,706 individuals (22% of the 44,373 individuals in the original merged dataset). To ensure the matched population was comparable to the non-matched population, the original demographic analyses were rerun to ensure sufficient similarity for key variables. No areas of concern were found.

Analysis

Using the propensity score matched sample, regressions were conducted to examine differences in health care utilization and costs as they relate to the presence of onsite services staff and services. A generalized linear model was applied using the GENMOD (with Generalized Estimating Equations) method in SAS.[7] For more details on the dependent and independent variables discussed below, see Appendix A in the report for the project in which the HHS/HUD dataset was created, found here: *http://aspe.hhs.gov/basic-report/picture-housing-and-health-medicare-and-medicaid-use-among-older-adults-hud-assisted-housing*.

Regressions were performed for each of the dependent variables listed in Table A4. These variables were chosen because it was predicted that the availability of onsite services staff or services might have a relationship with health care utilization or spending. The dependent variables were generally defined as those available in the Medicare Beneficiary Summary File and the Medicaid Analytic eXtract (MAX) Person Summary File. In a few instances, variables were combined to create a summary variable of related services. All dependent variables use 2008 data.

Table A4: Dependent Variables

Variable	Variable Code and Definition	Variable Format(s)[8]
Medicare emergency department (ED) visits without an admission	HOP_ER_VISITS: Count of unique emergency department revenue center dates (as a proxy for an ED visit) in the hospital outpatient data file for a given year.	• # visits per Medicare-enrolled month in 2008 • 1/0 flag - 1 if any ED visit without an admission in 2008
Medicare acute inpatient admissions	ACUTE_STAYS: Count of hospital stays (unique admissions, which may span more than one facility) in the acute inpatient setting for a given year. An acute stay is defined as a set of one or more consecutive acute claims where the beneficiary is only discharged on the most recent claim in the set. Acute care settings include a hospital, ED, and short-stay facilities for shorter-term treatment.	• # admissions per Medicare-enrolled month in 2008 • 1/0 flag - 1 if any acute inpatient admissions in 2008

[7] Due to concern that variance may be clustered at the property level (where outcomes of individuals in the same property may be positively correlated due to property-specific characteristics), regression models were fit using the Generalized Estimating Equations (GEE) method. Repeated measures were specified by property ID using an exchangeable correlation structure. The GEE method ensures that all estimates use a robust calculation of standard errors that accounts for the correlation within properties. Without this correction, clustered variance could adversely affect parameter variance estimates in the regressions (and hence estimated p-values).

[8] Variables measured in counts and dollars utilize a negative binomial distribution and the "log" link function in the GENMOD regression. Variables measured as 1/0 flags utilize a binomial distribution and the "logit" function in the GENMOD regression.

Variable	Variable Code and Definition	Variable Format(s)[8]
Medicare physician office visits	EM_EVENTS + PHYS_EVENTS EM_EVENTS: Count of events for the Part B evaluation and management (E&M) services for a given year. E&M claims are a subset of the claims in the Part B Carrier and DME data files, and a subset of physician claims. PHYS_EVENTS: Count of events in the Part B physician office services (PHYS) for a given year. Physician office claims are a subset of the claims in the Part B Carrier and DME data files, and a subset of physician evaluation and management claims.	• # visits per Medicare-enrolled month in 2008
Total Medicare medical payments (Excludes Part D drugs.)	TOT_MED_MDCR Sum of payments for the following elements: – Acute stay admissions (ACUTE_MDCR_PMT) – Other inpatient admissions (OIP_MDCR_PMT) – Medicare skilled nursing facility days (SNF_MDCR_PMT) – Medicare home health visits (HH_MDCR_PMT) – Medicare hospice days (HOS_MDCR_PMT) – Hospital outpatient visits (HOP_MDCR_PMT) – Physician office visits (EM_MDCR_PMT + PHYS_MDCR_PMT) – Ambulatory surgery center visits (ASC_MDCR_PMT) – Dialysis events (DIALYS_MDCR_PMT) – Anesthesia events (ANES_MDCR_PMT) – Imaging events (IMG_MDCR_PMT) – Test events (TEST_MDCR_PMT) – Other procedures (OPROC_MDCR_PMT) – Durable medical equipment (DME_MDCR_PMT) – Part B drugs (PTB_DRUG_MDCR_PMT)	• $ per Medicare-enrolled month in 2008
Total Medicare Part D payments (Limited to individuals with Part D coverage.)	PTD_MDCR_PMT: Payment for all events for Part D drugs for a given year. An event is a dispensed (filled) drug prescription covered by the Part D benefit.	• $ per month that individual is both Medicare-enrolled and Part D-enrolled in 2008
Total Medicaid payments (Limited to individuals who are full-benefit dual eligibles and have no Medicaid managed care in 2008.)	TOT_MDCD_PYMT_AMT: Total amount of money paid by Medicaid for the recipient during the calendar year (fee-for-service and premium payments), for all types of service and any type of claim.	• $ per month that individual is a full-benefit dual eligible in 2008

Table 5 lists the independent variables and a description, if one was included, from the services survey.

Table A5: Independent Variables

Variable	Description
Onsite Services Staffing	
Service coordinator	A person whose role is to assist residents with identifying and accessing benefits and services.
Nurse	Not described.
Onsite Services	
Transportation services	Not described.
Exercise and fitness programs	Not described.
Health education programs	Not described.
Health screening or monitoring services	Such as checking blood pressure or weight.
Medication assistance	Such as help taking medications as prescribed or education on potential complications.
Primary health care services provided by a nurse or physician	Not described.
Mental health services	Not described.

Independent and control variables were selected for inclusion in each regression model, based on an expected relationship with the dependent variable. Table A6 details which independent and control variables were entered in each model.

Each model was run with an indicator variable for the frequency with which each available service was provided (i.e. daily, weekly, monthly and other). No predictive or analytic value was found with these variables and they were removed from the overall analysis.

Methods appropriate for GENMOD regressions to assess collinearity among independent variables were used in each model. Although collinearity was identified between age and the model intercept, as well as among property-level, supply-side variables, this was not considered a threat to the subsequent regression analyses because the predictor variables were not involved.[9]

[9] A version of the root GENMOD model was run with an option to output a diagonal matrix of weights called the Hessian matrix and a table of correlations among the parameter estimates of the fitted model. This Hessian matrix was then specified as the relative weights for a weighted least-squares regression (PROC REG) that included options (COLLIN and COLLINOINT) for assessing collinearity. There was no collinearity among service or staffing variables, only among control variables (specifically, the provider supply variables, VIF>10, and large proportion of variance associated with a high condition index (>20)). Collinearity among the control variables does not impact their performance as controls and does not impact coefficient estimates for the service and staffing variables.

Table A6: Independent and Control Variables Used in Each Regression Model

Variables	Medicare ED Visits Without an Admission	Medicare Acute Inpatient Admission	Medicare Physician Office Visits	Total Medicare Medical Payments	Total Medicare Part D Payments	Total Medicaid Expenditures
Independent Variables: Onsite Services Staffing (from Services Survey dataset)						
Service coordinator (1/0)	x	x	x	x	x	x
Nurse (1/0)	x	x	x	x	x	x
Independent Variables: Onsite Services (from Services Survey dataset)						
Transportation services (1/0)	x	x	x	x	x	x
Exercise and fitness programs (1/0)	x	x		x	x	x
Health education programs (1/0)	x	x	x	x	x	x
Health screening or monitoring services (1/0)	x	x	x	x	x	x
Medication assistance (1/0)	x	x	x	x	x	x
Primary health care services provided by a nurse or physician (1/0)	x	x	x	x	x	x
Mental health services (1/0)	x	x	x	x	x	x
Control Variables: Individual Characteristics (from Medicare Beneficiary Summary File and included in HHS/HUD dataset)						
Sex (male omitted)	x	x	x	x	x	x
Race (Non-Hispanic White omitted)	x	x	x	x	x	x
Age category (85+ omitted)	x	x	x	x	x	x
Living alone (1/0)	x	x	x	x	x	x
Has disability (Medicare original reason for eligibility) (1/0)	x	x	x	x	x	x
# of chronic conditions*	x	x	x	x	x	x
Has depression (1/0)*	x	x	x	x	x	x
Any Medicare/Medicaid enrollee (MME) status (1/0)	x	x	x	x	x	
State of residence (New York omitted)	x	x	x	x	x	x

Variables	Medicare ED Visits Without an Admission	Medicare Acute Inpatient Admission	Medicare Physician Office Visits	Total Medicare Medical Payments	Total Medicare Part D Payments	Total Medicaid Expenditures
Control Variables: Concentration of Provider Resources (from Area Health Resource File)						
PCPs per 10,000 (65+) in core-based statistical area	x	x	x	x	x	x
Specialists per 10,000 (65+) in core-based statistical area	x	x	x	x	x	x
SNF beds per 10,000 (65+) in core-based statistical area				x	x	x
Hospital beds per 10,000 (65+) in core-based statistical area				x	x	x
Control Variables: Prior Health Care Utilization and Spending (from Medicare Beneficiary Summary File and included in HHS/HUD dataset)						
Prior ED visits without an admission per Medicare-enrolled month (2007)	x	x		x	x	x
Prior acute stay admissions per Medicare-enrolled month (2007)	x	x		x	x	x
Prior physician office visits per Medicare-enrolled month (2007)			x			
Prior SNF visits per Medicare-enrolled month (2007)	x	x		x	x	x
Prior Medicare Medical expenditures per Medicare-enrolled month (2007)				x	x	
Prior Medicare Part D expenditures per Medicare Part D-enrolled month (2007)					x	
Prior Medicaid expenditures per Medicaid-enrolled month (2007)						x

*Chronic conditions were identified for individuals using Chronic Condition Warehouse (CCW) end-of-year flags in the Medicare Beneficiary Summary File. CCW identifies 27 chronic conditions. A summary variable was created that summed up flags across 26 of the 27 conditions (excluding Alzheimer's chronic condition to not double count with Alzheimer's and related conditions flag) for a given individual. For example, an individual with three end-of-year chronic condition flags would be assigned a three for the given calendar year.

Appendix B: Full Logistic Regression Model Results

Table B1: Medicare ED Visits without Admission per Enrolled Month, 2008

	Parameter Estimate (*B*)	Standard Error (*SE*)	95% Confidence Limits	Z	Odds Ratio	*p* -Value
Independent Variables						
Service coordinator	-0.10	0.07	[-0.23, 0.04]	-1.37	0.91	0.17
Nurse	-0.02	0.10	[-0.21, 0.17]	-0.20	0.98	0.84
Transportation	-0.03	0.07	[-0.17, 0.10]	-0.47	0.97	0.64
Exercise and fitness	-0.06	0.08	[-0.23, 0.10]	-0.73	0.94	0.47
Health education	0.19	0.09	[0.02, 0.36]	2.20	1.21	0.03*
Health screening	-0.07	0.08	[-0.22, 0.09]	-0.83	0.94	0.41
Medication assistance	0.07	0.09	[-0.11, 0.26]	0.77	1.08	0.44
Primary health care	-0.05	0.13	[-0.30, 0.21]	-0.36	0.95	0.72
Mental health care	0.16	0.13	[-0.09, 0.41]	1.23	1.17	0.22
Control Variables						
Female	0.02	0.06	[-0.10, 0.13]	0.29	1.02	0.77
Hispanic	0.24	0.09	[0.07, 0.42]	2.74	1.28	0.01*
Black	0.24	0.10	[0.05, 0.43]	2.48	1.27	0.01*
Asian	-0.23	0.14	[-0.50, 0.03]	-1.71	0.79	0.09**
Indian	-0.20	0.51	[-1.20, 0.81]	-0.38	0.82	0.70
Other race	-0.23	0.21	[-0.65, 0.18]	-1.11	0.79	0.27
Age 65 to 69	0.16	0.11	[-0.06, 0.37]	1.44	1.17	0.15
Age 70 to 74	-0.11	0.09	[-0.28, 0.07]	-1.20	0.90	0.23
Age 75 to 79	-0.07	0.07	[-0.21, 0.07]	-0.96	0.93	0.34
Age 80 to 84	-0.08	0.07	[-0.23, 0.07]	-1.09	0.92	0.28
Lives alone	0.00	0.08	[-0.15, 0.15]	-0.01	1.00	0.99
Disability status	0.11	0.08	[-0.05, 0.26]	1.35	1.11	0.18
# Chronic conditions	0.14	0.01	[0.12, 0.16]	13.42	1.15	<.0001*
Depression	0.26	0.07	[0.12, 0.39]	3.73	1.29	0.0002*
Any MME status	0.17	0.06	[0.05, 0.30]	2.76	1.19	0.01*
State of residence						
CA	0.31	0.20	[-0.08, 0.69]	1.57	1.36	0.12
CT	0.31	0.13	[0.05, 0.56]	2.38	1.36	0.02*
MA	0.40	0.12	[0.17, 0.63]	3.38	1.49	0.001*
NC	0.00	0.00	[0.00, 0.00]	.	1.00	.
NH	0.87	0.24	[0.39, 1.34]	3.58	2.38	0.0003*
NJ	0.13	0.11	[-0.10, 0.35]	1.11	1.14	0.27
OH	0.22	0.12	[-0.02, 0.47]	1.81	1.25	0.07**
VA	0.00	0.00	[0.00, 0.00]	.	1.00	.
VT	0.61	0.15	[0.31, 0.91]	4.01	1.84	<.0001*
WI	0.20	0.22	[-0.23, 0.64]	0.91	1.23	0.36
Concentration of health provider resources (65+)						
PCPs per 10,000	-0.0004	0.003	[-0.01, 0.005]	-0.16	1.00	0.87
Specialists per 10,000	-0.0004	0.0005	[-0.002, 0.001]	-0.69	1.00	0.49
Prior health care utilization and spending						
Prior ED visits without admission (2007)	1.90	0.26	[1.40, 2.40]	7.45	6.69	<.0001*
Prior acute stay admissions (2007)	0.73	0.38	[-0.02, 1.47]	1.92	2.07	0.06**
Prior SNF stays (2007)	-0.54	0.98	[-2.46, 1.39]	-0.55	0.58	0.58

*$P < .05$, **$P < .10$

Table B2: Medicare ED Visits without Admission, At Least One Visit, 2008

	Parameter Estimate (*B*)	Standard Error (*SE*)	95% Confidence Limits	Z	Odds Ratio	*p* -Value
Independent Variables						
Service coordinator	-0.09	0.07	[-0.22, 0.04]	-1.40	0.91	0.16
Nurse	0.03	0.10	[-0.17, 0.23]	0.28	1.03	0.78
Transportation	-0.08	0.08	[-0.23, 0.07]	-1.05	0.92	0.29
Exercise and fitness	0.01	0.08	[-0.14, 0.16]	0.15	1.01	0.88
Health education	0.27	0.09	[0.10, 0.44]	3.10	1.31	0.002*
Health screening	-0.14	0.09	[-0.31, 0.03]	-1.63	0.87	0.10
Medication assistance	-0.16	0.10	[-0.35, 0.04]	-1.6	0.85	0.11
Primary health care	0.26	0.15	[-0.03, 0.55]	1.77	1.30	0.08**
Mental health care	0.13	0.15	[-0.16, 0.42]	0.89	1.14	0.37
Control Variables						
Female	0.11	0.07	[-0.03, 0.24]	1.5	1.11	0.13
Hispanic	0.33	0.10	[0.13, 0.53]	3.26	1.39	0.001*
Black	0.17	0.10	[-0.02, 0.37]	1.72	1.19	0.09**
Asian	-0.25	0.14	[-0.52, 0.03]	-1.77	0.78	0.08**
Indian	0.28	0.81	[-1.32, 1.87]	0.34	1.32	0.74
Other race	-0.25	0.25	[-0.75, 0.24]	-1.00	0.78	0.32
Age 65 to 69	0.08	0.12	[-0.15, 0.32]	0.67	1.08	0.50
Age 70 to 74	-0.07	0.09	[-0.25, 0.10]	-0.81	0.93	0.42
Age 75 to 79	-0.18	0.08	[-0.34, -0.03]	-2.31	0.83	0.02*
Age 80 to 84	-0.07	0.08	[-0.23, 0.09]	-0.84	0.93	0.40
Lives alone	0.06	0.09	[-0.10, 0.23]	0.74	1.07	0.46
Disability status	0.23	0.08	[0.07, 0.39]	2.76	1.26	0.01*
# Chronic conditions	0.17	0.01	[0.15, 0.20]	14.2	1.19	<.0001*
Depression	0.20	0.08	[0.05, 0.35]	2.62	1.22	0.01*
Any MME status	0.02	0.07	[-0.12, 0.16]	0.26	1.02	0.80
State of residence						
CA	0.17	0.18	[-0.19, 0.53]	0.94	1.19	0.35
CT	0.54	0.14	[0.27, 0.82]	3.86	1.72	<.0001*
MA	0.67	0.12	[0.44, 0.90]	5.73	1.95	<.0001*
NC	0.00	0.00	[0.00, 0.00]	.	1.00	.
NH	0.95	0.13	[0.70, 1.19]	7.47	2.57	<.0001*
NJ	0.21	0.11	[-0.01, 0.42]	1.86	1.23	0.06**
OH	0.36	0.12	[0.12, 0.61]	2.92	1.44	0.004*
VA	0.00	0.00	[0.00, 0.00]	.	1.00	.
VT	0.64	0.16	[0.31, 0.96]	3.87	1.89	<.0001*
WI	0.17	0.22	[-0.27, 0.60]	0.74	1.18	0.46
Concentration of health provider resources (65+)						
PCPs per 10,000	0.003	0.003	[-0.002, 0.01]	1.06	1.00	0.29
Specialists per 10,000	-0.002	0.001	[-0.003, -0.001]	-2.93	1.00	0.003*
Prior health care utilization and spending						
Prior ED visits without admission (2007)	5.89	0.41	[5.09, 6.69]	14.42	361.12	<.0001*
Prior acute stay admissions (2007)	1.57	0.35	[0.67, 2.47]	3.43	4.80	0.001*
Prior SNF stays (2007)	-2.78	0.82	[-4.58, -0.98]	-3.03	0.06	0.003*

*$P < .05$, **$P < .10$

Table B3: Medicare Acute Stays per Enrolled Month, 2008

	Parameter Estimate (*B*)	Standard Error (*SE*)	95% Confidence Limits	Z	Odds Ratio	*p* -Value
Independent Variables						
Service coordinator	-0.09	0.06	[-0.21, 0.03]	-1.47	0.91	0.14
Nurse	-0.08	0.08	[-0.23, 0.07]	-1.01	0.93	0.31
Transportation	-0.04	0.06	[-0.15, 0.07]	-0.70	0.96	0.49
Exercise and fitness	-0.09	0.07	[-0.23, 0.05]	-1.30	0.91	0.19
Health education	0.05	0.08	[-0.11, 0.21]	0.61	1.05	0.54
Health screening	0.05	0.08	[-0.09, 0.20]	0.71	1.06	0.48
Medication assistance	0.00	0.09	[-0.18, 0.18]	-0.05	1.00	0.96
Primary health care	-0.05	0.11	[-0.26, 0.17]	-0.44	0.95	0.66
Mental health care	0.16	0.09	[-0.02, 0.33]	1.72	1.17	0.09**
Control Variables						
Female	-0.15	0.05	[-0.26, -0.04]	-2.77	0.86	0.01*
Hispanic	0.16	0.08	[0.01, 0.31]	2.13	1.18	0.03*
Black	0.09	0.09	[-0.08, 0.26]	1.08	1.10	0.28
Asian	-0.18	0.13	[-0.43, 0.07]	-1.38	0.84	0.17
Indian	0.81	0.25	[0.32, 1.31]	3.22	2.25	0.001*
Other race	-0.59	0.16	[-0.90, -0.28]	-3.69	0.56	0.0002*
Age 65 to 69	0.04	0.09	[-0.14, 0.21]	0.40	1.04	0.69
Age 70 to 74	-0.09	0.07	[-0.23, 0.05]	-1.25	0.91	0.21
Age 75 to 79	-0.17	0.06	[-0.28, -0.06]	-3.01	0.84	0.003*
Age 80 to 84	-0.04	0.06	[-0.16, 0.08]	-0.61	0.96	0.54
Lives alone	0.32	0.07	[0.18, 0.47]	4.41	1.38	<.0001*
Disability status	-0.05	0.06	[-0.17, 0.06]	-0.90	0.95	0.37
# Chronic conditions	0.31	0.01	[0.30, 0.33]	37.02	1.37	<.0001*
Depression	-0.02	0.06	[-0.13, 0.09]	-0.36	0.98	0.72
Any MME status	0.04	0.05	[-0.06, 0.13]	0.79	1.04	0.43
State of residence						
CA	0.01	0.16	[-0.30, 0.32]	0.06	1.01	0.95
CT	0.21	0.10	[0.00, 0.41]	1.96	1.23	0.05**
MA	0.12	0.09	[-0.06, 0.29]	1.29	1.12	0.20
NC	0.00	0.00	[0.00, 0.00]	.	1.00	.
NH	0.02	0.11	[-0.20, 0.25]	0.21	1.02	0.83
NJ	-0.07	0.09	[-0.25, 0.11]	-0.72	0.94	0.47
OH	0.11	0.10	[-0.09, 0.31]	1.08	1.12	0.28
VA	0.00	0.00	[0.00, 0.00]	.	1.00	.
VT	0.18	0.14	[-0.10, 0.45]	1.26	1.19	0.21
WI	0.53	0.13	[0.27, 0.79]	3.93	1.70	<.0001*
Concentration of health provider resources (65+)						
PCPs per 10,000	0.002	0.002	[-0.002, 0.01]	0.82	1.00	0.41
Specialists per 10,000	-0.001	0.001	[-0.003, 0.001]	-0.89	1.00	0.37
Hospital beds per 10,000	0.54	0.16	[0.23, 0.84]	3.45	1.71	0.001*
Prior health care utilization and spending						
Prior ED visits without admission (2007)	1.20	0.24	[0.73, 1.67]	4.99	3.32	<.0001*
Prior acute stay admissions (2007)	-0.55	0.52	[-1.56, 0.46]	-1.07	0.58	0.29
Prior SNF stays (2007)	0.0003	0.0004	[-0.0005, 0.001]	0.70	1.00	0.49

*$P < .05$, **$P < .10$

Table B4: Medicare Acute Stays, At Least One Stay, 2008

	Parameter Estimate (*B*)	Standard Error (*SE*)	95% Confidence Limits	Z	Odds Ratio	*p* -Value
Independent Variables						
Service coordinator	-0.20	0.08	[-0.36, -0.03]	-2.36	0.82	0.02*
Nurse	-0.14	0.11	[-0.36, 0.08]	-1.25	0.87	0.21
Transportation	-0.01	0.08	[-0.16, 0.15]	-0.11	0.99	0.92
Exercise and fitness	-0.14	0.10	[-0.34, 0.07]	-1.32	0.87	0.19
Health education	0.08	0.12	[-0.15, 0.32]	0.69	1.09	0.49
Health screening	0.08	0.11	[-0.12, 0.29]	0.78	1.09	0.43
Medication assistance	-0.05	0.13	[-0.30, 0.20]	-0.37	0.95	0.71
Primary health care	0.08	0.15	[-0.22, 0.37]	0.51	1.08	0.61
Mental health care	0.35	0.15	[0.06, 0.64]	2.39	1.42	0.02*
Control Variables						
Female	-0.20	0.08	[-0.35, -0.05]	-2.63	0.82	0.01*
Hispanic	0.24	0.10	[0.04, 0.45]	2.35	1.28	0.02*
Black	-0.003	0.12	[-0.24, 0.23]	-0.03	1.00	0.98
Asian	-0.07	0.17	[-0.41, 0.27]	-0.41	0.93	0.68
Indian	1.79	0.70	[0.42, 3.16]	2.56	6.01	0.01*
Other race	-0.67	0.27	[-1.20, -0.15]	-2.51	0.51	0.01*
Age 65 to 69	-0.20	0.13	[-0.45, 0.05]	-1.54	0.82	0.12
Age 70 to 74	-0.27	0.11	[-0.48, -0.06]	-2.55	0.76	0.01*
Age 75 to 79	-0.39	0.10	[-0.59, -0.20]	-3.94	0.68	<.0001*
Age 80 to 84	-0.29	0.09	[-0.47, -0.11]	-3.15	0.75	0.002*
Lives alone	0.54	0.11	[0.33, 0.75]	5.02	1.72	<.0001*
Disability status	0.01	0.10	[-0.18, 0.20]	0.15	1.01	0.88
# Chronic conditions	0.50	0.02	[0.47, 0.53]	32.71	1.64	<.0001*
Depression	0.17	0.08	[0.003, 0.33]	2.00	1.18	0.05**
Any MME status	-0.01	0.08	[-0.16, 0.14]	-0.14	0.99	0.89
State of residence						
CA	0.12	0.24	[-0.36, 0.60]	0.50	1.13	0.62
CT	0.26	0.15	[-0.04, 0.56]	1.70	1.30	0.09**
MA	0.32	0.11	[0.09, 0.54]	2.79	1.37	0.01*
NC	0.00	0.00	[0.00, 0.00]	.	1.00	.
NH	-0.07	0.41	[-0.87, 0.73]	-0.18	0.93	0.86
NJ	0.004	0.11	[-0.21, 0.22]	0.04	1.00	0.97
OH	0.20	0.14	[-0.09, 0.48]	1.37	1.22	0.17
VA	0.00	0.00	[0.00, 0.00]	.	1.00	.
VT	0.35	0.19	[-0.03, 0.73]	1.82	1.42	0.07**
WI	0.50	0.25	[0.01, 0.99]	2.00	1.64	0.05**
Concentration of health provider resources (65+)						
PCPs per 10,000	0.003	0.003	[-0.004, 0.01]	0.80	1.00	0.43
Specialists per 10,000	-0.001	0.002	[-0.004, 0.00]	-0.80	1.00	0.42
Hospital beds per 10,000	1.46	0.37	[0.73, 2.19]	3.91	4.31	<.0001*
Prior health care utilization and spending						
Prior ED visits without admission (2007)	3.94	0.49	[2.97. 4.91]	7.97	51.25	<.0001*
Prior acute stay admissions (2007)	-2.57	1.00	[-4.54, -0.60]	-2.56	0.08	0.01*
Prior SNF stays (2007)	0.000	0.001	[-0.0011, 0.0014]	0.19	1.00	0.85

*$P < .05$, **$P < .10$

Table B5: Medicare Office Visits per Enrolled Month, 2008

	Parameter Estimate (*B*)	Standard Error (*SE*)	95% Confidence Limits	Z	Odds Ratio	*p* -Value
Independent Variables						
Service coordinator	0.002	0.03	[-0.06, 0.06]	0.08	1.00	0.94
Nurse	0.003	0.04	[-0.08, 0.09]	0.06	1.00	0.95
Transportation	0.004	0.03	[-0.05, 0.06]	0.13	1.00	0.89
Health education	-0.02	0.03	[-0.08, 0.05]	-0.53	0.98	0.60
Health screening	0.03	0.03	[-0.04, 0.09]	0.86	1.03	0.39
Medication assistance	-0.04	0.05	[-0.13, 0.05]	-0.92	0.96	0.36
Primary health care	-0.004	0.08	[-0.17, 0.16]	-0.05	1.00	0.96
Mental health care	0.01	0.06	[-0.11, 0.13]	0.13	1.01	0.90
Control Variables						
Female	-0.01	0.03	[-0.07, 0.05]	-0.29	0.99	0.77
Hispanic	-0.03	0.05	[-0.12, 0.06]	-0.68	0.97	0.50
Black	-0.07	0.05	[-0.16, 0.02]	-1.48	0.93	0.14
Asian	-0.12	0.06	[-0.24, 0.005]	-1.89	0.89	0.06**
Indian	0.33	0.28	[-0.23, 0.88]	1.15	1.39	0.25
Other race	-0.19	0.07	[-0.33, -0.05]	-2.71	0.83	0.01*
Age 65 to 69	0.13	0.04	[0.05, 0.22]	3.23	1.14	0.001*
Age 70 to 74	0.04	0.03	[-0.02, 0.10]	1.42	1.04	0.16
Age 75 to 79	0.04	0.03	[-0.02, 0.10]	1.29	1.04	0.20
Age 80 to 84	0.07	0.03	[0.01, 0.13]	2.12	1.07	0.03*
Lives alone	0.05	0.03	[0.00, 0.11]	1.86	1.06	0.06**
Disability status	-0.01	0.03	[-0.07, 0.06]	-0.17	0.99	0.87
# Chronic conditions	0.21	0.01	[0.20, 0.22]	41.4	1.23	<.0001*
Depression	0.09	0.03	[0.03, 0.15]	3.02	1.10	0.003*
Any MME status	0.05	0.03	[-0.003, 0.10]	1.83	1.05	0.07**
State of residence						
CA	-0.17	0.08	[-0.33, -0.02]	-2.19	0.84	0.03*
CT	-0.04	0.05	[-0.14, 0.05]	-0.91	0.96	0.36
MA	-0.18	0.04	[-0.27, -0.10]	-4.39	0.83	<.0001*
NC	0.00	0.00	[0.00, 0.00]	.	1.00	.
NH	-0.38	0.05	[-0.49, -0.28]	-7.09	0.68	<.0001*
NJ	-0.003	0.04	[-0.09, 0.08]	-0.06	1.00	0.95
OH	-0.17	0.04	[-0.25, -0.08]	-3.79	0.85	0.0001*
VA	0.00	0.00	[0.00, 0.00]	.	1.00	.
VT	-0.50	0.10	[-0.71, -0.30]	-4.78	0.61	<.0001*
WI	-0.25	0.08	[-0.40, -0.09]	-3.03	0.78	0.002*
Concentration of health provider resources (65+)						
PCPs per 10,000	0.003	0.001	[0.001, 0.01]	2.57	1.00	0.01*
Specialists per 10,000	-0.001	0.0002	[-0.001, -0.0003]	-3.09	1.00	0.002*
Total office visits	0.08	0.01	[0.06, 0.09]	9.24	1.08	<.0001*

*$P < .05$, **$P < .10$

Table B6: Medicare Expenditures (Medical Only) per Enrolled Month, 2008

	Parameter Estimate (*B*)	Standard Error (*SE*)	95% Confidence Limits	Z	Odds Ratio	*p* -Value
Independent Variables						
Service coordinator	-0.03	0.05	[-0.13, 0.07]	-0.55	0.97	0.58
Nurse	-0.04	0.07	[-0.19, 0.10]	-0.59	0.96	0.55
Transportation	0.05	0.05	[-0.04, 0.15]	1.09	1.05	0.28
Exercise and fitness	-0.10	0.06	[-0.22, 0.02]	-1.58	0.91	0.11
Health education	0.14	0.08	[-0.01, 0.29]	1.84	1.15	0.07*
Health screening	-0.004	0.06	[-0.12, 0.12]	-0.07	1.00	0.94
Medication assistance	-0.09	0.08	[-0.24, 0.06]	-1.14	0.92	0.25
Primary health care	-0.002	0.11	[-0.22, 0.22]	-0.02	1.00	0.99
Mental health care	0.12	0.09	[-0.06, 0.29]	1.33	1.12	0.18
Control Variables						
Female	-0.10	0.05	[-0.20, 0.001]	-1.94	0.90	0.05*
Hispanic	-0.13	0.07	[-0.26, -0.002]	-1.99	0.88	0.05*
Black	-0.08	0.08	[-0.25, 0.08]	-0.99	0.92	0.32
Asian	-0.15	0.11	[-0.35, 0.06]	-1.38	0.86	0.17
Indian	0.52	0.57	[-0.60, 1.64]	0.91	1.68	0.36
Other race	-0.47	0.10	[-0.66, -0.27]	-4.68	0.63	<.0001*
Age 65 to 69	0.02	0.11	[-0.19, 0.23]	0.19	1.02	0.85
Age 70 to 74	-0.09	0.06	[-0.21, 0.04]	-1.37	0.92	0.17
Age 75 to 79	-0.17	0.06	[-0.29, -0.05]	-2.77	0.85	0.01*
Age 80 to 84	-0.07	0.06	[-0.18, 0.05]	-1.09	0.94	0.28
Lives alone	0.13	0.06	[0.003, 0.25]	2.01	1.14	0.04*
Disability status	-0.001	0.06	[-0.12, 0.11]	-0.01	1.00	0.99
# Chronic conditions	0.37	0.01	[0.35, 0.39]	41.47	1.44	<.0001*
Depression	0.08	0.06	[-0.03, 0.19]	1.36	1.08	0.18
Any MME status	0.16	0.05	[0.05, 0.26]	2.99	1.17	0.003*
State of residence						
CA	-0.01	0.14	[-0.29, 0.27]	-0.08	0.99	0.94
CT	0.15	0.13	[-0.10, 0.41]	1.18	1.17	0.24
MA	0.07	0.08	[-0.09, 0.22]	0.84	1.07	0.40
NC	0.00	0.00	[0.00, 0.00]	.	1.00	.
NH	0.03	0.28	[-0.51, 0.58]	0.12	1.03	0.90
NJ	-0.01	0.08	[-0.16, 0.14]	-0.16	0.99	0.87
OH	-0.22	0.10	[-0.42, -0.03]	-2.26	0.80	0.02*
VA	0.00	0.00	[0.00, 0.00]	.	1.00	.
VT	-0.19	0.10	[-0.38, 0.01]	-1.90	0.83	0.06*
WI	0.18	0.20	[-0.21, 0.58]	0.91	1.20	0.36
Concentration of health provider resources (65+)						
PCPs per 10,000	0.001	0.002	[-0.003, 0.01]	0.53	1.00	0.60
Specialists per 10,000	-0.001	0.001	[-0.003, 0.001]	-1.12	1.00	0.26
Hospital beds per 10,000	0.001	0.0004	[-0.0002, 0.001]	1.40	1.00	0.16
SNF beds per 10,000	0.0003	0.0003	[-0.0003, 0.001]	0.89	1.00	0.38
Prior health care utilization and spending						
Prior ED visits without admission (2007)	0.92	0.24	[0.45, 1.39]	3.86	2.52	<.0001*
Prior acute stay admissions (2007)	-0.72	0.44	[-1.59, 0.15]	-1.63	0.49	0.10
Prior SNF stays (2007)	-3.27	0.74	[-4.71, -1.82]	-4.42	0.04	<.0001*
Total Medicare expenditure (no part D)	0.0002	0.00	[0.0002, 0.0003]	11.17	1.00	<.0001*

*$p < .05$, **$p < .10$

Table B7: Medicare Part D Expenditures per Enrolled Month, 2008

	Parameter Estimate (*B*)	Standard Error (*SE*)	95% Confidence Limits	Z	Odds Ratio	*p* -Value
Independent Variables						
Service coordinator	-0.01	0.02	[-0.06, 0.03]	-0.53	0.99	0.60
Nurse	0.06	0.06	[-0.06, 0.19]	0.97	1.06	0.33
Transportation	-0.05	0.03	[-0.12, 0.02]	-1.45	0.95	0.15
Exercise and fitness	0.11	0.04	[0.03, 0.19]	2.76	1.11	0.01*
Health education	-0.08	0.04	[-0.15, -0.01]	-2.11	0.92	0.03*
Health screening	-0.04	0.03	[-0.10, 0.03]	-1.11	0.96	0.27
Medication assistance	0.12	0.07	[-0.01, 0.25]	1.79	1.13	0.07**
Primary health care	-0.13	0.08	[-0.30, 0.03]	-1.60	0.87	0.11
Mental health care	-0.03	0.06	[-0.15, 0.10]	-0.41	0.97	0.68
Control Variables						
Female	-0.02	0.04	[-0.10, 0.06]	-0.46	0.98	0.65
Hispanic	-0.05	0.04	[-0.13, 0.02]	-1.40	0.95	0.16
Black	-0.13	0.05	[-0.24, -0.03]	-2.54	0.88	0.01*
Asian	0.04	0.06	[-0.08, 0.16]	0.68	1.04	0.50
Indian	0.32	0.21	[-0.10, 0.74]	1.51	1.38	0.13
Other race	-0.08	0.07	[-0.22, 0.05]	-1.22	0.92	0.22
Age 65 to 69	0.08	0.06	[-0.04, 0.20]	1.26	1.08	0.21
Age 70 to 74	0.04	0.04	[-0.03, 0.12]	1.17	1.05	0.24
Age 75 to 79	0.11	0.05	[0.01, 0.21]	2.12	1.11	0.03*
Age 80 to 84	0.05	0.04	[-0.03, 0.13]	1.32	1.05	0.19
Lives alone	-0.12	0.06	[-0.24, 0.00]	-1.96	0.89	0.05*
Disability status	0.03	0.04	[-0.04, 0.10]	0.92	1.03	0.36
# Chronic conditions	0.10	0.01	[0.09, 0.11]	16.25	1.10	<.0001*
Depression	0.01	0.03	[-0.05, 0.07]	0.25	1.01	0.80
Any MME status	0.29	0.03	[0.23, 0.36]	8.86	1.34	<.0001*
State of residence						
CA	-0.03	0.11	[-0.24, 0.18]	-0.28	0.97	0.78
CT	0.07	0.09	[-0.11, 0.25]	0.75	1.07	0.45
MA	-0.08	0.05	[-0.17, 0.01]	-1.82	0.92	0.07**
NC	0.00	0.00	[0.00, 0.00]	.	1.00	.
NH	-0.11	0.04	[-0.18, -0.03]	-2.82	0.90	0.00*
NJ	0.07	0.04	[-0.02, 0.15]	1.48	1.07	0.14
OH	0.03	0.05	[-0.08, 0.13]	0.49	1.03	0.62
VA	0.00	0.00	[0.00, 0.00]	.	1.00	.
VT	-0.02	0.06	[-0.15, 0.10]	-0.37	0.98	0.71
WI	0.18	0.11	[-0.04, 0.40]	1.57	1.19	0.12
Concentration of health provider resources (65+)						
PCPs per 10,000	-0.003	0.001	[-0.005, -0.0003]	-2.18	1.00	0.03*
Specialists per 10,000	0.001	0.001	[-0.0003, 0.002]	1.24	1.00	0.21
Hospital beds per 10,000	-0.0001	0.0002	[-0.0004, 0.0003]	-0.35	1.00	0.73
SNF beds per 10,000	-0.0001	0.0002	[-0.0004, 0.0003]	-0.47	1.00	0.64
Prior health care utilization and spending						
Prior ED visits without admission (2007)	0.40	0.18	[0.06, 0.75]	2.27	1.50	0.02*
Prior acute stay admissions (2007)	-0.34	0.23	[-0.80, 0.11]	-1.49	0.71	0.14
Prior SNF stays (2007)	0.02	0.40	[-0.76, 0.80]	0.05	1.02	0.96
Total Medicare expenditure (no Part D)	0.00	0.00	[0.00, 0.00]	1.44	1.00	0.15
Total Medicare Part D expenditure	0.0003	0.00	[0.003, 0.003]	62.31	1.00	<.0001*

*$P < .05$, **$P < .10$

Table B8: Medicaid Expenditures (Among Full Duals) per Enrolled Month, 2008

	Parameter Estimate (*B*)	Standard Error (*SE*)	95% Confidence Limits	Z	Odds Ratio	*p* -Value
Independent Variables						
Service coordinator	0.13	0.07	[0.00, 0.27]	1.93	1.14	0.05**
Nurse	-0.03	0.08	[-0.19, 0.13]	-0.41	0.97	0.68
Transportation	-0.09	0.07	[-0.22, 0.04]	-1.33	0.92	0.18
Exercise and fitness	0.10	0.08	[-0.05, 0.26]	1.32	1.11	0.19
Health education	0.00	0.09	[-0.17, 0.17]	-0.02	1.00	0.98
Health screening	0.04	0.07	[-0.11, 0.18]	0.50	1.04	0.62
Medication assistance	-0.24	0.11	[-0.46, -0.02]	-2.10	0.79	0.04*
Primary health care	0.22	0.15	[-0.08, 0.52]	1.43	1.24	0.15
Mental health care	0.04	0.10	[-0.16, 0.24]	0.41	1.04	0.68
Control Variables						
Female	0.07	0.06	[-0.05, 0.18]	1.16	1.07	0.25
Hispanic	-0.07	0.08	[-0.22, 0.09]	-0.86	0.93	0.39
Black	-0.08	0.10	[-0.27, 0.12]	-0.79	0.92	0.43
Asian	-0.10	0.09	[-0.28, 0.08]	-1.09	0.90	0.27
Indian	0.24	0.34	[-0.43, 0.91]	0.69	1.27	0.49
Other race	0.00	0.12	[-0.23, 0.23]	0.02	1.00	0.99
Age 65 to 69	-0.62	0.11	[-0.83, -0.41]	-5.82	0.54	<.0001*
Age 70 to 74	-0.38	0.09	[-0.57, -0.20]	-4.07	0.68	<.0001*
Age 75 to 79	-0.33	0.08	[-0.48, -0.18]	-4.39	0.72	<.0001*
Age 80 to 84	-0.17	0.08	[-0.32, -0.01]	-2.14	0.85	0.03*
Lives alone	-0.11	0.09	[-0.28, 0.06]	-1.29	0.90	0.20
Disability status	0.06	0.06	[-0.06, 0.19]	0.99	1.06	0.32
# Chronic conditions	0.15	0.01	[0.13, 0.17]	13.87	1.16	<.0001*
Depression	0.20	0.07	[0.06, 0.33]	2.83	1.22	0.00*
State of residence						
CA	0.35	0.15	[0.05, 0.65]	2.30	1.42	0.02*
CT	-0.11	0.20	[-0.50, 0.28]	-0.56	0.90	0.58
MA	-0.26	0.18	[-0.62, 0.09]	-1.44	0.77	0.15
NC	0.00	0.00	[0.00, 0.00]	.	1.00	.
NH	-0.09	0.38	[-0.84, 0.66]	-0.23	0.92	0.82
NJ	-0.09	0.14	[-0.36, 0.18]	-0.68	0.91	0.50
OH	0.16	0.15	[-0.13, 0.45]	1.08	1.17	0.28
VA	0.00	0.00	[0.00, 0.00]	.	1.00	.
VT	-0.05	0.23	[-0.49, 0.40]	-0.20	0.96	0.84
WI	0.38	0.25	[-0.12, 0.88]	1.48	1.46	0.14
Concentration of health provider resources (65+)						
PCPs per 10,000	-0.001	0.004	[-0.01, 0.01]	-0.17	1.00	0.87
Specialists per 10,000	0.001	0.001	[-0.002, 0.003]	0.43	1.00	0.67
Hospital beds per 10,000	-0.001	0.001	[-0.002, 0.001]	-1.00	1.00	0.32
SNF beds per 10,000	0.0003	0.0004	[-0.001, 0.001]	0.82	1.00	0.41
Prior health care utilization and spending						
Prior ED visits without admission (2007)	0.59	0.36	[-0.11, 1.30]	1.65	1.81	0.10
Prior acute stay admissions (2007)	-0.48	0.40	[-1.27, 0.31]	-1.19	0.62	0.23
Prior SNF stays (2007)	1.74	0.74	[0.30, 3.18]	2.37	5.70	0.02*
Total Medicaid expenditure	0.001	0.00	[0.00, 0.00]	28.29	1.00	<.0001*

*P < .05. **P < .10