The Impact of Green House Adoption on Medicare Spending and Utilization

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Objective. To evaluate the impact of the Green House (GH) model of nursing home care on Medicare acute hospital, other hospital, skilled nursing facility, and hospice spending and utilization.

Data Sources/Study Setting. Medicare claims and enrollment data from 2005 through 2010 merged with resident-level minimum data set (MDS) assessments.

Study Design. Using a difference-in-differences framework, we compared Medicare Part A and hospice expenditures and utilization in 15 nursing homes that adopted the GH model relative to changes over the same time period in 223 matched nonadopting nursing homes. We applied the same method for residents of GH homes and for residents of “legacy” homes, the original nursing homes that stay open alongside the GH home(s).

Principal Findings. The adoption of GH had no detectable impact on Medicare Part A (plus hospice) spending and utilization across all residents living in the nursing home. When we analyzed residents living in GH homes and legacy units separately, however, we found that the adoption of the GH model reduced overall annual Medicare Part A spending by \$7,746 per resident, although this appeared to be partially offset by an increase in spending in legacy homes.

Conclusions. To the extent that the GH model reduces Medicare spending, adopting nursing homes do not receive any of the related Medicare savings under traditional payment mechanisms. New approaches that are currently being developed and piloted, which better align financial incentives for providers and payers, could incentivize greater adoption of the GH model.

Key Words. Nursing homes, Medicare spending, Green House nursing home, culture change

Recent studies have suggested that certain nursing home practices can lower Medicare utilization and spending on other health care services such as hospitalizations. For example, nursing home practices such as the INTERACT program (Ouslander et al. 2011), off-hour physician telemedicine coverage (Grabowski and O'Malley 2014), and the Evercare model (Kane et al. 2003)

have all been found to decrease utilization of Medicare services outside the nursing home. Culture change initiatives, which offer a more person-centered model of care, may have a similar impact on Medicare utilization of services. However, to our knowledge, no previous research considering this relationship has been published.

In this study, we examined the impact of the introduction of a systematic culture change initiative, the Green House (GH) model, on Medicare utilization and spending. GH, first adopted in 2003, has three primary tenets that deviate from the traditional nursing home model. First, the GH model consists of small homes with 8–12 *elders* (which is the GH term for residents). Second, the GH model strives to empower residents with greater control over their lives and care relative to a traditional nursing home. Finally, the GH model strives to eliminate the hierarchical nurse staffing structure often found in traditional nursing homes and empowers the *Shahbazim*, the GH term for direct caregivers, to manage daily life in each GH home. The GH model employs a universal work model in which the Shahbazim provide assistance to the elders in a number of domains, including personal care, activities, meal preparation and service, laundry, and light housekeeping duties. In terms of oversight of the Shahbazim, direct care activities are supervised by a nurse, while nondirect care activities are supervised by a Guide, the GH term for an administrative staff member, who is usually not a nurse but serves as a coach and a resource (Bowers and Nolet 2014). The GH model strives for consistent assignment of Shahbazim to particular GH homes, thereby strengthening the interaction between the Shahbazim and elders.

We examined the adoption of 15 new GH homes over the period 2005–2010 and compared pre-post Medicare use and spending among GH adopters relative to matched comparison nursing homes. Specifically, we examined the impact of GH adoption on hospital use, skilled nursing facility (SNF) use, other hospital use such as inpatient rehabilitation facilities (IRFs) and long-term care hospitals (LTCHs), and hospice care.

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Conceptual Framework

A nursing home culture change initiative such as GH could have either positive or negative effects on utilization of Medicare-covered health care services (Bowers et al. 2016b). Under a model with greater resident control and staff autonomy, along with a smaller homelike environment, the potential exists for inappropriate medical spending to be lowered. For example, due to the smaller size of a GH home, Shahbazim reported enhanced resident oversight and improved resident interactions (Cohen et al. 2016), which may result in fewer incidents like pneumonia, exacerbation of chronic obstructive pulmonary disease, or infections that typically result in avoidable hospitalizations and postacute care use. If the Shahbazim are more familiar with the residents due to consistent assignment relative to traditional nursing home staff, they can prevent or address these conditions before they result in a hospitalization. If a hospitalization is avoided, then this will also lower postacute care in SNFs, IRFs, and LTCHs. Similarly, even after a hospitalization, the GH home might be able to deliver postacute care more efficiently to allow the elder to transition more rapidly out of postacute care.

On the other hand, GH homes may provide improved resident direction and staff autonomy but at the expense of higher Medicare Part A spending. For example, through the universal worker model and a less hierarchal staff structure, the Shahbazim might communicate less effectively with nurses and primary care physicians, resulting in a higher likelihood of Medicare-financed hospitalization and postacute care utilization. For example, Bowers et al. (2016b) found variation across GH homes in clinical care (and resulting hospital transfers), depending on how effectively information was communicated from Shahbazim to nurses and medical providers.

The impact of GH on hospice care could also work in either direction. On the one hand, hospice has often been used as a measure of high-quality end-of-life care in the nursing home setting (e.g., Baer and Hanson 2000; Teno et al. 2004; Goldfeld et al. 2013). For this reason, we might expect a nursing home that has embraced culture change—which emphasizes residents' quality of life—to use hospice more often than a traditional nursing home. An empowered Shahbazim might be more likely to discuss hospice with the resident's family than a certified nurse aide in a typical nursing home (Bowers et al. 2016b). However, an alternate hypothesis suggests that GH homes might already provide strong person-centered end-of-life care, negating the need for hospice services.

Finally, for GH adopters that also operate a “legacy home,” the original nursing home that stays open alongside the new GH home(s), GH adoption may have both direct and indirect impacts on Medicare Part A spending. The direct impact would refer to spending and utilization within the GH units, while the indirect impact would refer to spending and utilization within the legacy units. The overall GH impact on the organization is the combined direct and indirect effects. We hypothesize that the indirect effect of GH adoption for the legacy unit could run in the same or opposite direction as the direct effect for the GH units. By definition, the legacy unit cannot adopt the “small house” model, but other tenets of the GH culture such as resident empowerment and staffing philosophy can “spillover” to the legacy part of the organization. If so, we would expect the legacy impact to run in the same direction as the GH impact, although attenuated relative to the direct effect. Alternatively, if behaviors adopted in the GH unit “crowd out” organizational resources, for example, by attracting more skilled staff, then we would expect the legacy results to run in the opposite direction of the main GH unit findings. In addition, if healthier residents select or are assigned to GH homes and analytic methods do not address this selection fully, legacy unit effects similarly will run in the opposite direction. For these reasons, it is important to examine spending and utilization for the GH home and legacy unit and for them combined, that is, for the organization as a whole.

DATA AND METHODS

Data

Our analyses used three different data files, all maintained by the Centers for Medicare and Medicaid Services (CMS): resident-level assessment data from the minimum data set (MDS 2.0), nursing home-level data from the Online Survey, Certification, and Reporting (OSCAR) file, and beneficiary-level Medicare enrollment and claims data. We merged these administrative files with data on GH residence. We describe each of these in greater detail below.

MDS Data. We used assessment-level data from the MDS for the years 2005–2010. We restricted our analysis to records with assessment dates through September 30, 2010, because MDS 3.0 was adopted on October 1, 2010. Using these data, we constructed a resident-quarter-year-level dataset. If an

individual resided in a nursing home at any point during a given calendar quarter (e.g., January 1, 2005 through March 31, 2005), we created an observation in the file for that resident in that time period. We generated observations for cases in which no MDS assessment was present for the beneficiary during the quarter if assessment data were present immediately before and after the quarter, suggesting the resident was present in the nursing home that quarter. We gathered data from the MDS for a series of variables (described below), using information from the earliest assessment record in the quarter.

OSCAR Data. We used the OSCAR data in two ways. First, we used nursing home characteristics in the data to find suitable non-GH matches for each GH organization, as described below. Second, in our regressions, we included independent variables from the most recent (roughly annual) OSCAR describing the percentage of residents in each nursing home whose payer was Medicaid (the omitted category), Medicare, or other. (Medicare-paid residents receive postacute care in the nursing home following a hospitalization, while Medicaid and other-payer residents typically receive long-term chronic care services).

Medicare Enrollment and Claims Data. Using the resident's Social Security number, we merged the MDS file with Medicare enrollment data, using data from the month of nursing home admission. We then dropped residents who were not entitled to Medicare Parts A and B at any point during the quarter. We excluded cases where the resident was enrolled in the Medicare Advantage (MA) program during the month of admission, because hospital and SNF claims were missing for these cases. We used the merged data to assess whether the resident was also entitled to Medicaid during the month of admission, using the "state buy-in" data available in the Medicare enrollment data. This measure was included as an independent variable in our regression models, described below.

We also used the Medicare Provider Analysis and Review (MedPAR) file, which contains the hospital and SNF claims files. Using this file, we created eight variables: the resident's total number of Medicare days and total Medicare spending in acute care hospitals during the quarter, other hospitals (e.g., IRFs), and SNFs. Medicare spending encompassed all payments from the Medicare beneficiary, third-party payers, and the Medicare program. We analyzed claims for hospice care and calculated the total number of Medicare

hospice days and total Medicare hospice spending for the quarter. Importantly, we do not analyze any Medicare Part B or Part D utilization or spending in this study.

Green House Residence. The Green House Project, which is a program administered by Capital Impact Partners that provides technical assistance to GH homes, provided us with a list of the 18 organizations that adopted the GH model during the period 2005 through 2010 (two GHs adopted in 2006, five in 2007, three in 2008, two in 2008, and three in 2010). Each new adopter enters into a “trademark agreement” that defines the associated 25 quality standards for becoming a “certified” Green House home. Dr. Bill Thomas, the founder of the Green House model, defined and trademarked these standards. Technically, Dr. Thomas owns the trademark and grants a sublicense to GH adopters for use. Given our estimation approach below, we required that the nursing homes had been in operation prior to the adoption of the GH model. Ultimately, we identified 15 nursing home organizations that adopted the GH model over our study period and were in operation in the period preceding the adoption. These adopters, which collectively built 72 GH homes, were located in Alabama, Arkansas, Kansas, Massachusetts, Michigan, Montana, Nebraska, New York, Pennsylvania, Tennessee, and Texas. We included one GH “adopter” that established a new license because the legacy home was located nearby.

As discussed below, we examined the overall impact of GH adoption in two ways. First, we examined the overall impact of GH adoption on all residents in the nursing home organization, including those in GH units and those in the legacy unit. This analysis used all 15 nursing homes, 10 of which included a mix of GH homes and legacy units, while the other 5 organizations had converted entirely to GH homes and had only GH residents. Second, we examined the impact specifically on those individuals residing in a GH home. Because we were not able to ascertain GH residence from the MDS, each of the participating GH homes was asked to provide data on the timing of GH residence for all individuals living at the nursing home. These identifiers were linked to the Medicare claims files by a CMS data contractor. Three of the nursing homes with a mix of GH and legacy residents did not provide resident identifiers and had to be excluded from this second set of analyses, leaving us with 12 GH adopters (5 with only GH residents and 7 with a mix of GH and legacy residents) for our analysis of Medicare utilization in GH homes and legacy units.

Regressions

Our initial regression model took the following form:

$$Y_{iht} = \alpha + \beta GH_{ht} + \gamma X_{iht} + \eta_h + \theta_t + \varepsilon_{iht} \quad (1)$$

where Y_{iht} was the utilization or spending measure for individual i in nursing home h for quarter-year t , GH_{ht} described the percentage of beds in each nursing home that were in GH units at time t (set to 0 for all matched controls), X_{iht} was a vector of resident-level characteristics, and η_h and θ_t were nursing home and quarter-year fixed effects, respectively. GH_{ht} , our key independent variable in this model, measures the impact of GH adoption in that the effect should be larger in those nursing homes with a greater percentage of GH beds. The nursing home fixed effects controlled for any time-invariant nursing home-specific omitted variables. Such variables may include, for example, nursing home management practices and geographic characteristics. The year dummies controlled for national trends in nursing home delivery that may be correlated with the utilization of Medicare services such as federal payment or regulatory changes. Thus, the basic identification strategy implicit in equation (1) purged the unobserved and potentially confounded cross-sectional heterogeneity by relying on within-nursing home variation in GH adoption and by using nursing homes that did not implement GH as a control for unrelated time-series variation. Put alternatively, this so-called difference-in-differences model examined the pre-post difference in Medicare utilization over time for the nursing homes that adopted GH relative to the pre-post difference over time in Medicare utilization for the nonadopting nursing homes.

Equation (1) examined the overall impact of the GH model on Medicare utilization of all residents in a GH organization combined. This average effect estimate has the advantage of averaging over any possible resident or nursing home selection of particular types of residents into the GH versus legacy units and for any possible spillovers of GH adoption to legacy residents. Our second specification included separate indicators for individuals residing in a GH unit (GHU) and the legacy nursing home unit (L):

$$Y_{iht} = \alpha + \beta GHU_{iht} + \gamma L_{iht} + \delta X_{iht} + \eta_h + \theta_t + \varepsilon_{iht} \quad (2)$$

This model has the advantage of focusing directly on an individual resident's GH status, but it is susceptible not only to spillover effects but also to

potential selection bias in that certain types of residents may be cared for in the GH homes relative to the legacy part of the nursing home. As described below, we control for observable characteristics through propensity score weighting, but unmeasured characteristics may still be correlated with selection into a GH unit. With these tradeoffs in mind, the two specifications combine to provide important information about the direct, indirect, and overall impacts of the GH program.

In terms of the model covariates, the resident-level characteristics X were gender, black/non-black, age (younger than 65, 65–74, 75–84, 85 or older), an indicator for whether the resident was also enrolled in Medicaid, and a series of chronic condition indicators from the MDS (diabetes mellitus, congestive heart failure, hypertension, dementia, depression, chronic obstructive pulmonary disease, and cancer). We included two measures to capture resident acuity: an ADL score and a cognitive performance scale.

Due to the large number of zeros in our quarterly outcome variables, it is not optimal to run a least squares regression. We thus ran a two-part model (Mullahy 1998). For each setting of care (acute care hospital, other hospital, SNF, hospice), we first modeled the probability that the resident had any utilization/spending of that type during the quarter using a logistic regression model. Next, conditional on any utilization/spending, we modeled both the number of service days (utilization) and spending in the resident quarter using a least squares regression model. We then combined the results from each of these two regressions to estimate the average impact of the GH model across all residents. For example, using equation (2) above, we calculated the impact of being in a GH unit on total spending by multiplying the predicted probability of any spending by the predicted total spending conditional on any utilization. The first stage of the category spending models estimated the probability of any spending in that category, while the second stage was conditional on spending in that category. We calculated these for a GH resident with the “GH” indicator set to 1, the “L” indicator set to 0, and all other variables set to their means; the analogous predictions for a resident from a non-GH nursing home were calculated setting both of the relevant indicators to 0 and the other variables to their means (the same mean values as in the previous calculation). Because of the application of two-part statistical models, we used bootstrapping methods to calculate the standard errors. We performed 100 replications of our regressions, resampling observations from our analysis dataset at each iteration.

In each regression and iteration of the bootstrap described above, we accounted for clustering at the nursing home level by computing Huber–White robust standard errors. Clustering at the nursing home level accounted for most of the clustering at the resident level. Thus, we did not formally account for repeated measurements on residents.

Finding Matched Controls

We used a two-stage process to construct our comparison groups. First, because GH organizations likely differed in systematic ways from non-GH ones, we used matching methods to find controls for each GH nursing home. To find matches, we selected from the set of nursing homes that were in operation within that state in the year each GH came online. We excluded from the set of potential control nursing homes any of the nursing homes that eventually adopted the GH model. Then for each combination of state and year of GH adoption, we sought to find matched control nursing homes in that state and at that time period. All of the matches we found for each GH organization were included for the entire 2005–2010 study period in the subsequent analysis.

Using the OSCAR data, we employed nearest neighbor matching for each GH organization, which determined “nearest” based on the Mahalanobis distance in which the weights were constructed via the inverse of variance-covariance matrix using the following 12 dichotomous covariates: ownership (nonprofit, for-profit, government), chain status, size (75 beds or fewer, 76–125 beds, 126 or more beds), rural location, above median Medicaid share, above median Medicare share, above median private-pay share, and a nursing home-level aggregate activities of daily living (ADL) score (0 if less than 4 on a scale of 0–5, 1 otherwise). For our organization-level analysis, our approach yielded a total of 223 matched control nursing homes for the 15 GH treatment nursing home adopters in 11 states. Overall, our full sample consisted of 415,108 quarterly assessments for 135,282 unique individuals. We repeated this process to identify comparison nursing homes for the sample of 12 GH organizations in 10 states used in our analysis of residents living in GH and legacy units, yielding a total of 178 matched control nursing homes. This sample consisted of 326,672 quarterly assessments for 109,672 unique individuals.

The second stage in constructing the comparison group addressed potential differences in residents in GH organizations and the matched

comparison homes by using individual-level propensity score weighting. For the organization-level analysis with the 15 GH adopters, we calculated the conditional probability (propensity) of being in a GH organization using a logistic regression model. For the unit-level analysis with 12 GH adopters, we calculated the propensity of being in a GH home, legacy home, or non-GH organization using a multinomial logistic regression model. The covariates in these models were gender, black, age (younger than 65, 65–74, 75–84, 85 or older), Medicaid enrollment, diabetes mellitus, congestive heart failure, hypertension, dementia, depression, chronic obstructive pulmonary disease, cancer, an ADL score, and a cognitive performance scale. We weighted the data based on the inverse of the propensity score.

Using the first analysis sample, we examined our GH organizations and comparison nursing homes along a range of resident-level measures such as demographics and health characteristics for the entire study period (see Table 1). Although the measures were statistically different across the GH and comparison nursing homes due to the large sample size, the actual differences were relatively small in the majority of instances. The GH sample was slightly older with a higher prevalence of chronic conditions and more dually eligible beneficiaries, suggesting any remaining bias from these observables would run against finding an impact in the GH organizations.

RESULTS

On average, the typical resident in our full sample generated \$6,654 in Medicare Part A (plus hospice) expenditures per quarter (see Table 2). The bulk of these expenditures were due to acute hospital (\$1,269/resident quarter) and SNF (\$4,738/resident quarter) spending. Hospice (\$369/resident quarter) and other hospital (\$81/resident quarter) spending were much lower by comparison.

We examined two different model specifications. In the first model (equation 1), we examined the impact of the proportion of GH residents in an organization on utilization and spending for all residents in the organization. In the second model (equation 2), we examined the impact of GH on spending and utilization for individuals residing in the GH homes and for individuals residing in the legacy units. After applying the propensity weights based on the inverse of the propensity score, 13.6 percent of the sample resided in an organization that adopted the GH model in the first model speci-

Table 1: Comparison of Green House and Comparison Nursing Homes, Baseline Sample

<i>Variables</i>	<i>Green House</i>	<i>Comparison</i>
Female	0.729	0.708***
Black race	0.064	0.069***
Age <65	0.044	0.051***
Age 65–74	0.104	0.125***
Age 75–84	0.379	0.361***
Age 85+	0.473	0.462***
Dually eligible for Medicaid/Medicare	0.287	0.260***
Activities of daily living score	12.074	11.862***
Cognitive impairment	1.888	1.821***
Diabetes mellitus	0.299	0.285***
Congestive heart failure	0.284	0.257***
Hypertension	0.735	0.719***
Dementia	0.379	0.331***
Depression	0.437	0.432*
Chronic obstructive pulmonary disease	0.198	0.191***
Cancer	0.113	0.095***
Number of residents	26,640	388,468

Notes. Statistical significance based on two-sample *t*-tests examining difference across Green House and comparison groups.

*Statistically significant at 10% level; **Statistically significant at 5% level; ***Statistically significant at 1% level.

fication (see Table 2). In the second model specification, which was estimated using 12 instead of 15 organizations, 44.4 percent of the propensity-weighted sample resided in a GH organization, 7.4 percent in a GH home, and 37 percent in a legacy unit.

In a descriptive comparison of mean differences using the full sample (model 1 specification), Part A (plus hospice) Medicare spending declined by \$581 per quarter in nursing homes that adopted GH relative to \$71 in the comparison nursing homes (see Table 3). Thus, an unadjusted difference-in-difference estimate suggests the adoption of GH lowered Medicare spending by \$509(= −\$580 − (−\$71)) per quarter relative to the comparison nursing homes. The primary source of this difference was SNF (\$339) and acute hospital (\$112) spending. In terms of utilization, the adoption of a GH organization is associated with just under one fewer SNF days relative to the comparison nursing homes.

When we examined Part A (plus hospice) Medicare spending in a regression framework, expenditures for all residents in the organizations adopting the GH were lower than comparison expenditures, but these differences were

Table 2: Descriptive Statistics: Full Sample and Sample Identifying Residence in GH Homes or Legacy Units

<i>Variable</i>	<i>(1) Full Sample Mean (SD)</i>	<i>(2) Sample with GH Identifiers Mean (SD)</i>
Independent variables		
Percent GH	0.502	—
Resident in GH home	—	0.074
Resident in a legacy unit	—	0.370
Female	0.719	0.706
Black race	0.066	0.073
Age <65	0.047	0.060
Age 65–74	0.114	0.133
Age 75–84	0.370	0.363
Age 85+	0.468	0.445
Dual eligible	0.274	0.285
Activities of daily living score	11.971	11.779
Cognitive impairment	1.856	1.801
Diabetes mellitus	0.292	0.296
Congestive heart failure	0.271	0.243
Hypertension	0.727	0.717
Dementia	0.356	0.316
Depression	0.435	0.420
Chronic obstructive pulmonary disease	0.195	0.184
Cancer	0.104	0.091
Dependent variables (per quarter)		
Overall spending	\$6,654 (\$9,110)	\$6,456 (\$8,990)
Acute hospital spending	\$1,308 (\$4,466)	\$1,269 (\$4,419)
Other hospital spending	\$86 (\$1,353)	\$81 (\$1,349)
Skilled nursing facility spending	\$4,946 (\$6,908)	\$4,738 (\$6,754)
Hospice spending	\$314 (\$1,719)	\$369 (\$1,864)
Acute hospital days	0.904 (3.211)	0.923 (3.303)
Other hospital days	0.082 (1.327)	0.075 (1.269)
Skilled nursing facility days	19.832 (26.451)	18.787 (25.733)
Hospice days	2.162 (12.133)	2.598 (13.339)
Number of quarterly assessments	415,108	326,672
Number of unique residents	135,282	109,672
Number of nursing homes	238	190
Number of GH nursing homes	15	12

Notes. The full sample (column 1) was used to generate the results presented in Table 4 (column 1) and Table 5 comparing residents in Green House (GH) organizations with residents in non-GH nursing homes. The GH home and legacy identifier sample (column 2) was used to generate the results presented in Table 4 (column 2) and Table 6 comparing individuals residing in GH homes and “legacy” units with residents of non-GH nursing homes. The “legacy” nursing home was the original nursing home that remained open alongside the GH homes. Three nursing homes (and their matched comparisons) were dropped in the GH identifier sample (column 2) because these nursing homes did not provide data on which residents lived in the GH homes.

Table 3: Unadjusted Comparison of Pre-Post Spending and Utilization Across Green House (GH) and Comparison Nursing Homes Home ($N = 415,108$ Quarterly Assessments)

	(1) Green House Pre-Post Difference	(2) Comparison Pre-Post Difference	(3) GH versus Comparison Difference
Overall spending	-580.50	-71.49	-509.01
Acute hospital spending	-20.91	90.73	-111.64
Other hospital spending	-12.35	15.68	-28.03
Skilled nursing facility spending	-611.34	-271.89	-339.45
Hospice spending	64.10	93.98	-29.89
Acute hospital days	-0.133	-0.087	-0.05
Other hospital days	-0.008	0.002	-0.01
Skilled nursing facility days	-3.729	-2.784	-0.94
Hospice days	0.331	0.532	-0.20

Notes. Column 3 represents the unadjusted difference-in-difference estimates presenting the pre-post difference in Green House nursing homes minus the pre-post difference in the comparison nursing homes.

not statistically significant (see Table 4, Model 1). This was true whether we used the full sample of 15 GH adopters or the smaller subset of 12 GH adopters with identifiers. The magnitudes of the differences, however—\$794 and \$455 per resident per quarter, respectively, or 12 percent and 7 percent reductions relative to total expenditures in Table 1—would be meaningful if implemented broadly.

When we separated residents in the GH homes and the legacy units using the smaller sample of 12 GH adopters, we found that the adoption of GH lowered ($p < .06$) overall Medicare spending by \$1,937 per resident quarter for residents of GH homes, a reduction of 30 percent starting from a base of \$6,456. Put alternatively, the adoption of the GH model decreased *annual* Medicare Part A (plus hospice) spending by \$7,746 per resident. Although not statistically significant, the estimated spending in legacy units was in the opposite direction, \$946 (\$3,784 annually), or 15 percent, higher than that in comparison homes. This increase in legacy units may partially offset the reduction in GH units resulting in the observed smaller, nonsignificant difference in overall spending.

To determine whether GH affected specific components of Medicare spending and utilization, we next analyzed the impact of GH by service category. GH adoption did not significantly impact spending or utilization in any of the spending or utilization categories either for all residents in the organization or for residents living in GH homes or in legacy units (see Tables 5 and 6).

Table 4: Estimated Impact of Green House (GH) Adoption on Overall Medicare Part A (Plus Hospice) Spending per Quarter

	(1) Full Sample	(2) Sample with GH Identifiers
Model 1		
GH organization	−797 (1,064)	−455 (1,421)
Model 2		
GH home		−1,937* (1,022)
Legacy home		946 (930)
Nursing homes	238	190
Observations	415,108	326,672

Notes. The results presented in Model 1 included both residents in the GH homes and “legacy” units, while the results presented in Model 2 present results for these two groups separately. The “legacy” nursing home was the original nursing home that remained open alongside the GH homes. The smaller sample size in Column 2 was due to the exclusion of three nursing homes and their matched controls because of missing GH identifiers. Robust standard errors clustered at the nursing home level are presented in parentheses. All regressions included covariates in Table 2, nursing home-level payer mix measures, and time (quarter) and nursing home fixed effects.

*Statistically significant at 10% level; **Statistically significant at 5% level; ***Statistically significant at 1% level.

Importantly, we may have lacked sufficient statistical precision to detect GH impacts for individuals residing in a GH home for particular Medicare spending categories such as hospitalization or SNF utilization. Specifically, the point estimates for several categories suggested relatively large reductions relative to average spending: 18 percent reduction in acute hospital spending; 20 percent, in SNF days; and 31 percent in SNF spending. These apparent reductions could, however, be chance occurrences; the large standard errors prohibited us from drawing any statistically significant inferences about these categories. We return to this issue below.

DISCUSSION

Although we did not find a statistically significant effect on expenditures for the GH organizations as a whole, for residents of GH homes, the adoption of the model reduced Medicare Part A spending. Although we did not observe a statistically significant impact in any one spending area, it is likely that the overall decline we observed was driven by decreases in acute hospital and SNF spending, given that these are the largest components of overall Part A expenditures. We consider both of these potential pathways below.

Table 5: Regression Results: Predicted Values from Two-Part Models of Utilization and Spending per Quarter, Full Sample (Model 1)

	(1) <i>Acute Hospital Days</i>	(2) <i>Acute Hospital Spending</i>	(3) <i>Other Hospital Days</i>	(4) <i>Other Hospital Spending</i>
GH	-0.173 (0.158)	-217 (187)	0.022 (0.024)	-16 (28)
Observations	415,508	415,508	363,840	363,840
	(5) <i>Skilled Nursing Facility Days</i>	(6) <i>Skilled Nursing Facility Spending</i>	(7) <i>Hospice Days</i>	(8) <i>Hospice Spending</i>
GH	0.313 (1.988)	-442 (898)	-0.180 (1.126)	-31 (139)
Observations	415,508	415,508	413,750	413,750

Notes. The Green House (GH) organization encompassed both residents in the GH homes and “legacy” units. The “legacy” nursing home was the original nursing home that remained open alongside the GH homes. Robust standard errors clustered at the nursing home level are presented in parentheses. All regressions included covariates in Table 2, nursing home-level payer mix measures, and time (quarter) and nursing home fixed effects.

*Statistically significant at 10% level; **Statistically significant at 5% level; ***Statistically significant at 1% level.

GH might decrease the volume or the intensity of SNF services. The GH model was initially conceived primarily as a way to improve the quality of life for long-stay nursing home residents. Yet some of the economic and clinical value of the model may spillover to residents requiring SNF services, as has been observed in other nursing home contexts (Konetzka et al. 2006; Grabowski et al. 2010). Under the GH model, postacute SNF care for long-staying residents is typically delivered in their GH home. Although the delivery of therapy services might be similar across GH and non-GH settings, care in a home-based setting may lead to increased communication and coordination between Shahbazim, primary care physicians, and therapists under the GH model (Bowers et al. 2016b), which could decrease the need for high-cost rehabilitation services and thereby lower Medicare Part A expenditures.

A second possible mechanism through which Medicare Part A expenditures could be reduced is through lower hospital use. Afendulis et al.’s (2016) finding that organizations adopting GH reduced 30-day readmissions by 5.5 percentage points and Bowers et al.’s (2016b) finding that GHs create important opportunities to avoid hospitalizations together provide additional reason to suspect that reduced hospital use may be a mechanism through which GH reduced Medicare Part A spending.

Although we were not able to identify the source of the savings, our findings suggest that GH homes may reduce Medicare Part A (plus hospice)

Table 6: Regression Results: Predicted Values from Two-Part Models of Utilization and Spending per Quarter, GH Overall, and Residents of Green House (GH) and Legacy Homes

	(1) <i>Acute Hospital Days</i>	(2) <i>Acute Hospital Spending</i>	(3) <i>Other Hospital Days</i>	(4) <i>Other Hospital Spending</i>
Model 1				
GH organization	−0.170 (0.190)	−234 (200)	0.022 (0.027)	30 (49)
Model 2				
GH home	−0.217 (0.164)	−220 (243)	0.003 (0.013)	4 (11)
Legacy home	−0.076 (0.244)	−109 (344)	0.066 (0.248)	−61 (335)
Observations	326,672	326,672	291,491	291,491
	(5) <i>SNF Days</i>	(6) <i>SNF Spending</i>	(7) <i>Hospice Days</i>	(8) <i>Hospice Spending</i>
Model 1				
GH organization	0.839 (2.93)	−149 (1,187)	0.018 (1.718)	−8 (226)
Model 2				
GH home	−3.827 (2.364)	−1,484 (948)	−0.562 (0.644)	−79 (94)
Legacy home	3.145 (2.067)	1,027 (876)	0.442 (1.504)	64 (230)
Observations	326,672	326,672	325,314	325,314

Notes. The results presented in Model 1 included both residents in the GH homes and “legacy” units, while the results presented in Model 2 present results for these two groups separately. The “legacy” nursing home was the original nursing home that remained open alongside the GH homes. Robust standard errors are presented in parentheses. All regressions included covariates in Table 2, nursing home–level payer mix measures, and time (quarter) and nursing home fixed effects.

*Statistically significant at 10% level; **Statistically significant at 5% level; ***Statistically significant at 1% level.

spending. Medicare policy makers may wish to invest in a larger scale study that would more comprehensively assess whether savings exist when all Medicare spending is accounted for and whether the savings persist over a longer time period.

If these findings are still present, policy makers may want to encourage greater investment in GH. However, the misalignment between who bears the cost of GH and who accrues the savings serves as a disincentive for further investment in the model. The GH model requires a substantial capital investment (Jenkins et al. 2011), and these costs typically fall entirely on the nursing home. The adoption of culture change models such as GH may increase occupancy rates and revenue as one well-designed study has shown (Elliot 2010), but most of the savings from lower health care use go to the Medicare program. Researchers have observed a similar disconnect around the adoption of other nursing home innovations such as off-hour physician telemedicine coverage (Grabowski and O’Malley 2014) and the INTERACT program

(Ouslander et al. 2011). Put simply, nursing homes bear the cost of the innovation, while the savings from decreased health utilization accrue to Medicare.

Not surprisingly, the adopters of GH and other culture change models to date have largely been higher resource nursing homes (Grabowski et al. 2014). Different Medicaid payment policies might help to bridge this misalignment and encourage a more diverse group of adopters. Some states have experimented with Medicaid pay-for-performance-type models that provide additional resources to culture change nursing homes (Miller et al. 2014b). In particular, models that direct additional resources for capital-based expenditures for small household models might be particularly effective (Miller et al. 2014a). However, given Medicaid does not share in any savings from decreased hospitalizations, it is unclear whether states would be able to make these capital-based investments (Grabowski 2007). Toward this end, Arkansas House Bills 1363 and 1364 are an example of an innovative payment approach that attempts to address the large fixed costs associated with implementing comprehensive culture change models (Chi Partners 2012). Signed into law in 2007, these bills allow funds collected under civil monetary penalties to be used for specialized reimbursements for nursing homes that implement a Green House project or an Eden Alternative program.

Given the null findings for Part A expenditures in GH organizations overall and most utilization and spending categories, we analyzed whether the lack of statistically significant effects were due to a true null relationship or limited precision. If the standard errors were relatively small, we could reject relatively small effects, thereby suggesting no relationship. However, if the standard errors were large, then the null findings—even when the estimated effect is meaningful from a policy perspective—would be the result of limited precision in the estimates. We concluded that the null findings may well be due to limited statistical precision.

For example, when we examined the impact of GH adoption on acute hospital spending for GH home residents, we would have had to obtain an effect size of \$392 lower spending per resident quarter ($= -1.96 \times 200$) to achieve statistical significance. From an economic perspective, this amount definitely would be considered a meaningful effect size in that it represents a 30.8 percent decrease in average Medicare spending for acute hospitalizations. Indeed, even a 10 percent decrease would be meaningful if implemented widely. Our estimated decrease of 18.4 percent, however, was too small to be considered statistically significant given our sample size and study design.

With the relatively small number of adopters (12 or 15 GH organizations depending on our model specification) and the inclusion of nursing home fixed effects, it is perhaps unsurprising that we had limited precision in some of our spending and utilization categories. Moving forward, we argue for continued analysis of the impact of the GH model using larger samples of adopters over longer periods of study. The data in this study provide an excellent foundation from which to build this analytic sample.

In addition to unavoidable low statistical precision, the analysis was limited in several other ways. First, we examined Medicare utilization and spending on Part A and hospice care, but we did not examine Part B or Part D utilization and spending. We also did not estimate potential impacts on spending by Medicaid or private-payers. For example, out-of-pocket prices for residents of GH homes are somewhat higher than for residents of legacy units (Cohen et al. 2016). Moreover, changes in utilization may shift costs among payers. For example, if GH leads to fewer SNF days, as the nonsignificant differences for GH residents suggest might be the case, then it would in at least some cases lead to increased nursing home days covered by Medicaid and private payers, offsetting some of the Medicare savings. Cost shifting to private-payers would not impact public savings, while cost shifting to Medicaid would, of course, impact overall public spending (Grabowski 2007).

Second, although we tried to match the treatment and comparison nursing homes, we acknowledge that some nursing home “unobservables” may still be correlated with both GH adoption and our outcomes of interest. Similarly, our effort to use propensity score weighting of residents in the comparison nursing homes may have omitted important unmeasured factors that may have been related to selection of residents into GH homes versus legacy units.

Third, the data were subject to inevitable limitations. In matching the GH identifiers provided by the organizations to the Medicare claims, we may have instances in which individuals were incorrectly assigned across GH homes and legacy units due to data errors or missing identifiers. We also had to eliminate all Medicare Advantage recipients from the analysis due to missing claims information.

Fourth, our primary results represented an average effect across all GH adopters. Our study is embedded in a larger mixed methods evaluation of GH. As other primary data and qualitative research in this issue found, GH organizations have varied in their implementation (Cohen et al. 2016) and sustainability (Bowers, Nolet, and Jacobson 2016a) of the model. It could be the case that certain GH adopters were able to decrease Medicare utilization, while others were not.

Finally, this study did not evaluate other potential outcomes related to quality of life/engagement or organizational impact such as lower staff turnover or higher resident occupancy. Indeed, the focus of the GH model is to improve the quality of life for the residents, not necessarily to lower Medicare utilization and spending. If the GH model can emphasize quality of life and person-centeredness without adding any increased burden in terms of Medicare Part A spending (or even decrease Medicare spending as we observed in this study), then some might conclude that the model is working as intended without any negative spillovers to the Medicare program. Similarly, we did not consider whether GH offered a return on investment for the adopting organization. It is possible for GH to be highly beneficial to an organization irrespective of its impact on Medicare spending. If nursing homes were able to share in some of the Medicare savings, the “business case” for adoption would be even stronger.

Toward this end, Medicare is currently exploring ways to realign incentives such as value-based payment (L&M Policy Research 2013), bundled payment models (Sood et al. 2011), and accountable care organizations (Fisher et al. 2009). These programs strive to incentivize providers to invest in practices that lower Medicare spending while maintaining strong quality. To date, these new payment programs have generally not considered the role of GH and other small household culture change models. Our results suggest policy makers should consider whether these models might play a role moving forward.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.