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RESEARCH ARTICLE

The Association between Long-Term Care Setting and Potentially Preventable Hospitalizations among Older Dual Eligibles

Andrea Wysocki, Robert L. Kane, Ezra Golberstein, Bryan Dowd, Terry Lum, and Tetyana Shippee

Objective. To compare the probability of experiencing a potentially preventable hospitalization (PPH) between older dual eligible Medicaid home and community-based service (HCBS) users and nursing home residents.

Data Sources. Three years of Medicaid and Medicare claims data (2003–2005) from seven states, linked to area characteristics from the Area Resource File.

Study Design. A primary diagnosis of an ambulatory care sensitive condition on the inpatient hospital claim was used to identify PPHs. We used inverse probability of treatment weighting to mitigate the potential selection of HCBS versus nursing home use.

Principal Findings. The most frequent conditions accounting for PPHs were the same among the HCBS users and nursing home residents and included congestive heart failure, pneumonia, chronic obstructive pulmonary disease, urinary tract infection, and dehydration. Compared to nursing home residents, elderly HCBS users had an increased probability of experiencing both a PPH and a non-PPH.

Conclusions. HCBS users' increased probability for potentially and non-PPHs suggests a need for more proactive integration of medical and long-term care.

Key Words. Long-term care, home care/nursing homes, acute inpatient care, Medicaid, Medicare

Elderly long-term care (LTC) users in both nursing homes and home and community-based settings often have complex needs that require support for functional and cognitive limitations, as well as medical care for acute and chronic conditions. These individuals are generally frail with substantial medical needs, and thus, they have a high risk for hospitalization (Castle and Mor 1996; Grabowski et al. 2008; Konetzka, Spector, and Limcangco 2008; Walsh

et al. 2012). While some hospitalizations may be necessary to treat conditions and symptoms and to restore function, certain hospitalizations may be unnecessary or avoidable if good outpatient care is provided. Potentially preventable hospitalizations (PPHs) refer to hospitalizations that result from conditions or events that are thought to be avoidable altogether or manageable in an individual's current setting with access to medical and outpatient services (Ouslander and Berenson 2011). PPHs are an important outcome to analyze because they signal quality of care in a given setting and are significant drivers of costs (Walsh et al. 2012).

There has been increasing attention to issues around hospitalization of nursing home residents. Specifically, studies examining PPHs among nursing home residents have found these hospitalizations to be frequent and associated with a number of resident and facility characteristics (Carter 2003; Intrator, Zinn, and Mor 2004; Carter and Porell 2005; Grabowski, O'Malley, and Barhydt 2007; Becker et al. 2010; Ouslander et al. 2010, 2011; Walsh et al. 2012). Given the empirical evidence on hospitalizations, a number of policy initiatives have been implemented to reduce hospitalizations from the nursing home (Ouslander and Berenson 2011; Centers for Medicare and Medicaid Services 2012).

Although attention has been focused on the nursing home population, less is known about PPHs among elderly home and community-based service (HCBS) users. There has been a substantial increase in LTC delivered through HCBS over the last several decades, and state Medicaid programs have made varying efforts to create a more balanced LTC system with HCBS options as alternatives to nursing home care (Kitchener, Carrillo, and Harrington 2003; Ng, Harrington, and Kitchener 2010; Kaiser Family Foundation's Kaiser Commission on Medicaid and the Uninsured's 2011). With the increase in HCBS, most types of LTC needs can be met in a number of alternative settings, often through a combination of different support services. How an individual's LTC needs are addressed within his or her setting likely affects how his or her medical needs are dealt with, and PPHs may result from a failure to meet an individual's care needs (Konetzka, Spector, and Limcangco 2008).

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While there have been a few studies of PPHs among HCBS users, none of them have examined how PPHs in this population of LTC users compared to PPHs in nursing home residents (Kane et al. 2004, 2006a,b; Walsh et al. 2010, 2012; Konetzka, Karon, and Potter 2012). Understanding how the HCBS versus nursing home setting affects the risk for a PPH is important to inform decisions about the organization and financing of LTC and policy initiatives.

It is not obvious whether the nursing home or HCBS setting would lead to a higher risk for PPHs among LTC users, given that there may be offsetting factors. Nursing homes have a more medical model of care than HCBS since they rely on professional nursing staff, care available 24 hours per day, and required assessments at regular intervals along with a physician's contact (Ouslander, Osterweil, and Morley 1997). Nursing home staff play a central role in medical decisions regarding residents. HCBS rely more on direct-care workers or paraprofessional staff, often with assistance from informal caregivers, to provide many support services, and there are no standard requirements for HCBS programs for ongoing assessments or physician visits (Institute of Medicine 2008; Harahan, Stone, and Shah 2009; Stone and Harahan 2010). The medical orientation of nursing home care may lead nursing home residents to have a lower risk for a PPH compared to HCBS users if their acute and LTC needs are better coordinated and met, if conditions are recognized at an earlier stage so fewer serious events occur, and if staff have the resources and training to treat residents within the nursing home setting and can avoid a hospital transfer.

Alternatively, more staff resources may need to be devoted to caring for residents who have an event or an exacerbation of an existing condition, and nursing homes may not have an incentive to do so. Under current payment policy, nursing homes are not financially penalized for hospitalizing a resident, and in states where bed-hold policies are in place, nursing homes are paid to hold the bed for a Medicaid resident who is hospitalized (Intrator et al. 2007). Nursing homes will also receive a higher reimbursement rate for dual eligible (i.e., individuals eligible for both Medicaid and Medicare) Medicaid residents if they reenter the nursing home under the Medicare skilled nursing facility benefit after a qualifying hospital stay. Therefore, nursing homes may decide to hospitalize a patient rather than devote the necessary resources to his or her care within the nursing home setting. Nursing homes may also be fearful of litigation from residents or family members. If a nursing home chooses to treat a resident within the facility rather than hospitalize him or her and the condition worsens, the nursing home may be subject to legal recourse

(Intrator et al. 2007; Perry et al. 2010; Ouslander and Berenson 2011). These incentives for more hospital use do not exist for HCBS users and may result in nursing home residents having a higher risk for a PPH compared to HCBS users. Additionally, nursing home residents may be sicker and require more hospital care than HCBS users.

As the number of elderly individuals served through HCBS continues to increase, it is important to better understand the extent to which LTC setting affects hospitalization risk. This analysis compares the probability of experiencing a PPH between elderly dual eligible Medicaid HCBS recipients and nursing home residents.

METHODS

Data Sources

The data for this analysis came from the Medicaid offices in Arkansas, Florida, Minnesota, New Mexico, Texas, Vermont, and Washington, the Centers for Medicare and Medicaid Services (CMS), and the Health Resources and Services Administration (HRSA). The Medicaid and CMS data were available through a data reuse agreement from a CMS contract to examine states' progress in "rebalancing" their LTC service options toward more HCBS.

The seven state Medicaid offices identified HCBS waiver and LTC state plan recipients in their Medicaid programs for each month from 2002 to 2005 and provided "finder files" with each individual categorized on a monthly basis. For this analysis, waiver recipients included enrollees in aged/physically disabled waivers, and LTC state plan recipients included Medicaid beneficiaries that utilized home health, personal care, or nursing home state plan services. The state "finder files" contained the CMS Eligible Identifier Number and the CMS Health Insurance Claim number to link individuals to their Medicaid and Medicare claims files.

CMS provided the 2002–2005 Medicaid and Medicare claims data for the seven states. We linked the state "finder files" for the study population to the MAX person summary files, which contain demographic information, and the MAX utilization files, which include the MAX inpatient file, the MAX long-term care file, and the MAX other therapy file. We also extracted and linked the Medicare claims for our study population. The Medicare files included the Medicare Denominator file; the Medicare Provider Analysis and Review file; the Outpatient, Home Health, and

Hospice Institutional standard analytic files; and the Carrier Non-Institutional standard analytic files.

We used the Area Resource File (ARF) from HRSA to obtain county-level market factors.

Study Population

The study population for this analysis included dual eligible Medicaid fee-for-service LTC users of age 65 and older in AR, FL, MN, NM, TX, VT, and WA from 2003 to 2005. We analyzed the data at the person-quarter level. The HCBS population was defined as dually eligible individuals of age 65 and older who were identified by the states as being in an aged/physically disabled HCBS waiver or as using home health or personal care state plan services for 3 months during the person-quarter at time$_t$. The nursing home population was defined as dually eligible individuals of age 65 and older who were identified by the states as using Medicaid nursing facility state plan services for all 3 months during the person-quarter at time$_t$. We focus on the dual eligible population because most elderly individuals receiving LTC services through Medicaid are also eligible for Medicare, and there is an effort to understand how to better serve this frail and costly population.

Variables

Our outcome of interest in this analysis was a PPH. However, an individual could also experience a non-PPH or die, so these outcomes also needed to be taken into account. Therefore, we defined a four-category outcome as follows: (1) the individual experienced a PPH during the person-quarter at time$_{t+1}$ (identified by having a hospitalization with an ambulatory care sensitive (ACS) condition as the primary diagnosis); (2) the individual experienced a non-PPH during the person-quarter at time$_{t+1}$ (identified as having a hospitalization with a non-ACS condition as the primary diagnosis); (3) the individual died during the person-quarter at time$_{t+1}$ (without experiencing a hospitalization prior to death); and (4) reference group (individual did not experience a hospitalization of any type and did not die). Individuals who died during the person-quarter at time$_{t+1}$ after experiencing a hospitalization were categorized in the relevant hospitalization category. The ACS conditions for this analysis included angina, asthma, cellulitis, chronic obstructive pulmonary disease, congestive heart failure, dehydration, diabetes mellitus, gastroenteritis,

epilepsy, hypertension, hypoglycemia, urinary tract infection, pneumonia, and severe ear, nose, and throat infections (Culler, Parchman, and Przybylski 1998; Carter 2003; Intrator, Zinn, and Mor 2004; Grabowski, O'Malley, and Barhydt 2007).

The independent variable of interest was an individual's type of LTC, defined by HCBS use or nursing home use during the person-quarter at time$_t$. We included variables for age, gender, race/ethnicity, urban or rural residence, and the reason for Medicaid eligibility to control for demographic characteristics. These variables were defined for the person-quarter at time$_t$. Age was categorized as 65–70, 71–75, 76–80, 81–85, 86–90, and 91 and older. Race/ethnicity was classified as White, Black, Hispanic, Asian, Native American, or Other. The urban or rural categorization for this analysis was based on the beneficiaries' county of residence and on the Metropolitan Statistical Area classifications of counties. The reason for Medicaid eligibility was classified as poverty/cash or medically needy/other.

We included dummy variables for a number of diseases/conditions to control for clinical characteristics that may be associated with PPHs in this population. The diseases/conditions included anemia, anxiety, arthritis, cancer, chronic kidney disease, chronic obstructive pulmonary disease, dementia, depression, diabetes, heart failure, hypertension, ischemic heart disease, and stroke. These diseases/conditions were identified from diagnosis codes on claims with a look-back period of 1 year from the person-quarter at time$_t$, so an individual was coded as having a disease/condition if he or she had a diagnosis on any claim file from the previous year. Since identification of the diseases/conditions used a look-back period of 1 year, 2002 claims were used for 2003 person-quarters.

Because having a previous hospitalization also reflects health status, we included a dummy variable indicating whether an individual had a hospitalization of any type during the person-quarters at time$_t$ or time$_{t-1}$ (i.e., in the 6 months prior to the outcome measure); data from 2002 were used for a look-back period for the first person-quarter in 2003.

We included the number of hospital beds per 1,000 individuals of age 65 and older and the per-capita income in an individual's county of residence to control for market factors that may be related to hospital use. These variables were obtained from the ARF. Additionally, we included dummy variables for the component economic area of residence and the quarter of the observation to control for unobserved factors. The component economic area is a regional market area defined by the Bureau of Economic Analysis. The levels of regional hierarchy are counties, core-based statistical areas (metropolitan statistical

areas and micropolitan statistical areas), combined statistical areas, component economic areas, and economic areas.

Analysis

For this analysis, we were interested in examining the effect of an individual's type of LTC (defined by HCBS or nursing home use) on hospitalization. In addition to measurable differences, there were likely to be unmeasured differences between individuals who used HCBS or nursing home care. To help mitigate the selection issues, we performed a propensity score analysis using inverse probability of treatment weighting.

First, we used a logit model to estimate the probability of being an HCBS user given the set of covariates described above. We then used a multinomial logit model to regress our outcome variable on the LTC type variable and the predictor variables. We weighted each observation by its inverse probability of the type of LTC actually received. We used cluster-robust standard errors by county to account for correlation between individuals within counties. We also predicted the average marginal effects for each of the outcomes.

To examine the consistency of the results, we performed a number of sensitivity analyses. First, we redefined the outcome using an alternative classification of a PPH (Walsh et al. 2010, 2012). This classification distinguished a set of conditions that may be more appropriately prevented/managed without a hospitalization for the home and community-based population because it is not clear that the ACS conditions apply to HCBS users. We used this more conservative definition of the outcome for both the HCBS and nursing home groups. Second, we ran the model excluding the variable indicating whether or not an individual had any type of hospitalization in the previous 6 months. Next, we redefined the outcome variable with individuals who experienced a hospitalization prior to death recoded as part of the death category, rather than as part of the relevant hospitalization category as they were in the primary analysis. Lastly, we combined the non-PPH and death outcome categories (resulting in three outcome categories) to attempt to reduce the potential confounding from death and to examine the estimate of LTC type on these outcomes. The main effects from these sensitivity analyses are presented in Table S1.

We also report the main effect from the multinomial logit model without inverse probability of treatment weighting in Table S1. The propensity score distribution by LTC group is presented in Figure S1.

RESULTS

Descriptive statistics are shown in Table 1. HCBS recipients had a slightly higher unadjusted frequency of both PPH and non-PPH and a lower frequency of death compared to nursing home residents. For nursing home residents, the conditions that accounted for the majority of PPHs included pneumonia (30.6 percent), urinary tract infection (23.9 percent), congestive heart failure (18.0 percent), chronic obstructive pulmonary disease (7.1 percent), and dehydration (6.6 percent); for HCBS users they included congestive heart failure (27.3 percent), pneumonia (20.5 percent), chronic obstructive pulmonary disease (14.5 percent), urinary tract infections (12.6 percent), and dehydration (6.0 percent). There were a number of differences in diagnoses between the groups. The HCBS sample was younger, less likely to be white, more likely to be eligible for Medicaid based on poverty, and less likely to have dementia.

The results from the model predicting HCBS use and from the multinomial logit model with inverse probability of treatment weighting are presented in Tables 2 and 3, respectively, and the distributions of estimated propensity scores for the nursing home and HCBS groups are shown in Figure S1. Individuals with dementia or depression and individuals who were eligible for Medicaid based on medical need were less likely to be HCBS users, while individuals who were nonwhite were more likely to be HCBS users. There was moderate overlap in the distributions of propensity scores. HCBS and nursing home users without dementia and nonwhite individuals had more overlap in the distributions. The marginal effect from the multinomial logit model indicates that on average, being an HCBS user increased the probability of experiencing a PPH within a quarter by 1 percentage point ($p < .01$) relative to being a nursing home resident. Compared to nursing home residents, being an HCBS user increased the probability of experiencing a nonPPH within a quarter by 2.1 percentage points ($p < .01$) and decreased the probability of dying by 1.5 percentage points ($p < .01$). The descriptive model that did not include inverse probability of treatment weighting produced similar results (see main effect in Table S1). Compared to nursing home residents, being an HCBS user increased the probability of experiencing a PPH within a quarter by 1.1 percentage points, increased the probability of experiencing a non-PPH within a quarter by 2.3 percentage points, and decreased the probability of dying by 1.4 percentage points (all marginal effects $p < .01$).

Table 1: Sample Description of Elderly Medicaid Nursing Home and Home and Community-Based Long-Term Care Users

	Mean (SD) or Percent	
Variable	*Nursing Home (N = 1,065,228)*	*HCBS (N = 1,207,712)*
Outcome		
Potentially preventable hospitalization	3.7	4.3
Non–potentially preventable hospitalization	8.8	9.8
Died	3.3	0.8
None	84.2	85.1
Characteristics		
Age		
65–70	9.6	20.8
71–75	13.2	22.1
76–80	19.3	22.5
81–85	22.4	17.4
86–90	20.2	11.2
91+	15.3	6.0
Gender		
Male	24.8	24.3
Female	75.2	75.7
Race		
White	75.1	48.2
Black	12.7	15.3
Hispanic	8.6	29.9
Asian	0.5	1.8
Native American	0.6	1.3
Other	2.5	3.5
Urban/rural residence		
Urban	72.5	69.4
Rural	27.5	30.6
Reason for Medicaid eligibility		
Poverty/cash	16.2	49.2
Medically needy/Other	83.8	50.8
Diagnosis		
Anemia	50.7	34.1
Anxiety	12.0	8.8
Arthritis	40.3	50.4
Cancer	9.1	11.0
Chronic kidney disease	13.3	14.8
Chronic obstructive pulmonary disease	24.3	25.9
Dementia	63.2	17.9
Depression	36.1	14.7
Diabetes	36.2	42.1
Heart failure	41.9	30.7

continued

Table 1. *Continued*

Variable	*Mean (SD) or Percent*	
	Nursing Home (N = 1,065,228)	*HCBS (N = 1,207,712)*
Hypertension	69.9	74.4
Ischemic heart disease	42.3	43.4
Stroke	30.5	16.2
Previous hospitalization		
No	80.8	78.4
Yes	19.2	21.6
Number of hospital beds per 1,000 population 65+ in county (10s)	2.6 (2.1)	2.6 (2.0)
Per-capita county income (1,000s)	29.2 (7.2)	25.4 (8.1)

Note. All variables significantly different at $p < .05$.
HCBS, home and community-based services.

The results from each of the sensitivity analyses (found in Table S1) were consistent with the results from the primary analysis. To examine whether the effects for the PPHs were driven by conditions that may not actually be preventable or manageable among the HCBS population, we used an alternative definition of a PPH which defined a separate list of conditions that may be more appropriate for HCBS users. We applied this definition for both HCBS users and nursing home residents (Walsh et al. 2010). This may provide a more comparable definition of a PPH, although it is a conservative definition for the nursing home population. The most notable difference between this alternative set of conditions and the ACS conditions used for the main analyses is the omission of pneumonia in the alternative set. The unadjusted results indicate that HCBS users more frequently experienced PPHs than did nursing home residents. The results from the regression model are similar to our main results. Compared to nursing home residents, being an HCBS user increased the probability of experiencing a PPH within a quarter by 1 percentage point, increased the probability of experiencing a non-PPH by 2.1 percentage points, and decreased the probability of dying by 1.5 percentage points. Each of these effects was significant ($p < .01$).

The other sensitivity analyses, including a redefinition of death in the outcome categories and the omission of the potentially endogenous previous hospitalization predictor variable, also indicated that HCBS users had an increased probability for experiencing a PPH and a non-PPH and a decreased probability of dying compared to nursing home residents. The analysis exam-

Table 2: Results from Model Predicting Home and Community-Based Service Use

Variable	*Coefficient*	*Standard Error*
Age (65–70 = reference)		
71–75	−0.170**	0.021
76–80	−0.395**	0.026
81–85	−0.626**	0.033
86–90	−0.889**	0.034
91+	−1.278**	0.042
Gender (Male = reference)		
Female	0.375**	0.020
Race (White = reference)		
Black	0.779**	0.096
Hispanic	0.854**	0.042
Asian	0.521**	0.158
Native American	0.442*	0.193
Other	0.621**	0.097
Urban/rural residence (Urban = reference)		
Rural	−0.028	0.051
Medicaid eligibility (Poverty/Cash = reference)		
Medically needy/Other	−1.662**	0.088
Diagnosis		
Anemia	−0.744**	0.033
Anxiety	−0.017	0.023
Arthritis	0.435**	0.026
Cancer	0.393**	0.017
Chronic kidney disease	0.135**	0.025
Chronic obstructive pulmonary disease	0.315**	0.029
Dementia	−1.842**	0.034
Depression	−1.013**	0.033
Diabetes	−0.117**	0.017
Heart failure	−0.539**	0.041
Hypertension	0.340**	0.026
Ischemic heart disease	0.313**	0.019
Stroke	−0.622**	0.024
Previous hospitalization		
Yes	0.668**	0.019
Number of hospital beds per 1,000 population 65+ in county (10s)	0.012	0.008
Per-capita county income (1,000s)	−0.026**	0.005

Note. Model also included dummy variables for quarter of observation and component economic area of residence.
*$p < .05$; **$p < .01$.

ining the combined non-PPH/death outcome found that HCBS users had an increased probability for experiencing a PPH and a non-PPH/death. Compared to nursing home residents, being an HCBS user increased the

Table 3: Results from Multinomial Logit Model with Inverse Probability of Treatment Weighting for HCBS versus Nursing Home Users

	Potentially Preventable Hospitalization		*NonPotentially Preventable Hospitalization*		*Died*	
Variable	*Coefficient (SE)*	*Marginal Effect (SE)*	*Coefficient (SE)*	*Marginal Effect (SE)*	*Coefficient (SE)*	*Marginal Effect (SE)*
Long-term care type (Nursing home = reference)						
HCBS	0.260** (0.029)	0.010** (0.001)	0.238** (0.022)	0.021** (0.002)	−0.738** (0.035)	−0.015** (0.001)
Age (65–70 = reference)						
71–75	0.034 (0.030)	0.001 (0.001)	0.010 (0.020)	0.000 (0.002)	0.229** (0.044)	0.003** (0.001)
76–80	0.035 (0.033)	0.001 (0.001)	−0.031 (0.019)	−0.004* (0.002)	0.479** (0.042)	0.007** (0.001)
81–85	0.103** (0.033)	0.004** (0.001)	−0.032 (0.020)	−0.005* (0.002)	0.647** (0.042)	0.010** (0.001)
86–90	0.128** (0.036)	0.005** (0.001)	−0.011 (0.026)	−0.003 (0.002)	0.866** (0.043)	0.014** (0.001)
91+	0.173** (0.036)	0.006** (0.001)	−0.037 (0.028)	−0.007** (0.002)	1.256** (0.045)	0.025** (0.001)
Gender (Male = reference)						
Female	−0.009 (0.020)	0.000 (0.001)	−0.086** (0.015)	−0.007** (0.001)	−0.180** (0.032)	−0.003** (0.001)
Race (White = reference)						
Black	−0.072** (0.026)	−0.003** (0.001)	0.009 (0.018)	0.002 (0.002)	−0.239** (0.046)	−0.004** (0.001)
Hispanic	0.012 (0.037)	0.000 (0.001)	0.064** (0.024)	0.006** (0.002)	−0.222** (0.047)	−0.004** (0.001)
Asian	−0.183** (0.057)	−0.006** (0.002)	−0.047 (0.081)	−0.002 (0.007)	−0.289 (0.155)	−0.005* (0.002)
Native American	0.259** (0.087)	0.011* (0.004)	0.157** (0.044)	0.013** (0.004)	−0.211 (0.119)	−0.004* (0.002)
Other	−0.009 (0.070)	−0.000 (0.003)	−0.038 (0.038)	−0.003 (0.003)	0.039 (0.049)	0.001 (0.001)
Urban/rural residence (Urban = reference)						
Rural	−0.075* (0.036)	−0.003* (0.001)	0.051** (0.019)	0.005** (0.002)	−0.155** (0.037)	−0.003** (0.001)
Medicaid eligibility (Poverty/Cash = reference)						
Medically needy/Other	0.081** (0.022)	0.002** (0.001)	0.065** (0.014)	0.004** (0.001)	0.644** (0.075)	0.010** (0.001)
Diagnosis						
Anemia	0.081** (0.022)	0.002* (0.001)	0.182** (0.013)	0.015** (0.001)	0.094** (0.026)	0.001** (0.000)

continued

Table 3. *Continued*

	Potentially Preventable Hospitalization		*NonPotentially Preventable Hospitalization*		*Died*	
Variable	*Coefficient (SE)*	*Marginal Effect (SE)*	*Coefficient (SE)*	*Marginal Effect (SE)*	*Coefficient (SE)*	*Marginal Effect (SE)*
Anxiety	0.039 (0.027)	0.001 (0.001)	0.057** (0.022)	0.005* (0.002)	−0.048 (0.052)	−0.001 (0.001)
Arthritis	−0.029 (0.023)	−0.001 (0.001)	0.003 (0.018)	0.001 (0.001)	−0.295** (0.023)	−0.005** (0.000)
Cancer	0.074** (0.026)	0.002 (0.001)	0.152** (0.026)	0.013** (0.002)	0.319** (0.028)	0.006** (0.001)
Chronic kidney disease	0.257** (0.026)	0.008** (0.001)	0.318** (0.016)	0.027** (0.002)	0.453** (0.036)	0.009** (0.001)
Chronic obstructive pulmonary disease	0.562** (0.029)	0.023** (0.001)	0.173** (0.016)	0.011** (0.001)	0.227** (0.028)	0.004** (0.001)
Dementia	0.006 (0.016)	−0.000 (0.001)	0.063** (0.011)	0.005** (0.001)	0.302** (0.016)	0.006** (0.000)
Depression	0.045* (0.018)	0.002* (0.001)	0.041** (0.012)	0.004** (0.004)	−0.153** (0.028)	−0.003** (0.001)
Diabetes	0.225** (0.021)	0.008** (0.001)	0.145** (0.015)	0.012** (0.001)	−0.038 (0.024)	−0.001** (0.000)
Heart failure	0.468** (0.022)	0.018** (0.001)	0.181** (0.012)	0.013** (0.001)	0.228** (0.027)	0.004** (0.001)
Hypertension	0.019 (0.028)	0.001 (0.001)	0.036* (0.017)	0.004** (0.001)	−0.394** (0.033)	−0.008** (0.001)
Ischemic heart disease	0.196** (0.020)	0.007** (0.001)	0.200** (0.014)	0.016** (0.001)	0.022 (0.026)	−0.000 (0.000)
Stroke	0.063** (0.021)	0.002 (0.001)	0.156** (0.013)	0.013** (0.001)	0.140** (0.025)	0.002** (0.000)
Previous hospitalization						
Yes	0.720** (0.016)	0.027** (0.001)	0.673**(0.015)	0.058** (0.002)	1.073** (0.030)	0.023** (0.001)

Note. Model also included dummy variables for quarter of observation and component economic area of residence and controlled for the number of hospital beds per 1,000 population 65+ in county and per-capita county income.
*$p < .05$; **$p < .01$.
HCBS, home and community-based services; SE, standard error.

probability of experiencing a PPH within a quarter by 1 percentage point ($p < .01$) and increased the probability of experiencing a non-PPH or death by 0.7 percentage points ($p < .01$).

DISCUSSION

After controlling for individual characteristics, we found that being an HCBS user was associated with an increased probability of experiencing a PPH, compared to nursing home residents. Being an HCBS user was also associated with an increased probability of a non-PPH. The results were consistent across a number of sensitivity analyses. This may be suggestive of a significant effect of the setting in which an individual receives LTC, although our statistical methods preclude us from identifying a true causal effect of LTC setting. The results point to a need to improve medical care in the community. Previous research has not explicitly examined the effect of LTC setting on the risk for a PPH, and these results should spur efforts to look for ways to reduce hospitalizations and improve outcomes, particularly among dual eligible LTC users. Attention must be paid to both the medical and LTC components of individuals' care. The increased risk for HCBS users compared to nursing home residents may be related to the medical care that is provided within the nursing home setting, which results in fewer events and different treatment of events when they do occur. Policies, such as the use of advance directives within a nursing home, may also result in different treatment of events. It is important that further initiatives to reduce hospitalizations should also address HCBS users, rather than only focusing on nursing home residents, since HCBS users have a significant risk for hospitalization. More proactive medical care may be needed for individuals in home and community settings to reduce hospitalizations among this population.

PPHs are typically used as measures of quality. However, we cannot directly ascertain the mechanism that produced the lower rate of PPHs in nursing homes. The outcome could result from better care or a decision not to hospitalize. Distinguishing between conditions or events that are prevented and those that are treated within the setting without transfer to a hospital is currently difficult because there are no specific measures of event rates. With most available data, this distinction cannot be made, so it is not clear whether nursing homes are more frequently preventing the incidence of these conditions or events or whether these events are occurring and nursing homes are treating them within the facility without a hospital transfer.

However, this is important to disentangle, particularly in the context of providing payments or incentives for medical care that is delivered in the nursing home or other outpatient settings which subsequently reduce hospital transfers.

There are a number of policy issues around payment approaches and incentives related to these results. As states have more flexibility and opportunities under the Affordable Care Act to provide HCBS, it is important for them to think about ways to integrate both medical and LTC for individuals with LTC needs because they are highly interconnected (O'Malley Watts, Musumeci, and Reaves 2013). While a few programs for dual eligibles currently coordinate care, these programs are not widespread and are limited in enrollment. New models of care for Medicare beneficiaries, including accountable care organizations (ACOs), aim to increase coordination across providers by requiring the organizations to take financial responsibility for their set of patients across all settings (Berwick 2011). ACOs may be a way to integrate medical and LTC for individuals with LTC needs. As these models grow in the future, research should address whether all the needs of LTC users can be met by the providers within these organizations and how to optimally include Medicaid within this model. One possible way that has been suggested to integrate the care of Medicaid LTC users within an ACO is shared savings for the beneficiaries' Medicare and Medicaid providers if they reduce the total costs of care of beneficiaries (Konetzka, Karon, and Potter 2012).

Payment reforms, such as bundled payments, may also incentivize providers to improve coordination of care and transitions across different settings. Meeting the preferences of LTC users is an important goal, but the different rates of hospitalizations suggest that there may be a hidden cost associated with HCBS. This cost will fall on Medicare, whereas HCBS is primarily covered by Medicaid. Although HCBS may appear to be a cheaper alternative to nursing home care, this accounting is frequently considered solely from the Medicaid perspective and largely ignores the costs that are incurred by Medicare. If states implement payment reforms, CMS and states need to think carefully about the potential conflicting incentives that could arise to minimize the cost-shifting between Medicare and Medicaid that is likely at play for dual eligibles within the current system. Results from ongoing demonstration projects to better align the financial incentives between Medicare and Medicaid for dual eligibles may provide insight into payment models that reduce cost-shifting between Medicare and Medicaid. Not only are hospitalizations costly to the health care system, but they are also "costly" from the patient's perspective. Hospitalizations can be particularly distressing for frail elderly

patients. These patients are more vulnerable to adverse events, and transfers between multiple settings can be physically uncomfortable and disorienting, sometimes leading to further decline (Creditor 1993; Ouslander, Weinberg, and Phillips 2000). The potential health implications and stress of hospitalizations may adversely impact patients' quality of life. Although most individuals prefer HCBS, the cost of hospitalizations may make the choice of setting more complicated for certain LTC users.

Better communication and coordination between providers may allow more timely primary care and lower intensity interventions to prevent exacerbation of events. This includes communication with the LTC providers in the community and the patient about their needs and preferences, as well as with informal care providers who often play a critical role in HCBS users' overall health and well-being by providing support services and medical tasks such as medication management. Ongoing assessment for the HCBS population may also help care providers become aware of issues and unmet need to intervene prior to a hospital transfer.

The five most frequent conditions accounting for PPHs (congestive heart failure, pneumonia, chronic obstructive pulmonary disease, urinary tract infection, and dehydration) were the same for HCBS users and nursing home residents, although the rank order was different. These results are consistent with previous research that has found a few conditions to account for the majority of PPHs (Grabowski, O'Malley, and Barhydt 2007; Walsh et al. 2010, 2012). This suggests that it may be most valuable to initially concentrate on care and interventions for a specific set of conditions to reduce PPHs. A large proportion of the PPHs among both groups were due to acute conditions, including pneumonia and urinary tract infections, which could likely be treated at a lower level of care if individuals have access to timely and high-quality outpatient services. Focusing on specific conditions that are most amenable to preventive and outpatient care should reduce these hospitalizations among both HCBS and nursing home users.

Some limitations of this work should be noted. First, we focused on PPHs based on ICD-9 codes from the hospital claims, but without further information, we cannot be certain that all of these hospitalizations were actually preventable (Ouslander and Maslow 2012). The states used in this analysis were based on data availability and may not be representative of all state LTC users. Additionally, the results may not be generalizable to managed care enrollees since they may have different utilization patterns. We were unable to examine the effect of other factors such as do-not-hospitalize orders, physical or cognitive functioning, or social support on the outcomes due to the limited

characteristics available in the data. These factors are likely to be associated with the choice of LTC setting and may impact hospitalizations, but we were unable to account for them. The results from the unweighted model were similar to those from the model with inverse probability of treatment weighting. Although we employed several adjustment techniques, we are not certain that the adjustment for selection or death was adequate. There may be unmeasured differences in health status between nursing home and HCBS users that were not addressed by our propensity score analysis. The difference in the death rates between the groups also suggests that there is residual confounding that was not corrected by the propensity score methods. We performed sensitivity analyses to attempt to address this issue, and the results indicate that there remains a significant difference in experiencing a hospitalization, but there is likely still unadjusted confounding due to death. Lastly, we examined the first event within a quarter, but we did not analyze multiple events or individuals' transitions over time.

In conclusion, both HCBS and nursing home users are hospitalized frequently, and many of these hospitalizations could likely be prevented. We find that receiving LTC in the HCBS setting is associated with a higher probability of experiencing a preventable and a nonpreventable hospitalization. For HCBS users, incorporating more proactive medical care and improving communication between their multiple providers and caregivers may reduce unnecessary hospitalizations and lead to better outcomes. Enthusiasm for increasing community-based LTC should at least recognize the hidden costs of more hospitalizations. With the increasing number of individuals who will require LTC and want to remain in home and community settings, focusing on better integration of care is critical.

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SUPPORTING INFORMATION

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

Appendix SA1: Author Matrix.
Table S1: Main Effect Results from Sensitivity Analyses.
Figure S1: Propensity Score Distributions by Long-Term Care Group.