Published in final edited form as:
J Am Med Dir Assoc. 2015 February 1; 16(2): 155–159. doi:10.1016/j.jamda.2014.08.010.

The Effect of Hospice on Hospitalizations of Nursing Home Residents

Nan Tracy Zheng, PhD,
Aging, Disability and Long Term Care Division of Health Services and Social Policy Research RTI International Waltham, MA

Dana B. Mukamel, PhD,
Department of Medicine Health Policy Research Institute University of California, Irvine

Bruce Friedman, PhD,
Department of Public Health Sciences University of Rochester School of Medicine and Dentistry

Thomas V. Caprio, MD, and
Department of Medicine Division of Geriatrics and Aging University of Rochester

Helena Temkin-Greener, PhD
Department of Public Health Sciences & Center for Ethics, Humanities and Palliative Care University of Rochester School of Medicine and Dentistry

Abstract

Objectives—Hospice enrollment is known to reduce risk of hospitalizations for nursing home residents who use it. We examined whether residing in facilities with a higher hospice penetration: 1) reduces hospitalization risk for non-hospice residents; and 2) decreases hospice-enrolled residents' hospitalization risk relative to hospice-enrolled residents in facilities with a lower hospice penetration.

Method—Medicare Beneficiary File, Inpatient and Hospice Claims, Minimum Data Set Version 2.0, Provider of Services File and Area Resource File. Retrospective analysis of long-stay nursing home residents who died during 2005-2007. Overall, 505,851 non-hospice (67.66%) and 241,790 hospice-enrolled (32.34%) residents in 14,030 facilities nationwide were included. We fit models predicting the probability of hospitalization conditional on hospice penetration and resident and facility characteristics. We used instrumental variable method to address the potential endogeneity between hospice penetration and hospitalization. Distance between each nursing home and the closest hospice was the instrumental variable.

corresponding author ntzheng@rti.org.

CONFLICT OF INTEREST The authors have no conflict of interest.

Main Findings—In the last 30 days of life, 37.63% of non-hospice and 23.18% of hospice residents were hospitalized. Every 10% increase in hospice penetration leads to a reduction in hospitalization risk of 5.1% for non-hospice residents and 4.8% for hospice-enrolled residents.

Principal Conclusions—Higher facility-level hospice penetration reduces hospitalization risk for both non-hospice and hospice-enrolled residents. The findings shed light on nursing home end-of-life care delivery, collaboration among providers and cost benefit analysis of hospice care.

Keywords

end-of-life care; hospice care; hospitalization; nursing homes

INTRODUCTION

Nursing homes have increasingly become Americans' last site of care [1-4]. The quality of end-of-life care in nursing homes is often suboptimal, a matter of great concern to patients and their families[5]. Nursing home residents are often transferred to hospitals at the end of life,[6,7] although such transfers may result in adverse clinical outcomes [8 9 10,11] and disruption of care plans. [12] Many hospitalizations are potentially avoidable (i.e., the conditions could be managed in the nursing homes) and, moreover, inconsistent with residents' wishes. [12,13]

Medicare hospice care reduces nursing home residents' risk of hospitalization at the end of life. [14] Miller et al. suggested that hospice's effect on reducing hospitalization risk of hospice residents may "spills over" to non-hospice residents [6], that is, non-hospice residents in nursing homes with moderate hospice penetration (proportion of residents in a nursing home receiving hospice care) may have a lower risk of end-of-life hospitalization compared to non-hospice residents in facilities with low or no hospice presence. Using an instrumental variable method we examined whether residing in facilities with a higher hospice penetration: 1) reduces the risk of hospitalization for non-hospice residents (the spill-over effect); and 2) decreases hospice residents' risk of hospitalization relative to hospice residents in facilities with a lower hospice penetration (the expertise effect).

METHODS

Data and Population

The Medicare beneficiary file was linked with the Minimum Data Set (MDS) to identify nursing home residents who died in 2005 - 2007. We extracted resident-level characteristics from each resident's last MDS assessment. Medicare inpatient and hospice claims were used to identify hospitalization events and hospice use at the end of life. The Provider of Services (POS) file was used to identify facility characteristics and the locations of nursing homes, hospices and hospitals. The Area Resource File (ARF) provided county-level characteristics.

All Medicare and/or Medicaid certified US nursing homes were eligible for this study, except for facilities with fewer than 20 decedents during the study period. Long-stay residents (those who stayed in their last nursing home for more than three months) who died between 2005 and 2007 were included. Residents who enrolled in managed care plans or

who were in coma were excluded. Overall, 747,641 residents in 14,030 nursing homes (87.86% of the total) were included the analytical sample.

Analytical Approach

The study outcome was any hospital admission in the last 30 days of life. The key independent variable was facility hospice penetration, defined as the proportion of decedents who received hospice care in the last 30 days of life. Other covariates were identified based on a review of the literature and consultation with clinical experts. [15] Staffing and proportion of Medicare and Medicaid residents were not used as covariates in the final models, despite the literature showing an association with risk of hospitalization, [15,16] due to potential endogeneity. We conducted a sensitivity analysis estimating the models with these variables and the results from the sensitivity analysis did not change the study findings.

We used an instrumental variable (IV) approach to address endogeneity between hospice penetration and residents' risk of hospitalization. [17] Nursing homes with more expertise of palliative care may be less likely to hospitalize residents at the end of life and more likely to refer residents to hospice. Ignoring this possible endogeneity and attributing reduced hospitalization risk among non-hospice residents to hospice penetration may lead to erroneous conclusions, impacting policies and practice. An IV has to: a) be correlated with the endogenous "treatment" variable; and b) not directly affect the outcome variable (i.e. the IV can only influence the outcome through the "treatment" variable). Distance between each nursing home and the closest hospice satisfies these two conditions. First, it was shown that nursing home residents were more likely to use hospice when such were available within 15 miles of their nursing homes. [14] Hospice's location is not related to a nursing home's location. Overall, less than one third of hospice enrollees are in nursing home and a very small group of hospices (about 8%) have two-thirds or more of their enrollees residing in nursing homes.[18] Second, distance from each nursing home to the closest hospice should not directly impact individual residents' risk of hospitalization.

To empirically test the appropriateness of distance as an IV we followed Staiger and Stock who argued that an incremental F-statistic greater than 10 supports the correlation between the instrument and the endogenous variable.[19] We also applied Stock and Yogo's suggested criterion for weak instruments: for a 5% Wald tests for a hypothesized β less than 0.1, Stock and Yogo indicated that the first-stage F-statistic for the instrumental variable should be greater than 22.3.[20] For the sample of non-hospice residents, the distance was negatively related to hospice penetration ($\beta = -0.012$, $p < .001$), with an incremental F-statistic of 53.58. For the sample of hospice residents, the distance was also negatively associated with hospice penetration ($\beta = -0.017$, $p < .001$), with an incremental F-statistic of 46.92. Thus, the instrumental variable met both Staiger-Stock criterion and Stock- Yogo criterion.

We estimated probit models with an endogenous regressor—instrumented by the IV— and robust standard errors, separately for the non-hospice and hospice residents. In order to compare these results with those estimated without addressing endogeneity, we also fit probit regression models without the IV, but with facility random-effects and covariates. The study received exemption from the University of Rochester IRB.

RESULTS

Sample Characteristics

The characteristics of the national sample of facilities are depicted in Table 1. In the average facility, 28.31% of residents received Medicare hospice care in the last 30 days of life. On average, a nursing home was located 7.15 miles from its closest hospice and 3.01 miles from the closest hospital. Individual characteristics, by hospice use status, are presented in Table 2. Almost 38% of non-hospice residents were hospitalized in the last 30 days of life. Among residents who used hospice during the last 30 days of life, 23.18% also had at least one hospitalization.

Hospice Effect on Hospitalization

Table 3 presents the coefficient estimates and marginal effects for hospice penetration from both the instrumental variable and the random-effects models (which did not address endogeneity and was for comparison).

Spill-over effect—The results for the non-hospice sample support the spill-over effect ($\beta = -0.136$; $p < .001$). The marginal effect suggests that when living in a facility with a 10% higher hospice penetration, a non-hospice resident's risk of hospitalization at the end-of-life was reduced by 5.1 percentage points, or 13.56% of the national average of hospitalization risk for non-hospice residents (37.63%, Table 2). The results from the random-effects model (which did not adjust for endogeneity of the hospice penetration) showed the opposite, i.e., that higher hospice penetration was positively related to non-hospice residents' risk of hospitalization at the end-of-life ($\beta = 0.029$; $p = <.001$).

Expertise effect—In the hospice sample, both estimates from the IV model and the random-effects model showed a negative relationship between hospice penetration and risk of end-of-life hospitalization ($p < .001$ for both models), but the estimate from the random-effects model ($\beta = -0.039$) substantially underestimated the size of the effect compared to the IV model ($\beta = -0.164$). The marginal effect from the IV model indicated that for a 10% increase in the facility-level hospice penetration, hospice users' risk of hospitalization in the last 30 days of life was lower by 4.8 percentage points.

Factors Associated with End-of-life Hospitalization (Table 4)

Several facility characteristics were associated with residents' risk of end-of-life hospitalization. For-profit facilities and those with chain membership were more likely to hospitalize non-hospice residents at the end-of-life ($\beta = 0.112$; $p < .001$ and $\beta = 0.033$; $p = 0.002$, respectively), but less likely to hospitalize hospice residents ($\beta = -0.039$; $p = 0.034$ and $\beta = -0.074$; $p < .001$, respectively). The risk of end-of-life hospitalization in nursing homes located closer to a hospital ($\beta = -0.003$; $p = 0.003$) or in a county with more hospital beds ($\beta = 0.005$; $p = 0.018$) was higher for non-hospice residents, but not for those receiving hospice care. Several individual factors were associated with the risk of end-of-life hospitalization for both non-hospice and hospice residents.

DISCUSSION

In this study we empirically demonstrated that living in facilities with a higher hospice penetration reduces non-hospice residents' risk of hospitalization (spill-over effect) and decreases hospice residents' hospitalization risk, relative to those in facilities with a lower hospice penetration (expertise effect). While hospice enrollment has been shown to reduce enrollees' risk of hospitalization in nursing homes, [14,21,22] the present study focused on the effect of hospice penetration at the facility-level on reducing all residents' risk of hospitalization (regardless of individual hospice enrollment status) and is the first, to our knowledge, to address the endogeneity in facility-level hospice penetration. Our random-effects models confirmed that the endogeneity can bias the evaluation of the hospice effect.

The spill-over and expertise effects of hospice found in the present study suggest that nursing home staff's exposure to palliative care provided by hospice staff may influence the way in which nursing home staff care for end-of-life residents. More exposure to the provision of palliative care may improve nursing home staff competencies in providing such care to all residents. Thus the spill-over effect may improve end-of-life care for non-hospice residents. In addition to the end-of-life appropriate care provided by hospice staff, hospice residents may also benefit from nursing home staff's improved end-of-life care competencies. More collaboration between nursing home and hospice staff may bring about more effective and efficient communication between the two parties, which may result in more successful attempts in preventing potentially avoidable end-of-life hospitalizations for both hospice and non-hospice residents. Additionally, more collaboration with hospice may allow nursing home staff to recognize residents' terminal status and the need to provide palliative care in a more timely fashion, which may result in earlier hospice enrollment and therefore lower risk of hospitalization in the last 30 days of life. Future analysis should examine the relationships between hospice penetration and the timing of hospice enrollment, which can be identified using Medicare hospice claims, and between the timing of the hospice enrollment and the risk of hospitalization in the last 30 days of life.

At the same time, one may wonder if the spill-over effect indeed leads to better quality of care for non-hospice residents at the end of life. If the non-hospice residents had actively chosen not to be on hospice (which may indicate their preferences for curative treatments), they may not find the lower rate of hospitalization in facilities with higher hospice penetration to be an appropriate care practice for them. Further research, which takes into account resident preferences, is needed to ascertain the value of the spill-over effect.

The present study extends the literature on hospice effect on government healthcare expenditures on nursing home residents. Given that hospitalizations in nursing home residents is responsible for a considerable portion of Medicare cost, our findings can contribute to a more comprehensive and complete understanding of hospice's effect on government healthcare expenditures. The current literature does not indicate overall cost savings for long-stay nursing home residents who enrolled in hospice relative to those who did not use hospice.[23,24] However, considering the sizable spill-over effect, future analyses may need to: 1) use the facility as the unit of analysis; and 2) compare the expenditures for non-hospice residents across facilities with various hospice penetration.

A few caveats need to be mentioned. First, medical staff availability and characteristics were not available and therefore not controlled for. Second, we used the address of hospices' primary location for the distance between each nursing home and the closest hospice. Some hospices may have satellite offices, but we did not have data on the locations of the satellite offices. If satellite offices are included, the average distance between a nursing home and a hospice should decrease and the relationship between the distance and hospice penetration should thus be stronger. Finally, it is noteworthy that around the time for which the data was used for this study, the number of hospice providers nationwide grew dramatically. Many nursing homes that may have been at different and larger distances from hospices in the 1990s had a hospice provider much closer around mid-2000s. This means that some nursing homes (with different rates of hospitalization and hospice penetration) became at similar distances from a hospice provider (the variance of the distribution of the distance decreased). Thus, although the instrumental variable (distance between each nursing home and the closest hospice) passed both Staiger-Stock test for valid instrument and Stock- Yogo test for weak instrument, it is still possible that distance did not fully correct for inherent facility differences that influence hospice penetration. To the extent that these uncorrectable inherent facility differences also influence residents' risk of hospitalization, our results may overestimate the spill-over effect and the expertise effect.

In conclusion, we demonstrate that in addition to hospice's effect on reducing enrollees' risk of hospitalization, higher facility-level hospice penetration has a spill-over effect on non-hospice residents and an expertise effect on hospice residents.

Acknowledgments

FOUNDING This work was supported by National Institute of Nursing Research R01 0727.

REFERENCE

1. Flory J, Young-Xu Y, Gurol P, et al. Place of death: US trends since 1980. Health Aff. May-Jun; 2004 23(3):194–200.
2. Weitzen S, Teno JM, Fennell M, Mor V. Factors associated with site of death -A national study of where people die. Med care. Feb; 2003 41(2):323–335. [PubMed: 12555059]
3. Gruneir A, Mor V, Weitzen S, et al. Where people die: a multilevel approach to understanding influences on site of death in America. Med Care Res Rev. Aug; 2007 64(4):351–378. [PubMed: 17684107]
4. National Center for Health Statistics. Mortality Data, Multiple Cause-of-Death Public-Use Data Files. Worktable 309. Deaths by place of death, age, race, and sex: United States, 1999-2005. National Center for Health Statistics; Jun 06. 2008 Worktable 309
5. Shield RR, Wetle T, Teno J, et al. Vigilant at the End of Life: Family Advocacy in the Nursing Home. J Palliat Med. May; 2010 13(5):573–579. [PubMed: 20420548]
6. Miller SC, Gozalo P, Mor V. Hospice enrollment and hospitalization of dying nursing home patients. Am J Med. Jul; 2001 111(1):38–44. [PubMed: 11448659]
7. Gozalo P, Teno JM, Mitchell SL, et al. End-of-Life Transitions among Nursing Home Residents with Cognitive Issues. N Engl J Med. Sep; 2011 365(13):1212–1221. [PubMed: 21991894]
8. Ouslander JG, Weinberg AD, Phillips V. Inappropriate hospitalization of nursing facility residents: A symptom of a sick system of care for frail older people. J Am Geriatr Soc. Feb; 2000 48(2):230–231. [PubMed: 10682957]

9. Boockvar KS, Gruber-Baldini AL, Burton L, et al. Outcomes of infection in nursing home residents with and without early hospital transfer. J Am Geriatr Soc. Apr; 2005 53(4):590–596. [PubMed: 15817003]
10. Creditor MC. Hazards of Hospitalization of the Elderly. Ann Intern Med. Feb 1; 1993 118(3):219–223. [PubMed: 8417639]
11. Fried TR, Gillick MR, Lipsitz LA. Short-term functional outcomes of long-term care residents with pneumonia treated with and without hospital transfer. J Am Geriatr Soc. Mar; 1997 45(3):302–306. [PubMed: 9063275]
12. Saliba D, Kington R, Buchanan J, et al. Appropriateness of the decision to transfer nursing facility residents to the hospital. J Am Geriatr Soc. Feb; 2000 48(2):154–163. [PubMed: 10682944]
13. Ouslander JG, Lamb G, Perloe M, et al. Potentially Avoidable Hospitalizations of Nursing Home Residents: Frequency, Causes, and Costs. J Am Geriatr Soc. Apr; 2010 58(4):627–635. [PubMed: 20398146]
14. Gozalo PL, Miller SC. Hospice enrollment and evaluation of its causal effect on hospitalization of dying nursing home patients. Health Serv Res. Apr; 2007 42(2):587–610. [PubMed: 17362208]
15. Grabowski DC, Stewart KA, Broderick SM, Coots LA. Predictors of nursing home hospitalization - A review of the literature. Med Care Res Rev. Feb; 2008 65(1):3–39. [PubMed: 18184869]
16. Intrator O, Castle NG, Mor V. Facility characteristics associated with hospitalization of nursing home residents - Results of a national study. Med care. Mar; 1999 37(3):228–237. [PubMed: 10098567]
17. Newhouse JP, McClellan M. Econometrics in outcomes research: The use of instrumental variables. Annu Rev Public Health. 1998; 19:17–34. [PubMed: 9611610]
18. Office of Inspector General. Medicare hospices that focus on nursing facility residents. Department of Health & Human Services Office of Inspector General; Washington DC: 2011. OEI-02-10-00070
19. Staiger D, Stock JH. Instrumental variables regression with weak instruments. Econometrica. 1997; 65(3):557–586.
20. Stock, JH.; Yogo, M. Testing for Weak Instruments in Linear IV Regression. In: Andrews, DWK.; Stock, JH., editors. Identification and Inference for Econometric Models: Essays in Honor of Thomas J. Rothenberg. Cambridge University Press; 2005.
21. Mukamel DB, Caprio T, Ahn R, et al. End-of-life quality-of-care measures for nursing homes: place of death and hospice. J Palliat Med. Apr; 2012 15(4):438–446. [PubMed: 22500481]
22. Zheng NT, Mukamel DB, Caprio T, et al. Racial Disparities in In-hospital Death and Hospice Use Among Nursing Home Residents at the End of Life. Med care. Nov; 2011 49(11):992–998. [PubMed: 22002648]
23. Gozalo PL, Miller SC, Intrator O, et al. Hospice effect on government expenditures among nursing home residents. Health Serv Res. Feb; 2008 43(1):134–153. [PubMed: 18211522]
24. Miller SC, Intrator O, Gozalo P, et al. Government expenditures at the end of life for short- and long-stay nursing home residents: differences by hospice enrollment status. J Am Geriatr Soc. Aug; 2004 52(8):1284–1292. [PubMed: 15271115]

Highlights

- We tested the spill-over & expertise effects of hospice on NH hospitalization risk.
- We addressed the endogeneity between hospice use and hospitalization.
- We confirmed both the spill-over and the expertise effects.
- The findings shed light on NH end-of-life care delivery and provider collaboration.
- We made recommendations on cost benefit analysis of hospice care.

Table 1

Facility characteristics for the national sample of nursing homes

Facility characteristics	**N = 14,030 %/ mean (SD)**
Hospice penetration	28.31% (21.05%)
Distance to the closest hospice (miles)	7.15 (10.08)
Size (bed × occupancy occupancy rate)	94.15 (58.10)
For-profit	68.00%
Chain membership	54.40%
Hospital based	17.27%
Hospice ownership	0.18%
Distance to the closest hospital (miles)	3.01 (4.92)
Number of hospital beds per 100 people age 65+ in the county	4.07 (3.05)

Table 2

Individual characteristics by hospice status

Individual characteristics	Non-hospice n=505,851 (67.66%) %/ mean (SD)	Hospice n=241,790 (32.34%) %/ mean (SD)	p-value
Rate of end-of-life			<.01
hospitalization	37.63%	23.18%	
Year of death			<.01
2005	37.34%	31.82%	
2006	33.27%	34.24%	
2007	29.40%	33.95%	
Age	86.76 (7.76)	86.57 (7.61)	<.01
Female	70.05%	72.52%	<.01
Race =Non-Hispanic White	87.57%	88.69%	<.01
Married	20.08%	21.16%	<.01
Education			<.01
Unknown	21.05%	18.06%	
Less than high school	28.79%	25.73%	
High school	31.33%	35.23%	
More than high school	18.37%	20.98%	
DNR	71.03%	75.58%	<.01
DNH	6.19%	8.25%	<.01
Activities of Daily Living (0-28)	21.03 (6.84)	22.07 (6.20)	<.01
Cognitive Performance Scale			<.01
(1-7)	4.54 (1.76)	4.73 (1.71)	
Diabetes	29.52%	27.46%	<.01
Number of Heart/ circulation			<.01
diseases	1.55 (1.12)	1.50 (1.11)	
Number of Neurological			0.30
diseases	0.34 (0.57)	0.35 (0.57)	
Asthma/ COPD	23.57%	22.48%	<.01
Cancer	9.73%	13.85%	<.01
Renal failure	10.14%	9.88%	<.01
Alzheimer’s disease	22.42%	24.71%	<.01
Parkinson’s disease	8.07%	8.73%	<.01
Urinary tract infection	15.76%	16.56%	<.01
Pneumonia	9.00%	8.47%	<.01
Septicemia	1.44%	1.39%	0.10
Viral hepatitis	0.07%	0.08%	0.53
HIV infection	0.02%	0.02%	0.56
Internal bleeding	1.30%	1.34%	0.09
Fracture	5.63%	5.86%	<.01

Individual characteristics	Non-hospice n=505,851 (67.66%) %/ mean (SD)	Hospice n=241,790 (32.34%) %/ mean (SD)	p-value
Surgical wound	6.29%	5.75%	<.01
Ulcers (stage two and higher)	21.75%	25.36%	<.01
NH length of stay (days)	817.99 (538.34)	793.90 (537.70)	<.01
Imputation indicator[a]	71.30	63.97	<.01

[a] Imputation indicator takes value one if the residents has quarterly assessment as their last MDS assessment.

Table 3

Effect of hospice penetration on end-of-life hospitalization

	Estimates for Hospice penetration* (per 10% increase)							
	Non-hospice Sample N = 505,851				Hospice Sample N = 241,790			
Model	**Beta**	**Robust SE**	**P-value**	**Marginal effect**	**Beta**	**Robust SE**	**P-value**	**Marginal effect**
Instrumental variable model	−0.136	0.036	<.001	−0.051	−0.164	0.037	<.001	−0.048
Random-effects model	0.029	0.002	<.001	0.011	−0.039	0.003	<.001	−0.011

* Instrumented by distance to the closest hospice and all other covariates. The incremental F-statistic for the instrumental variable was 53.58 in the non-hospice sample and 46.92 in the hospice sample.

Table 4

Factors associated with end-of-life hospitalization: results from the instrumental variable models

	Non-hospice Sample N = 505,851			Hospice Sample N = 241,790		
	Beta	**Robust SE**	**p-value**	**Beta**	**Robust SE**	**p-value**
Hospice penetration *	*−0.136*	*0.036*	*<.001*	*−0.164*	*0.037*	*<.001*
Individual characteristics						
Year of death (ref = 2005)						
2006	−0.014	0.005	0.006	−0.040	0.008	<.001
2007	−0.002	0.006	0.730	−0.044	0.010	<.001
Age (ref = younger than 80)						
80-90	−0.045	0.005	<.001	0.105×10^{-3}	0.008	0.990
90 and older	−0.179	0.007	<.001	−0.064	0.011	<.001
Female	−0.078	0.005	<.001	−0.096	0.007	<.001
Not Non-Hispanic White	0.128	0.008	<.001	0.072	0.013	<.001
Married	−0.002	0.005	0.662	0.012	0.008	0.147
Education (ref = less than high school)						
Unknown	−0.084	0.009	<.001	−0.064	0.011	<.001
High school	0.004	0.008	0.647	−0.015	0.009	0.115
More than high school	−0.028	0.012	0.024	−0.043	0.013	0.001
NH length of stay	0.072×10^{-3}	0.011×10^{-3}	<.001	0.114×10^{-3}	0.167×10^{-4}	<.001
NH length of stay ^2	-0.040×10^{-6}	0.046×10^{-7}	<.001	-0.497×10^{-7}	0.072×10^{-7}	<.001
DNR	−0.350	0.006	<.001	−0.326	0.009	<.001
DNH	−0.474	0.014	<.001	−0.340	0.015	<.001
Activities of Daily Living (0-28)	−0.006	0.001	<.001	−0.014	0.001	<.001
Cognitive performance (1-7)	−0.047	0.002	<.001	−0.011	0.002	<.001
Diabetes	0.094	0.004	<.001	0.093	0.007	<.001
Number of heart/ circulation diseases	0.048	0.002	<.001	0.043	0.003	<.001

	Non-hospice Sample N = 505,851			Hospice Sample N = 241,790		
	Beta	**Robust SE**	**p-value**	**Beta**	**Robust SE**	**p-value**
Number of neurological diseases	0.026	0.004	<.001	0.032	0.005	<.001
Asthma/ COPD	0.085	0.006	<.001	0.017	0.007	0.025
Cancer	−0.138	0.008	<.001	−0.277	0.010	<.001
Renal failure	0.079	0.007	<.001	0.114	0.010	<.001
Alzheimer's disease	−0.081	0.006	<.001	−0.026	0.008	0.001
Parkinson's disease	−0.018	0.007	0.010	−0.004	0.011	0.685
Urinary tract infection	0.279	0.007	<.001	0.309	0.009	<.001
Pneumonia	0.270	0.007	<.001	0.301	0.011	<.001
Septicemia	0.137	0.016	<.001	0.197	0.024	<.001
Viral hepatitis	−0.016	0.067	0.809	−0.007	0.103	0.944
HIV infection	−0.086	0.141	0.544	−0.427	0.223	0.056
Internal bleeding	0.007	0.018	0.698	0.136	0.025	<.001
Fracture	0.184	0.009	<.001	0.197	0.012	<.001
Surgical wound	0.087	0.008	<.001	0.122	0.013	<.001
Ulcers	0.066	0.006	<.001	−0.038	0.008	<.001
Imputing indicator	0.067	0.005	<.001	−0.034	0.007	<.001
Facility and environmental characteristic						
Size (bed × occupancy)	0.012×10^{-2}	0.009	0.184	-0.113×10^{-3}	0.924×10^{-4}	0.222
For-profit	0.112	0.010	<.001	−0.039	0.019	0.034
Chain membership	0.033	0.011	0.002	−0.074	0.011	<.001
Hospital based	−0.007	0.014	0.638	−0.027	0.014	0.050
Hospice ownership	0.125	0.108	0.246	−0.028	0.190	0.883
Distance to the closest hospital	−0.003	0.001	0.003	0.001	0.001	0.330
Number of hospital beds per 100 people 65+ in the county	0.005	0.002	0.018	0.002	0.001	0.172
C-statistic		0.672			0.646	

*Instrumented by distance to the closest hospice and all other covariates. The incremental F-statistic for the instrumental variable was 53.58 in the non-hospice sample and 46.92 in the hospice sample. Beta coefficients of state dummies not shown

J Am Med Dir Assoc. Author manuscript; available in PMC 2016 February 01.