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Associations of Hospice Disenrollment and Hospitalization with Continuous Home Care Provision

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Abstract

Objectives—To examine rates of hospice disenrollment and post-hospice hospitalization among patients that are enrolled in hospices that provide CHC (CHC hospices) compared with patients who are enrolled in hospices that do not offer CHC (non-CHC hospices).

Methods—We performed a retrospective cohort study among Medicare fee-for-service decedents between July and December 2011, who were 66 years and older and had used hospice in their last 6 months of life. We used propensity score matching to account for potential confounding characteristics of hospices. Generalized estimating equation models were applied to estimate between CHC hospices and non-CHC hospices the associations of hospice disenrollment/hospitalization, adjusted for patient characteristics. We also conducted subgroup analyses to examine how the association might have differed by hospice size, and by the percentage of enrollees who received CHC.

Results—After matching, we identified 936 pairs of CHC and non-CHC hospices, well balanced in terms of organizational characteristics. In fully adjusted models, compared with non-CHC hospices, CHC hospices had significantly lower disenrollment rates (adjusted rate ratio [ARR]: 0.73, 95% confidence interval [CI]: 0.60–0.87), and lower hospitalization rates (ARR: 0.79, 95% CI 0.66–0.95). These associations were significantly more pronounced among larger hospices (those with more than 175 enrollees during study period), and among hospices in which at least 7.3% of enrollees used CHC.

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Conclusions—CHC hospices had significantly lower rates of hospice disenrollment and post-hospice hospitalization, suggesting CHC service available may enable higher quality of end-of-life care.

Keywords

Hospice; Continuous home care; Hospice disenrollment; End-of-life care

Introduction

Hospice has been embraced as an indicator of high quality in end-of-life care¹, but even among hospice enrollees, disenrollment and hospitalization rates are substantial^{2,3}. Recent evidence has indicated that more than 10% of hospice users experience disenrollment from hospice before death, and approximately half of them are hospitalized⁴. Among nursing home residents, 24% of hospice users experienced post-hospice hospitalization in the last 30 days of life⁵. Disenrollment and hospitalization not only produce substantial patient and family burden⁶ but also increase costs of care at the end of life⁷.

Previous studies have examined factors associated with hospice disenrollment and post-hospice hospitalization. Patient comorbidity has been found significantly associated with increased rates of disenrollment and hospitalization⁸. Hospice-level characteristics also play important roles, as the disenrollment rates have been found to be higher in newer hospices, smaller hospices, and hospices in more competitive markets⁴. Another important factor is the level of hospice care provided. Among 4 levels of hospice care, continuous home care (CHC) provides intensive care at home and has the highest reimbursement rate^{9,10}. Medicare regulations require that CHC may be provided only during a period of crisis to maintain an individual at home. During a 24-hour day, the hospice must provide a minimum of 8 hours of nursing, hospice aide, and/or homemaker care, and the services provided must be predominantly nursing care⁹. Although studies have found that patients who use CHC are less likely to disenroll or be hospitalized in last 6 months of life^{11–13}, no studies have examined whether hospices that offer CHC (CHC hospices) compared to those do not (non-CHC hospices) differ in terms of disenrollment and post-hospice hospitalization rates. Furthermore, we do not know how the effect of CHC provision may differ for larger and smaller hospices. Nor do we know if a threshold effect exists, by which hospices in which at least some percentage of patients use CHC have lower disenrollment and hospitalization rates.

Accordingly, we conducted an exploratory study to examine the hospice-level variation of hospice disenrollment and post-hospice hospitalization rates. We hypothesized that CHC hospices would have lower hospice disenrollment and hospitalization rates compared to non-CHC hospices. We also anticipated that this effect would be more pronounced for larger hospices and for those in which a larger percentage of patients used CHC. We applied a novel approach to mimic a cluster randomized controlled trial. Using propensity score matching (PSM) approach, we identified and compared CHC and non-CHC hospices with similar hospice characteristics (ownership, geographic region, size, and operation duration). Findings from this study could advance our understanding of potential benefits of CHC,

particularly as hospice disenrollment and hospitalization have been linked with significantly increased costs at the end of life.

Methods

Study design and sample

We designed a retrospective cohort study with a population of all fee-for-service Medicare beneficiaries older than 66 years who died between July 1, 2011 and December 31, 2011. We retrieved their demographics and chronic conditions from the Master Beneficiary Summary File, as well as inpatient and hospice Medicare claims in the 6 months prior to death. Using their hospice claim data, we limited the study population to those who had at least 1 hospice claim to the Centers for Medicare & Medicaid Services (CMS) within 6 months before death. We obtained hospice characteristics from the Provider of Services (POS) file. Applying PSM, we assessed the relationship between CHC provision and rates of hospice disenrollment and post-hospice hospitalization. For the hospices, we excluded hospices that had 14 or fewer enrollees during the study period ($n=720$) and had missing hospice characteristics ($n=11$). The institutional review board of Yale University have reviewed the study, which was exempt from full review.

Intervention and outcome ascertainment

Per CMS Manual System^{14, 15}, we used the revenue center code values of 0652 to determine which hospice programs provided CHC based on the definition of having at least 1 patient who received CHC during the study period. To ascertain outcomes, we created 2 binary variables to indicate if the patient got disenrolled from hospice or if the patient was hospitalized after hospice disenrollment. Hospice disenrollment was defined as if: first, they had only 1 hospice enrollment period and the last hospice date on the final hospice claim was not the date of death; or second, if they had >1 hospice enrollment period. Hospitalization was determined by the presence of hospitalization claims. For the decedent who had more than 1 hospice provider in the study period, we assigned the first hospice provider to the decedent in the analyses.

Statistical Analysis

Propensity Score Matching (PSM) and Hospice-Level Covariates—To minimize the selection bias at the hospice level, we employed the PSM method, which mimics a cluster randomized controlled trial in our observational setting. Using logistic regression, including four hospice covariates listed in the previous section, we estimated for each hospice the probability of providing CHC. The PSM controlled for four hospice characteristics: Using the POS file, we determined hospice ownership type (for-profit and non-profit), hospice's location (rural vs. urban), and duration of hospice operation (years: <10 , 10–18, 19–23, and ≥ 24). We also counted the number of admissions (measured as the number of individuals enrolled during the study period by each hospice) and categorized it into quartiles.

We used 1:1 nearest neighbor matching without replacement. The caliper was set as 0.75 standard deviation to maximize sample size and to ensure matching quality. Each matched

pair contained a CHC hospice and a non-CHC hospice with similar hospice characteristics. Balance diagnostics were assessed by comparing prevalence of baseline characteristics using standardized differences (expressed as a percentage)¹⁶. Prior research has suggested that a standardized difference (absolute value) ≥ 10 indicates meaningful imbalance in the baseline covariate¹⁷.

Fully Adjusted Model and Patient-Level Covariates—In our fully adjusted model, we analyzed hospice users enrolled in the matched hospices, controlling for patient-level covariates. Patient demographics included age (categorized as 66–69 years, 70–74 years, 75–79 years, 80–84 years and ≥ 85 years), sex, race (non-Hispanic white, non-Hispanic black, Hispanic and other), primary diagnosis for hospice enrollment (including neoplasms, mental disorders, disease of nervous system, disease of circulatory system, disease of respiratory system, illness-defined conditions and other). Using data from the Master Beneficiary Summary File, we ascertained 8 chronic conditions, including heart disease, Alzheimer's disease or dementia, kidney disease, diabetes, chronic obstructive pulmonary disease or asthma, depression, stroke, and cancer. We then categorized decedents based on their count of comorbid conditions. We also adjusted for time from hospice enrollment to death (a continuous variable from 0 day to 179 days). We identified the county of residence for each beneficiary using zip code information. We examined data pertaining to the county in which the patient resided using the Area Resource File. We then constructed two ecological variables, including median county-level income and percentage of adults in the county with a high school education or less.

Primary analysis—In the matched sample, we examined the mean percentage of hospice disenrollment and post-hospice hospitalization at hospice level for CHC hospices and non-CHC hospices. We used Poisson regression models, clustering enrollees by individual hospices, to examine rates of hospice disenrollment and hospitalization between CHC hospices vs non-CHC hospices. The generalized estimating equation models were also clustered by matched sets to allow for correlation between matched pairs of hospices by status of CHC provision. For each outcome of interest, we further adjusted for decedents characteristics, as described in the previous section. Adjusted rate ratios (ARRs) were reported. We used at least 15 hospice enrollees per hospice in our analyses to avoid biased regression coefficients¹⁸. We also conducted sensitivity analyses, using the cut-off value of 5 or 25 hospice enrollees.

Subgroup analysis—We conducted additional subgroup analyses to explore whether the associations between CHC and outcomes differed by hospice characteristics. We acknowledged that the pair in the propensity score-matched sample might have unmatched characteristics. For instance, a non-profit CHC hospice could match with a for-profit non-CHC hospice. Therefore, we included the whole eligible hospices and enrollees prior to PSM, and used Poisson regression models, controlling for patient and hospice characteristics and including interaction terms between CHC status and hospice characteristics. Subgroup analyses were conducted for those hospice characteristics where a significant interaction exists. We dichotomized hospice size and duration of operation into large vs. small hospices and young vs. old hospices, based on the median number of enrollees or median length of

operation in our sample. Subgroup analyses on percentage of CHC use were performed among the post-PSM population because there was no mismatching issue. Using our propensity score-matched sample, we categorized CHC hospices into quintiles based on the percentage of enrollees who received CHC. Each subgroup contained CHC hospice in this quintile and their matched non-CHC hospices. We examined the ARR for each subgroup. All analyses were conducted using SAS (Version 9.4; SAS Institute, Cary, NC). Tests were two sided with an α of .05.

Results

Sample characteristics

Our original sample consisted of 311,090 hospice users in 3,509 hospices. After excluding hospice with 14 or fewer enrollees or those with missing hospice characteristics, we retained data for 305,498 Medicare hospice users (98.2% of the original sample) who were enrolled in 2,778 hospices (Appendix Figure). Among these hospices, 1,100 (39.6%) hospices provided CHC services to at least one of their enrollees. After PSM, we generated 936 hospice pairs, each containing 1 CHC hospice and 1 non-CHC hospice. Those hospices we excluded through PSM were more likely to be non-profit and rurally-located. After matching, hospice characteristics between those who provided CHC and those who did not were well balanced, with standardized differences less than 10%. A total of 103,803 decedents were enrolled in CHC hospices and 88,869 decedents were enrolled in non-CHC hospices (Table 1). Although patient characteristics were not included in the model for PSM, they were also well balanced, with the exception that decedents who had lived in zip codes in which more than 90% of the population had a high school education or less were more common in non-CHC hospices (standardized difference, -10.9). In CHC hospices, the crude mean percentage of decedents who had hospice disenrollment was 12.9% and the percentage of decedents who had post-hospice hospitalization was 7.5%; whereas in non-CHC hospices, the crude percentage was 12.0% and 6.8%, respectively (Table 2).

Hospice offering of CHC and disenrollment and hospitalization rates

When we clustered hospice enrollees by hospices and adjusted for patient characteristics, the ARRs between CHC hospices vs non-CHC hospices on hospice disenrollment or hospitalization were statistically significantly different from 1 (Table 3). Compared with non-CHC hospices, CHC hospices had a significantly lower rate of hospice disenrollment (ARR = 0.73; 95% CI: 0.60–0.87; p-value <.001) and a significantly lower rate of hospitalization (ARR = 0.79; 95% CI: 0.66–0.95; p-value =.014). Hospice enrollees who were older, female, or white were less likely to have hospice disenrollment or post-hospice hospitalization, compared with those who were younger, male, or non-whites (p-value <.05).

Interaction and subgroup analyses

We found a statistically significant interaction with hospice size (interaction p-value <.001 for hospice disenrollment and p-value <.002 for hospitalization), in which the association between being a CHC hospice and hospice disenrollment or hospitalization differed by the hospice size. Among small hospices (175 enrollees in the study period), offering CHC was not significantly associated with the outcomes of interest, with ARRs of 0.92 (95% CI:

0.83–1.02) for hospice disenrollment rates and 0.97 (95% CI: 0.86–1.08 for hospitalization rates (Figure 1). In contrast, among large hospices (176 or more enrollees in the study period), offering CHC was associated with decreased hospice disenrollment and hospitalization rates, with ARR of 0.52 (95% CI: 0.42–0.64) and 0.61 (95% CI: 0.49–0.76), respectively. Interaction effects were not significant for ownership type, urban/rural location, or duration of hospice operation (p-values > .20 except .07 for location with hospitalization rate).

We also found that the associations between enrollment in CHC hospice and the likelihood of hospice disenrollment were significantly modified by the percentage of patients who received CHC (Figure 2A). Among hospices where the fewer than 7.3% of patients used CHC (the lowest three quintiles), the effect of being cared for by a CHC hospice on disenrollment was non-significant. For instance, CHC hospices in which less than 7.3% of enrollees used CHC had an ARR of 0.98 (95% CI: 0.78–1.22) on hospice disenrollment, compared with their matched non-CHC hospices. In contrast, among hospices with at least 7.3% but less than 20.8% of patients using CHC (the second highest quintile), the effect was significant as the ARR of hospice disenrollment for CHC vs. non-CHC hospices was 0.52 (95% CI: 0.35–0.77). Interestingly, among hospices in which CHC was used by more than 20.8% of enrollees (highest quintile), the ARR of hospice disenrollment in comparison to non-CHC hospices did not further decrease (ARR = 0.56; 95% CI: 0.36–0.88). Similar patterns were apparent for the outcome of post-hospice hospitalization rate (Figure 2B). Sensitivity analyses, varying the cut-off value of 5 or 25 enrollees, reached similar conclusions (data not shown; available from the first author upon request).

Discussion

While the Medicare Hospice Benefit requires hospices to provide CHC, less than half of hospice providers had CHC claims in 2011. In this study, we found that hospices that provided CHC services had lower rates of hospice disenrollment or hospitalization than hospices which did not provide CHC services. Previous evidence has suggested that within CHC hospices, hospice enrollees who use CHC services may have better outcomes, including a decrease in hospice disenrollment or hospitalization at the end of life^{11–13}. Prior studies, however, analyzed data of CHC hospice enrollees only and were unable to examine whether hospice's offering of CHC may mitigate risks of disenrollment and hospitalization. In this first study comparing CHC and non-CHC hospices, we found that CHC hospices perform better in terms of reduced disenrollment and hospitalization, providing important information for patients and their family or physicians considering alternative hospice providers. The findings may also be useful for policy makers seeking indicators of quality in end-of-life care.

Our findings build upon previous work in important ways. First, the associations between CHC provision and hospice performance differed by hospice size. Our findings were consistent with the concept of scale economy: with increasing size, hospices may be able to provide CHC efficiently; whereas small hospices may struggle providing labor-intensive CHC services, given limited nursing staff¹⁹. According to Medicare hospice benefits, CHC services are provided by a licensed nurse for at least 50% of care hours and up to 24 hours

per day^{19, 20}. These services are offered as a last resort for those having complex needs. Furthermore, these nurses have to be considered employees of the hospice, and hospices cannot contract nurses on a regular basis to provide CHC⁹. As a consequence, small hospices are less likely to be able to provide CHC. Even if small hospices could provide CHC, they may have logistic issues, such as staffing shortage, which may compromise their performances. Enabling smaller hospices to provide CHC and routine hospice services simultaneously to their enrollees would be an important task for policy-makers who seek to promote CHC. For instance, the CMS may allow small hospices, such as those in the rural areas, to provide CHC through contracting hospitals or nurses.

Second, our findings suggest there may be a minimum percentage of patients who receive CHC services for a resulting decrease in hospice disenrollment and post-hospice hospitalization to be observed. We found that hospices which provided CHC services to a small percentage of their enrollees did not perform better than non-CHC hospices. Plausible explanations included that the CHC services offered in these hospices did not meet the needs of hospice enrollees; thus, they could not prevent disenrollment or hospitalization. For instance, these hospices might lack protocol or criteria for instituting CHC. Additionally, they might not have sufficient capacity to address enrollee's demand. Indeed, literature has suggested that the initiation of CHC is challenging²¹. Due to limited staffing, only very few patients are able to receive CHC; therefore, some hospice enrollees who need CHC to avoid disenrollment cannot get it. Staff in these hospices might also lack experience or training to provide CHC in a timely manner.

Third, we found that while hospices with 7.3–20.8% of their enrollees using CHC had significantly lower disenrollment and hospitalization rates, having even higher CHC use rates did not confer additional reductions in these outcomes. Literature suggested that the percentage of hospice enrollees who received CHC differed substantially across CHC hospices and, in some hospices, exceeded 75%^{13, 22}. There have been concerns about overuse of healthcare services in the United States²³; and there have been potential fraud hospice claims²⁴. Our results suggest that this very high utilization of CHC among some hospices is unlikely to reduce disenrollment and hospitalization rates. Although CHC use should be consistent with patient and family conditions and needs, our data suggest a potential benchmark of between 7–20% for the percentage of enrollees receiving CHC.

Fourth, we applied a novel approach to mimic a cluster randomized controlled trial. Propensity score methodology has been developed to reduce biases in outcomes research, yet most studies applying this approach created a pseudo-randomization at individual level. In this study, we used a PSM approach to create pairs, matching hospices which provided CHC services to hospices which did not provided CHC services. We identified patient characteristics and adjusted for these factors. Furthermore, we used Poisson regression clustering enrollees within each hospice; thus, we were able to mitigate potential confounding due to the hierarchical structure of data. For instance, the interpretation based on the crude percentages of post-hospice hospitalization rates in the CHC and non-CHC hospices were biased, potentially driven by small hospices. Our approach could be used to examine the effects of other interventions at hospice or hospital level.

Our findings should be interpreted in light of several limitations. As an observational design with a short time period for the study, we could not establish causal inferences, although we used PSM and adjusted for patient characteristics to reduce bias. Additionally, we defined CHC hospices when they had at least one CHC Medicare claim, which may have measurement errors. Although hospices use the revenue code 0652 to bill Medicare for CHC services and CHC has the highest reimbursement rate among 4 levels of hospice care, using this code to capture CHC has not been validated. We also acknowledge that we lack information about how and when hospices decided to offer CHC. Our results are not generalizable to the hospices excluded from our analyses because they did not have a match in our PSM process. Finally, we lacked data on patient preferences regarding CHC hospices and non-CHC hospices. It is, however, unlikely that patients who elected a CHC hospice systematically differed from those who elected a non-CHC hospices, given that the patient characteristics were very similar after propensity score matching of hospice-level characteristics. Nevertheless, understanding the patient and family roles in disenrollment and hospitalization events would help end-of-life care be consistent with patient preferences. To address this important issue, future research is needed.

In conclusion, hospices that offered CHC compared with those that did not offer CHC had significantly lower rates of hospice disenrollment and hospitalization. These effects were more prominent among hospices that were larger and had a substantial portion of enrollees using CHC services. Our findings suggest that programs to promote the offering of CHC by hospices may help avert disenrollment and hospitalization, potentially reducing unnecessary family burden and end-of-life costs of care.

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Appendix

Appendix Figure. Diagram of study population selection

CHC: Continuous home care; PSM: Propensity score matching

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Figure 1. Adjusted Rate Ratios of Hospice Disenrollment and Post-Hospice Hospitalization, CHC Hospices vs. Non-CHC Hospices According to Hospice Size, Entire Cohort*

*Reference: non-CHC hospices; Hospices with fewer than 176 enrollees during study period (median number of enrollees in our sample) were classified as small hospices.

CHC: Continuous home care

Figure 2. Adjusted Rate Ratios of Hospice Disenrollment and Post-Hospice Hospitalization, CHC Hospices vs. Non-CHC Hospices According to the Percentage of Enrollees Receiving CHC, Propensity Score Matched Sample*

*The percentage of enrollees receiving CHC were categorized into quintiles as: 1st quintile: less than 1.7%; 2nd quintile: 1.7–3.6%; 3rd quintile: 3.6–7.3%; 4th quintile: 7.3–20.8%; 5th quintile: 20.8% and above.

CHC: Continuous home care

Table 1
Hospice and Hospice Enrollee Characteristics Before and After Propensity Score Matching

Characteristics	Before Propensity Score Matching		After Propensity Score Matching	
	CHC Hospices N=1,100	Non-CHC Hospices N=1,678	CHC Hospices N=936	Non-CHC Hospices N=936
Hospice Level				
Hospice ownership				
For-profit	73.2	53.1	73.1	72.1
Non-profit	26.8	46.9	26.9	27.9
SD				
Geographical location				
Urban	85.6	65.7	83.2	83.0
Rural	14.4	34.3	16.8	17.0
SD				
Number of admissions				
1247	9.0	0.8	2.5	1.5
545–1246	15.6	7.9	12.9	13.6
241–544	25.6	20.5	26.1	23.7
<241	49.8	70.7	58.6	61.2
SD				
Years of hospice operation				
24	13.2	11.7	10.3	10.4
19–23	14.3	21.8	13.8	14.4
10–18	26.5	29.4	27.8	24.8
<10	46.1	37.1	48.2	50.4
SD				
Hospice Enrollee Level	N=173,346	N=132,152	N=103,803	N=88,869
Sex				
Male	41.5	41.9	41.3	41.4
Female	58.5	58.1	58.7	58.6
SD				
Race				
White	86.6	89.8	87.3	88.7
SD				

Characteristics	CHC Hospices	Non-CHC Hospices	SD	After Propensity Score Matching			SD
	Before Propensity Score Matching						
Black	7.4	5.9	6.3	7.3	6.5	2.9	
Hispanic	4.1	2.6	8.7	3.6	2.9	3.9	
Other	1.8	1.8	2.0	1.8	1.9	-1.3	
Age Group							
66-69	6.7	7.0	-0.9	6.6	6.8	-0.7	
70-75	10.1	10.5	-1.3	10.1	10.3	-0.8	
75-79	13.4	14.1	-1.9	13.4	13.8	-1.2	
80-84	19.4	19.5	0.03	19.5	19.3	0.6	
85+	50.1	48.9	2.6	50.4	49.8	1.1	
County-level education (high school)							
<60%	0.09	0.10	-0.4	0.1	0.1	-0.9	
60-70 %	1.23	1.99	-6.0	1.4	2.1	-5.5	
70-80%	14.36	14.52	-0.5	15.3	14.3	2.9	
80-90%	65.32	59.19	12.7	63.2	59.0	8.7	
>90%	18.99	24.20	-12.7	20.0	24.6	-10.9	
Median household income							
< \$33,000	0.59	1.15	-6.0	0.8	1.1	-2.9	
\$33,000-\$39,999	15.43	23.40	-20.3	16.9	20.8	-10.0	
\$40,000-\$49,999	38.28	38.23	0.1	38.4	37.8	-1.1	
\$50,000-\$62,999	29.72	24.47	11.8	27.9	26.1	3.9	
\$63,000	15.97	12.75	9.2	16.2	14.2	5.4	
Days of hospice stay	48.6	45.9	4.3	50.3	47.1	5.1	
Primary enrollment diagnosis							
Neoplasms	30.5	32.6	-4.5	29.9	31.0	-2.3	
Mental disorder	10.8	9.0	5.8	11.1	9.8	4.3	
Disease of nervous system	8.3	6.9	5.2	7.9	7.4	2.1	
Disease of circulatory system	18.8	17.7	2.7	18.8	17.5	3.5	

Characteristics	Before Propensity Score Matching		After Propensity Score Matching	
	CHC Hospices	SD	Non-CHC Hospices	SD
Disease of respiratory system	8.6	-0.06	8.6	8.6
Symptoms, signs, and ill-defined conditions	17.0	-4.6	18.7	19.6
Other	6.1	-1.1	6.4	6.1
Number of comorbidities				
0-2	22.9	3.8	25.5	25.1
3	21.7	-3.1	23.0	22.8
4	24.4	0.4	24.2	24.2
5	19.4	4.3	17.7	18.1
6	9.7	5.6	8.1	8.4
7-8	1.9	-6.1	1.4	1.5

CHC: Continuous home care; SD: Standardized difference

Table 2

Unadjusted Percentages of Hospice Disenrollment and Post-Hospice Hospitalization, CHC and Non-CHC Hospices, Propensity Score Matched Sample

	CHC Hospices		Non-CHC Hospices	
	Hospice disenrollment	Post-hospice hospitalization	Hospice disenrollment	Post-hospice hospitalization
Overall percentage	10.4%	6.0%	9.7%	5.0%
Mean percentage *	12.9%	7.5%	12.0%	6.8%

* The unit of analysis is hospice.

CHC: Continuous home care

Table 3

Adjusted Rate Ratio of CHC vs Non-CHC Hospices, Propensity Score Matched Sample

	Hospice Disenrollment Rate		Hospitalization Rate	
	Rate ratio (95% CI)	p-value	Rate ratio (95% CI)	p-value
Hospice Type				
Non-CHC hospice	Reference		Reference	
CHC hospice	0.73 (0.60, 0.87)	< .001	0.79 (0.66, 0.95)	.014
Sex				
Male	Reference		Reference	
Female	0.90 (0.88, 0.93)	< .001	0.92 (0.88, 0.96)	< .001
Age group				
66–69	1.31 (1.21, 1.41)	< .001	1.47 (1.33, 1.62)	< .001
70–75	1.20 (1.12, 1.28)	< .001	1.39 (1.30, 1.50)	< .001
75–79	1.18 (1.12, 1.25)	< .001	1.39 (1.31, 1.48)	< .001
80–84	1.11 (1.06, 1.16)	< .001	1.22 (1.15, 1.30)	< .001
85+	Reference		Reference	
Race				
Black	1.54 (1.35, 1.76)	< .001	2.12 (1.85, 2.42)	< .001
Hispanic	1.46 (1.25, 1.71)	< .001	1.65 (1.36, 2.01)	< .001
Other	1.41 (1.19, 1.67)	< .001	1.60 (1.33, 1.93)	< .001
White	Reference		Reference	
Education (high school)				
<60%	1.03 (0.57, 1.86)	.933	2.05 (1.04, 4.03)	.038
60–70	1.33 (0.99, 1.77)	.056	1.76 (1.30, 2.37)	< .001
70–80	1.61 (1.17, 2.22)	.004	2.00 (1.45, 2.76)	< .001
80–90	1.11 (0.86, 1.43)	.426	1.25 (0.98, 1.61)	.078
90	Reference		Reference	
Median household income				
< \$33,000	1.91 (1.32, 2.77)	< .001	2.07 (1.41, 3.05)	< .001
\$33,000–\$39,999	1.36 (1.00, 1.85)	.047	1.40 (1.03, 1.91)	.030
\$40,000–\$49,999	0.88 (0.56, 1.38)	.582	0.91 (0.60, 1.40)	.671
\$50,000–\$62,999	1.14 (0.93, 1.39)	.199	1.09 (0.89, 1.34)	.409
\$63,00	Reference		Reference	
Primary enrollment diagnosis				
Neoplasms	1.33 (1.22, 1.45)	< .001	1.45 (1.29, 1.63)	< .001
Mental disorder	1.24 (1.10, 1.41)	< .001	1.40 (1.21, 1.62)	< .001
Disease of nervous system	1.30 (1.16, 1.47)	< .001	1.42 (1.22, 1.64)	< .001
Disease of circulatory system	1.47 (1.34, 1.61)	< .001	1.96 (1.74, 2.21)	< .001

	Hospice Disenrollment Rate		Hospitalization Rate	
	Rate ratio (95% CI)	p-value	Rate ratio (95% CI)	p-value
Disease of respiratory system	1.43 (1.30, 1.57)	< .001	2.09 (1.85, 2.37)	< .001
Illness-defined conditions	1.64 (1.41, 1.90)	< .001	1.89 (1.62, 2.21)	< .001
Other	Reference		Reference	
Hospice stay time	1.01 (1.01, 1.01)	< .001	1.01 (1.01, 1.01)	< .001
Number of comorbidities				
0–2	Reference		Reference	
3	0.96 (0.92, 1.01)	.123	1.11 (1.04, 1.18)	.002
4	0.96 (0.92, 1.02)	.217	1.23 (1.15, 1.31)	< .001
5	0.97 (0.92, 1.03)	.323	1.31 (1.22, 1.41)	< .001
6	0.96 (0.89, 1.03)	.257	1.29 (1.18, 1.41)	< .001
7–8	0.97 (0.85, 1.12)	.773	1.36 (1.16, 1.59)	< .001

CHC: Continuous home care. Numbers in bold indicate p-value at .05 level.