Published in final edited form as:

Am J Hosp Palliat Care. 2016 July ; 33(6): 537–545. doi:10.1177/1049909115574263.

Race, Any Cancer, Income, or Cognitive Function: What Influences Hospice or Aggressive Services Use at the End of Life Among Community-Dwelling Medicare Beneficiaries?

Pauline Karikari-Martin, PhD, MPH¹, Judith J. McCann, PhD^{2,3}, Carol J. Farran, DNSc³, Liesi E. Hebert, ScD², Samuel C. Haffer, PhD⁴, and Marcia Phillips, PhD³

¹U.S. Public Health Service, Rockville, MD, USA

²Rush Institute for Health/ Aging, Chicago, IL, USA

³Rush University College of Nursing, Chicago, IL, USA

⁴Centers for Medicare & Medicaid Services, Baltimore, MD, USA

Introduction

Racial^{1,2} and diagnostic^{1,3,4} disparities in hospice use controlling for specific covariates are well documented but the findings are contradictory.^{1,4-6} One study (n = 614) controlling for age, sex, marital status, cancer diagnosis, insurance, and hospice referrals found white decedents were more likely than black decedents to enroll into hospice after referral but found no diagnostic differences in hospice use using administrative data.⁵ In a second study (n = 30 765), results showed that among Medicare and Medicaid dual-eligible nursing home residents without a cancer diagnosis, black residents were significantly less likely to use hospice than white residents; but among residents with a cancer diagnosis, there were no racial differences in hospice use.⁶ However, the covariates were limited to rural/urban, age, gender, marital status, education, and principal diagnosis. In a third national study, where the covariates age, sex, cause of death, and state of residence were included in the model (n = 1 811 720), black decedents were less likely to use hospice than white decedents across all conditions except for Alzheimer's disease.¹ We found no studies that examined the effects of race and any cancer on hospice use while controlling for a more comprehensive list of covariates to include age, gender, marital status, education level, income level, neighborhood socioeconomic status (SES), cognitive, and physical function.

Corresponding Authors: Pauline Karikari-Martin, PhD, MPH, U.S. Public Health Service, Rockville, MD 20852, USA, pkarikar@jhsp.h.edu; Judith J. McCann, PhD, Rush University Medical Center, Chicago, IL USA., judy_j_mccann@rush.edu.

Authors' Note: Pauline Karikari-Martin, Judy McCann, and Liesi Hebert contributed to study concept and design, Judy McCann, Liesi Hebert contributed to acquisition of subjects and/or data, Pauline Karikari-Martin, Judy McCann, and Liesi Hebert contributed analysis and interpretation of data. Pauline Karikari-Martin, Judy McCann, Liesi Hebert, Carol Farran, Chris Haffer, and Marcia Phillips contributed to preparation of manuscript.

Declaration of Conflicting Interests: The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article: This research was accomplished by the authors in their personal capacity. The opinions expressed in this article are the authors' own and do not reflect the view of the United States Public Health Service, Centers for Medicare and Medicaid Services, the Department of Health and Human Services, the United States government, Rush University College of Nursing, or Rush Institute for Healthy Aging.

Similarly, literature evidence on effects of race and any cancer in duration of hospice use is contradictory and the covariates are not comprehensive. In a study of more than 16 000 patients aged 65 years or older and served by a single hospice facility, African Americans and Hispanics had longer durations of hospice use than whites, and having a cancer diagnosis was associated with a shorter duration of hospice use compared to a noncancer diagnosis.⁷ A second study of almost 41 000 Medicare beneficiaries with cancer⁸ found that blacks were less likely than whites to use hospice; however, once enrolled in hospice, there were no racial differences in duration of hospice use. In another study of primarily male veteran affairs patients (n = 667), no racial differences in duration of hospice use were found; however, patients with cancer stayed significantly longer in hospice than those without cancer.⁹ Yet, no single study was found to examine effects of race and any cancer on duration of hospice while controlling for age, gender, marital status, education, health insurance, income level, neighborhood SES, cognitive, and physical function.

Despite a steady increase in the number of hospice providers from 1974 through 2012,¹⁰ studies using administrative or claims data document that the use of aggressive services such as hospitalizations, intensive care unit/coronary care unit (ICU, CCU) admissions, and emergency department (ED) visits at the end of life has increased significantly at the same time, from 1974 through 2008.¹¹⁻¹³ Yet, there are important gaps in our knowledge about the effect of race and any cancer diagnosis on use of aggressive services at the end of life. Three studies that examined the increased use of aggressive care at the end of life included only patients with cancer,¹¹⁻¹⁵ and only one of these studies examined the effects of race.¹¹ Another study focused on assisted-living residents only¹⁴ while other studies were conducted among residents of nursing homes and limited the outcome of interest to hospitalizations^{6,15,16} Further, every study defined end of life as the last 30 days of life and did not examine the use of aggressive services prior to that period. Most importantly, none of these studies examined use of aggressive services in the last 12 months of life nor controlled for the covariates such as income, neighborhood SES, cognitive, and physical function in a single study. Therefore, we conducted a study to examine whether differences in hospice use and use of aggressive services in the last 12 months of life are influenced by race or any cancer diagnosis while adjusting for the covariates age, gender, marital status, education level, neighborhood SES, cognitive function, and physical function.

We hypothesized that (1) compared to blacks and individuals with a cancer diagnosis, whites and individuals with a non-cancer diagnosis would be more likely to use hospice and would have longer durations of hospice use at the end of life while controlling for income, neighborhood (SES), cognitive, and physical function; (2) compared to nonhospice users, hospice users would have fewer hospitalizations, ICU/CCU admissions, and ED visits at the end of life while controlling for income, neighborhood SES, cognitive, and physical function. We expected that hospice use would attenuate race and any cancer effects on hospitalizations, ICU/CCU admissions, and ED visits at the end of life.

Conceptual Framework

This study was guided by the Hospice Use Model developed to reflect a comprehensive array of factors that may influence hospice use.¹⁷ This model integrates constructs from the

Behavioral Model of Hospice Use,⁵ the Revised Andersen's Behavioral Model of Health Service Utilization,¹⁸ and the Behavioral Model of Health Service Utilization.¹⁹ The Hospice Use Model¹⁷ posits that community characteristics, individual (care recipient) characteristics, and individual (caregiver) characteristics are associated with health care access outcomes: potential access (usual source of care), realized access (doctors' visits and hospice use), and access outcomes (hospitalizations, ED visits, and ICU/CCU admissions) at the end of life. The model also posits that potential access and realized access to hospice can affect access outcomes.

Methods

Design

This secondary analysis used interview data from the Chicago Health and Aging Project (CHAP; R01 AG11101) linked with respective Medicare claims data.

Description of the Data Sources

The CHAP was a longitudinal community study of more than 10 000 individuals' aged 65 years or older living in a geographically defined area of Chicago, Illinois.²⁰ The CHAP community population was approximately 60% black and 40% white. There are few people of other races or of Hispanic origin residing in the CHAP community. The CHAP study began with a door-to-door census from 1994 to 1996. All individuals aged 65 or older were invited to participate in a baseline home interview and 78.7% consented to do so (80.5% of blacks and 74.6% of non-blacks). Additional individuals in the community were invited to participate when they turn 65 years.

The CHAP interview data were collected on a range of health, psychological, and social measures, including brief performance tests of cognitive and physical function. For 18 years (1994-2012), enrolled participants were followed every 3 years until death, with high rates of follow-up (90%) participation. Follow-up in-home interviews were conducted with surviving participants every 3 years for up to 5 times with high rates of follow-up participation by race (89.1% for blacks and 91.1% for whites). For this analysis, we used the full CHAP sample for blacks and whites and their respective Medicare claims data from Inpatient, Outpatient, and Hospice Standard Analytic Files for the years 1993 through 2009. The CHAP participants of Hispanic or other origin were excluded due to the small sample size.

Analytic Sample

The analytic sample was limited to CHAP participants aged 65 years or older, who died by December 31, 2009 and were enrolled in fee-for-service Medicare for at least 1 year before death ($n = 2954$). Death was ascertained by follow-up contact, confirmation of death with an informant, and use of the National Death Index data files and/or Social Security data files. Since the Medicare hospice benefit is intended for the last 6 months of life, we examined interview data for the predictors of hospice use and duration of hospice use that were collected 6 months or more before death. For the group whose last interview occurred 6 months or more before death ($n = 2697$), we used data from the last interview before death.

For the group of participants whose last CHAP interview occurred less than 6 months before death ($n = 257$), we used data from the second to last interview before death. Medicare data for the analytic sample of CHAP participants were then merged with the respective participants' interview data. This study was approved by the Institutional Review Board at Rush University Medical Center.

Outcome Variables

Outcome data came from the Medicare claims files. Data for use of hospice services provided in a home, an inpatient facility, a hospital, and or a nursing home were coded as *ever used hospice* = 1 or *never used hospice* = 0. For duration of hospice use, we computed number of days in hospice from the start of hospice (up to 1 year before death) until death. Prior to analysis, we evaluated the assumptions of linear regression and found the data to be highly positively skewed. Log transformation of the outcome data met the assumption of linear regression. However, we considered there may be predictive implications of the large proportion (51%) of very short use (1-14 days) so we also modeled duration as a 3-category variable. Data for hospitalizations, 1CU/CCU admissions, and ED visits were computed as continuous variables, using counts of these events in the last year of life.

Predictor Variables

The CHAP interview predictor data included age, years of education, race (white and black), gender, marital status (married and not married), total annual household income using 10 income categories, and neighborhood SES. The neighborhood SES is a composite measure using data from the 2000 US Census Bureau which included information on percentage of population on public assistance,²¹ percentage with household income less than US\$30,000, and percentage of population unemployed. The information was z-scored and then averaged across the 3 indicators to obtain a measure of neighborhood SES for each of the 49 census tracts for neighborhoods that covered the geographic area of the CHAP study (range -4.5 to 4.0, where the more positive number implies higher SES). Social networks were assessed using the Established Populations for Epidemiologic Studies of the Elderly²² that quantified the number of children, relatives, and friends each participant reported seeing at least once a month, with higher scores indicating larger social networks.

Physical function was assessed with 6 basic activities of daily living (Katz Scale),²³ 3 aspects of gross mobility (Rosow-Breslau Scale),²⁴ and 5 aspects of upper and lower extremity function (Nagi Scale).²⁵ For each measure, items were summed to produce a score ranging from 0 (no disability) to the maximum score, indicating disability on all items (6 for the Katz, 5 for the Nagi, and 3 for the Rosow-Breslau). The Center for Epidemiological Studies Depression scale assessed depressive symptoms.²⁶ Unhealthy days were operationalized using the Centers for Disease Control measure of unhealthy days for health-related quality of life²⁷ and recoded for analysis into 3 categories: (1) 0 days = 0; (2) 1 to 29 days = 1; and (3) 30 days = 2.

Decline in cognitive function was computed by the annual change in each individual's composite measure of cognitive function, an average of z scores of the Mini-Mental State Examination,²⁸ immediate and delayed recall of a brief story,²⁹ and the oral version of the

Symbol Digit Modalities Test.³⁰ Any cancer was measured using the Medicare-claims *International Classification of Diseases, Ninth Revision* code for any cancer diagnosis to capture if the CHAP participant has a history of cancer and not just the primary diagnosis for a visit or an admission.

Statistical Analysis

The percentage of observations missing based on predictor variables was low (range 0%-6%). Therefore, we deleted the observations with missing values for any of the predictor variables in each model using listwise deletion. For the outcome of hospice use, we computed “any use of hospice” in the last year of life and modeled it as a binary variable, using forward stepwise logistic regression. Duration of hospice use was modeled as a 3-category variable and analyzed using unordered polynomial logistic regression with a 3-level outcome and forward stepwise selection.

To examine the effect of realized access (hospice use) on access outcomes (hospitalizations, ICU/CCU admissions, and ED visits), we limited the time of counting these outcomes to the time the person was using hospice services. To define comparable times of observation for nonhospice users, we began with the 3 time intervals for hospice stays (1-14 days, 15-180 days, and more than 180 days). We computed the proportion of hospice users and mean length of stay for hospice users in each time group. We then randomly assigned nonhospice users to one of the 3 time groups, in the same proportion as hospice users in the group. For nonhospice users, we counted outcomes that occurred in the interval before death defined by the mean length of stay for the group to which they had been assigned. We modeled each access outcome separately using forward stepwise Poisson regression.

All multivariate models included the variables age, education, and gender. Modeling was similar for all outcomes. We started the model-building process by adding each predictor to individual models, and then used the forward stepwise approach to identify significant predictors from among the variables that were significant in individual models, with the exception of race and cancer. To determine whether race or any cancer had any additional predictive effect on each outcome, we started with the core model and forced in race, then cancer, then both race and cancer. To examine the effect of hospice use on hospitalizations, ICU/CCU admissions, and ED visits, we forced into the final models a dichotomous indicator variable for hospice use. All analyses using SAS version 9.3³¹ defined significance as a *P* value equal to or less than .05.

Results

Table 1 provides detailed descriptive statistics for all outcomes and for predictors that were included in regression models.

Analytic Results

Hospice use and duration of hospice—The core model (Table 2, Model 1) indicated that higher neighborhood level SES, older age, poorer health, and higher income each significantly increased the likelihood of using hospice, while decline in cognitive function decreased that likelihood. For blacks compared to whites, the odds of hospice use were

significantly less (Table 2, Model 2) and neighborhood SES became nonsignificant, suggesting race has a more powerful effect on hospice use than neighborhood SES. The odds of hospice use were more than twice as great for individuals with any cancer diagnosis compared to individuals without a cancer diagnosis (Table 2, Model 3). The final model (Table 2, Model 4) shows that after adjusting for other covariates, having a cancer diagnosis significantly increased the odds of hospice use whereas black race significantly decreased the odds of hospice use. The final model was a good fit for the data (Hosmer-Lemeshow good of fit $\chi^2 = 14.05$, $df = 8$, $P = .08$). For duration of hospice use modeled as a 3-category variable: (1) 1 to 14 days (51.3%), (2) 15 to 180 days (39.6%), and (3) greater than 180 days (9.1%), we found no differences for race or any cancer diagnosis between short and longer stays in hospice.

Hospitalization—The core model (Table 3, Model 1) indicates that older age, higher education, and greater disability on the Katz index of activities of daily living were associated with a significantly decreased risk of hospitalization at the end of life. When we forced in race (Table 3, Model 2) and any cancer diagnosis (Table 3, Model 3) while adjusting for other factors, no differences in hospitalization by race or a cancer diagnosis were found. However, older age, higher education, and greater disability on the Katz index of activities of daily living remained associated with a significantly decreased risk of hospitalization. When we forced hospice use into the core model (Table 3, Model 4) decedents who used hospice had about half the risk of hospitalization at the end of life compared to decedents who did not use hospice (relative risk [RR] .53; confidence interval, 40-.69, $P = .00$). Older age and higher education were also associated with a significantly decreased risk of hospitalization ($P = .04$). The results suggest that hospice use, older age, and higher education play an important role in reducing hospitalizations at the end of life.

Intensive care unit/coronary care unit admission—The core model (Table 4, Model 1) indicates that older age was associated with decreased risk of an ICU/CCU admission at the end of life ($P = .02$). There were no differences in ICU/CCU admissions by race (Table 4, Model 2) or a cancer diagnosis (Table 4, Model 3). When we forced hospice use into the core model (Table 4, Model 4), hospice users had approximately one third the risk of an ICU/CCU admission at the end of life compared to participants who did not use hospice ($P = .002$) and age became nonsignificant ($P = .23$). Results suggest that hospice use plays a protective role against ICU/CCU admission at the end of life.

Emergency department visit—The core model (Table 5, Model 1) indicates that older age ($P = .001$), higher education ($P = .01$), and greater disability on the Katz index of activities of daily living ($P = .002$) were associated with a significantly decreased risk of an ED visit at the end of life. The RR of an ED visit was significantly greater for black participants compared to whites (Table 5, Model 2) and significantly less for those with a cancer diagnosis compared to those without cancer (Table 5, Model 3). When we forced hospice use into the core model (Table 5, Model 4), study participants who used hospice had approximately one seventh the risk of an ED visit at the end of life compared to participants who did not use hospice ($P = .000$). Additionally, the differences by age, race, any cancer

diagnosis, and level of disability disappeared, suggesting that hospice use has a more powerful effect than other predictors on reducing the risk of an ED visit.

Discussion

We hypothesized that racial and any cancer disparities exist in hospice use, duration of hospice use, and use of aggressive services in the last 12 months of life, when controlling for the covariates income level, neighborhood SES, age, gender, education, physical health, cognitive, and physical function. We also hypothesized that hospice use has a protective effect, reducing use of aggressive services at the end of life. Similar to other studies,^{3,6} our findings supported our hypothesis that racial differences exist in hospice use at the end of life although we looked at a longer end-of-life period of 12 months instead of 30 days. After adjusting for a more comprehensive list of covariates, which were not included in any one previous study, we found blacks were half as likely as whites to use hospice. Racial disparities in hospice use may suggest that blacks know less about hospice benefits or those providers refer blacks for hospice less often than whites. Providers may be reluctant to refer blacks to hospice based on perceptions of their cultural or spiritual beliefs. A study of older terminally ill patients⁵ found that non-whites were significantly less likely than whites to use hospice even after referral. However, that study found no differences by any cancer versus noncancer diagnoses. This result implies that although referrals to hospice are important, referrals alone are insufficient for increasing hospice use among blacks.

Studies have documented that older blacks are significantly less likely than older whites to discuss treatment preferences before death and to use advance care directives.^{32,33} In comparison to whites, treatment decisions for blacks were significantly more likely to be based on the desire to provide all care possible in order to prolong life.³² We did not have data on use of advance directives, so we could not explore this issue.

Furthermore, we found that age, physical health, cognitive function, and income also influence hospice use. Older age was associated with an increased likelihood of using hospice confirming reports that as the baby boomers get older, we will more likely see an increase in hospice services use among older Medicare beneficiaries.³⁴ Poorer health was associated with increased odds of hospice use, which is to be expected; however, cognitive decline was associated with decreased odds of hospice use. This suggests that equal access to the Medicare hospice benefit may not be sufficient to encourage hospice use among individuals with cognitive decline. As such we need to increase our efforts to educate providers, family members, and caregivers of Medicare beneficiaries about the benefits of using hospice for individuals experiencing cognitive decline. At the same time, revisit the Medicare hospice benefit to determine if this may be a barrier for this group.

Another interesting finding was the influence of neighborhood SES and income on hospice use. We found that higher SES is associated with higher use of hospice compared to lower SES similar to other studies.^{35,36} However when we forced in race or any cancer in the model, neighborhood SES was no longer a significant factor. But income remained significantly predictive of hospice use, even when race or any cancer was forced in the model. As our work force retires, their income definitely changes even though the Medicare

Hospice benefit is offered. Therefore, future targeted efforts need to consider beneficiaries' income when designing interventions to increase hospice use at the end of life.

Results did not support the hypothesis that people without cancer would be more likely to use hospice than those with cancer. Instead, similar to other studies,^{4,37} we found that individuals with any cancer diagnosis were more than twice as likely to use hospice at the end of life compared to those without a cancer diagnosis, even after adjusting for other significant factors. This may be because we defined "individuals with a cancer diagnosis" as those with any claims for a cancer diagnosis and not as those whose primary diagnosis for hospice referral was cancer. Also, providers may not be certain if individuals with a noncancer diagnosis have 6 months or less to live, which is a requirement for hospice certification³⁴—an uncertainty that may delay receiving appropriate hospice services.

Our findings suggest that, despite equal access to Medicare hospice benefits, blacks and individuals without any cancer diagnosis underutilized this benefit. However, once hospice was accessed, we found no racial or diagnostic disparities in duration of hospice use. Similarity in duration of hospice use might indicate that patients and families are satisfied with the care provided, and that patients do not withdraw from hospice for reasons related to cultural values, religious beliefs, or course of disease. Similarity in duration of hospice use suggests that one race or diagnostic group did not enroll significantly earlier or later in the course of their disease than the other group. However, the median length of stay in hospice was less than 2 weeks, suggesting that providers are referring most individuals to hospice too late in the course of their disease, or that most individuals wait too long before enrolling in hospice to take full advantage of the services.

This study also examined the effect of hospice on the use of aggressive services at the end of life. Similar to studies conducted in assisted-living¹⁴ and nursing-home settings,^{6,15,16} we found that hospice use significantly decreased the risk of hospitalizations, ICU/CCU admissions, and ED visits at the end of life. These findings are perhaps not unexpected since a condition of the hospice benefit is that patients forego other Medicare-covered benefits to treat their terminal illness. However, Medicare will continue to pay for covered benefits for any health problems that are not related to the terminal illness. More importantly these findings validate the Hospice Use Model assertion that realized access (hospice use) affects access outcomes (hospitalization, ICU/CCU admissions, and ED visits).

However, even after adjustment for hospice use, we found that age and education remained strong predictors of hospitalization at the end of life. Older and better educated Medicare recipients were less likely to be hospitalized at the end of life compared to younger and less educated Medicare recipients. To our knowledge, no study has examined the influence of these predictors in conjunction with hospice use on hospitalization in a single study. More research is needed to further examine these differences to guide targeted interventions for reducing hospitalization at the end of life.

We also found that hospice use was the only significant predictor of ICU/CCU admissions and ED visits among Medicare beneficiaries at the end of life. Because hospice care is generally less costly than more aggressive care services,³⁸⁻⁴⁰ timely and appropriate hospice

use could reduce the high costs associated with aggressive services at the end of life, as well as provide better quality of life, by receiving supportive care and adequate pain management, especially when the use of aggressive services does not usually change the outcome death.

This study had several limitations. First, reliance on existing data limited our ability to examine all aspects of the comprehensive Hospice Use Model such as knowledge of hospice care, cultural beliefs, caregiver factors, trust of the health care system, and provider patient relationship. We also did not know whether CHAP participants had ever been referred to hospice. Dichotomizing diagnosis as any cancer versus noncancer for analysis may have obscured effects of specific conditions such as congestive heart failure on the outcomes of interest. Finally, our study was limited to older adults in a defined geographic area, limiting the generalizability of these findings to other age-groups, other geographic areas, or other races such as His-panics or Asians.

Despite these limitations, one of the strengths of this study was all participants were enrolled in Medicare during the last year of life which ensured equal access to hospice and other services. Merging the CHAP interview data with Medicare claims data allowed us to examine a wider range of predictors and outcomes than would have been possible using claims data alone. Using interview data, we found that differences in age, cognitive function, physical health, and income influenced hospice use suggesting that future efforts to increase hospice use focus on other factors and not just race and/or a noncancer diagnosis. More, importantly, we were able to examine the effect of hospice use on several types of aggressive services after adjusting for other factors using data from the CHAP interview. To our knowledge, this is the first study to demonstrate the significant role of hospice in decreasing use of aggressive care services at the end of life within a single study using older community residents with a range of health conditions.

An additional strength of this study was the sampling frame. The secondary data came from a longitudinal study conducted in a community setting rather than from a clinic or a nursing home setting where incentives to use hospice and access to hospice may be quite different. We had an almost equal number of black and white decedents, which provided adequate statistical power to examine racial differences in the outcomes of interest. In addition, the average income distribution among both races was similar, controlling for any income variation. Because the study sample came from 4 adjacent neighborhoods in a defined geographic area of 12 square miles, participants varied little in access to health care resources such as hospice and hospitals.

Decisions to use hospice and other services at the end of life are complex and not unique. This study establishes research evidence that we need to be comprehensive and consider several factors particularly income, cognitive function, and age and not just race or any cancer when promoting hospice use at the end of life. More importantly, it advances the science that not just hospice use, but age and education also play a significant role in reducing potentially inappropriate hospitalizations at the end of life. As our older population increases, is more racially diverse, and lives longer with chronic conditions, there will be a higher demand for different types of health services, including hospice. Future research

should focus on considering other factors and not just race, a cancer diagnosis, and hospice use to inform the design and evaluation of innovative interventions to increase appropriate use of hospice, and decrease inapt use of aggressive services at the end of life.

Acknowledgments

Funding: The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by NIA/NIH grants ROI AG11101 and ROI AG030544; Golden Lamp Society of Rush University College of Nursing Dissertation Award; Rush University Graduate Student Council Travel Award; and the Veteran's GI Educational Benefit.

References

1. Connor SR, Elwert F, Spence C, Christakis NA. Racial disparity in hospice use in the United States in 2002. *Palliat Med*. 2008; 22(3):205–213. [PubMed: 18477714]
2. Virnig BA, Marshall McBean A, Kind S, Dholakia R. Hospice use before death: variability across cancer diagnoses. *Med Care*. 2002; 40(1):73–78. [PubMed: 11748429]
3. Greiner KA, Perera S, Ahluwalia JS. Hospice usage by minorities in the last year of life: results from the national mortality follow-back survey. *J Am Geriatr Soc*. 2003; 51(7):970–978. [PubMed: 12834517]
4. Iwashyna TJ, Zhang JX, Christakis NA. Disease-specific patterns of hospice and related healthcare use in an incidence cohort of seriously ill elderly patients. *J Palliat Med*. 2002; 5(4):531–538. [PubMed: 12243677]
5. Hill F. Factors associated with hospice use after referral. *J Hosp Palliat Nurs*. 2008; 10(4):240–252.
6. Kwak J, Haley WE, Chiriboga DA. Racial differences in hospice use and in-hospital death among Medicare and Medicaid dual-eligible nursing home residents. *Gerontologist*. 2008; 48(1):32–41. [PubMed: 18381830]
7. Park NS, Carrion IV, Lee BS, Dobbs D, Shin HJ, Becker MA. The role of race and ethnicity in predicting length of hospice care among older adults. *J Palliat Med*. 2012; 15(2):149–153. [PubMed: 22313431]
8. Smith AK, Earle CC, McCarthy EP. Racial and ethnic differences in end-of-life care in fee-for-service Medicare beneficiaries with advanced cancer. *J Am Geriatr Soc*. 2009; 57(1):153–158. [PubMed: 19054185]
9. Tang VL, French CJ, Cipher DJ, Rastogi P. Trends in hospice referral and length of stay at a veterans hospital over the past decade. *Am J Hosp Palliat Care*. 2012; 30(5):432–436.
10. Growth in US Hospice programs: 1974-2012. National Hospice and Palliative Care Organization; 2014. Web site, http://www.nhpco.org/sites/default/files/public/Statistics_Research/Graph_of_hospice_1974_2012.pdf [Accessed February 16, 2015]
11. Earle C, Neville B, Landrum M, Ayanian JZ, Block SD, Weeks JC. Trends in the aggressiveness of cancer care near the end-of-life. *J Clin Oncol*. 2004; 22(2):315–321. [PubMed: 14722041]
12. Gonsalves WL, Tashi T, Krishnamurthy J, et al. Effect of palliative care services on the aggressiveness of end-of-life care in the veteran's affairs cancer population. *J Palliat Med*. 2011; 14(11):1231–1235. [PubMed: 21877925]
13. Ho TH, Barbera L, Saskin R, Lu H, Neville BA, Earle CC. Trends in the aggressiveness of end-of-life cancer care in the universal health care system of Ontario, Canada. *J Clin Oncol*. 2011; 29(12):1587–1591. [PubMed: 21402603]
14. Dobbs D, Meng H, Hyer K, Volicer L. The influence of hospice use on nursing home and hospital use in assisted living among dual-eligible enrollees. *J Am Med Dir Assoc*. 2012; 13(2):189.c9–189.c13.
15. Gozalo P, Miller S. Predictors of mortality hospice enrollment and evaluation of its causal effect on hospitalization of dying nursing home patients. *Health Serv Res*. 2007; 42(2):587–610. [PubMed: 17362208]
16. Miller SC, Gozalo P, Mor V. Hospice enrollment and hospitalization of dying nursing home patients. *Am J Med*. 2001; 111(1):38–44. [PubMed: 11448659]

17. Karikari-Martin P, McCann JJ, Hebert LE, Haffer SC, Phillips M. Do community and caregiver factors influence hospice use at the end of life among older adults with Alzheimer's disease? *J Hosp Palliat Nurs*. 2012; 14(3):225–237.
18. Radina ME, Barber CE. Utilization of formal support services among Hispanic Americans caring for aging parents. *J Gerontol Soc Work*. 2004; 43(2-3):5–23.
19. Davidson PL, Andersen RM, Wyn R, Brown ER. A framework for evaluating safety-net and other community-level factors on access for low-income populations. *Inquiry*. 2004; 41(1):21–38. [PubMed: 15224958]
20. Bienias JL, Beckett LA, Bennett DA, Wilson RS, Evans DA. Design of the Chicago health and aging project (CHAP). *J Alzheimers Dis*. 2003; 5(5):349–355. [PubMed: 14646025]
21. Cagney KA, Glass TA, Skarupski KA, Barnes LL, Schwartz BS, Mendes de Leon CF. Neighborhood-level cohesion and disorder: Measurement and validation in two older adult urban populations. *J Gerontol B Psychol Set Soc Sci*. 2009; 64B(3):415–424.
22. Cornoni-Huntley, J., Brock, DB., Ostfeld, A., et al. Established Populations for Epidemiologic Studies of the Elderly Resource Data Book. Washington, DC: U.S. Department of Health and Human Services; 1986. NIH Publication No. 86-2443
23. Katz S, Akpom C. A measure of primary sociobiological functions. *Int J Health Serv*. 1976; 6(3): 493–508. [PubMed: 133997]
24. Rosow I, Breslau N. A guttmann health scale for the aged. *J Gerontol*. 1966; 21(4):556–559. [PubMed: 5918309]
25. Nagi SZ. An epidemiology of disability among adults in the United States. *Milbank Mem Fund Q Health Soc*. 1976; 54(4):439–467. [PubMed: 137366]
26. Kohout FJ, Berkman LF, Evans DA, Cornoni-Huntley J. Two shorter forms of the CES-D (Center for epidemiological studies depression) depression symptoms index. *J Aging Health*. 1993; 5(2): 179–93. [PubMed: 10125443]
27. [Accessed July 20, 2012] Measuring healthy days: Population assessment of health related quality of life. Nov 2000. (online). Web site <http://www.cdc.gov/hrqol/pdfs/mhd.pdf>
28. Folstein MF, Folstein SE, McHugh PR. “Mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975; 12(3):189–198. [PubMed: 1202204]
29. Albert M, Smith LA, Scherr PA, Taylor JO, Evans DA, Funkenstein HH. Use of brief cognitive tests to identify individuals in the community with clinically diagnosed Alzheimer's disease. *Int J Neurosci*. 1991; 57(3-4):167–178. [PubMed: 1938160]
30. Smith, A. Symbol Digit Modalities Test Manual Revised. Los Angeles, CA: Western Psychological Press.; 1984.
31. SAS Institute Inc. What's New in SAS® 9.3. Cary, NC: SAS Institute Inc.; 2012.
32. Hopp FP, Duffy SA. Racial variations in end-of-life care. *J Am Geriatr Soc*. 2000; 48(6):658–663. [PubMed: 10855602]
33. Waite KR, Federman AD, McCarthy DM, et al. Literacy and race as risk factors for low rates of advance directives in older adults. *J Am Geriatr Soc*. 2013; 61(3):403–406. [PubMed: 23379361]
34. Medicare Payment Advisory Commission. Report to the Congress: 2012 Chapter II Hospice Services: Assessing payment adequacy and updating payments. Washington, DC: MedPAC; 2012.
35. Hardy D, Chan W, Liu CC, Cormier JN, et al. Racial disparities in the use of hospice services according to geographic residence and socioeconomic status in an elderly cohort with nonsmall cell lung cancer. *Cancer*. 2011; 117(7):1506–1515. [PubMed: 21425152]
36. Saito AM, Landrum MB, Neville BA, Ayanian JZ, Weeks JC, Earle CC. Hospice care and survival among elderly patients with lung cancer. *J Palliat Med*. 2011; 14(8):929–939.
37. Lepore M, Miller S, Gozalo P. Hospice use among urban black and white U.S. nursing home decedents in 2006. *Gerontologist*. 2010; 51(2):251–260.
38. Taylor JD. The effect of hospice on Medicare and informal care costs: The U.S. experience. *J Pain Symptom Manage*. 2009; 38(1):110–114. [PubMed: 19615635]

39. Taylor J, Ostermann J, Van Houtven C, Tulsy JA, Steinhauser K. What length of hospice use maximizes reduction in medical expenditures near death in the US Medicare program? *Soc Sci Med*. 2007; 65(7):1466–1478. [PubMed: 17600605]
40. Kelley AS, Deb P, Du Q, Aldridge Carlson MD, Morrison RS. Hospice enrollment saves money for Medicare and improves care quality across a number of different lengths-of-stay. *Health Aff (Millwood)*. 2013; 32(3):552–561. [PubMed: 23459735]

Table 1

Descriptive Statistics for Select Predictor and Outcome Variables.

Variable	Range	n (%)	M (SD)
Neighborhood level socioeconomic status (SES)	−4.0–4.5	2658 (90.0)	−.37(2.6)
Age in years	66–108		82.9 (7.5)
White		1316(44.6)	
Black		1637 (55.4)	
Male		1252(42.4)	
Female		1702(57.6)	
Education (years of schooling)	0–30		11.8(3.6)
Married		1097(37.2)	
Not married		1854 (62.8)	
Total social network score	0–75		6.0 (5.8)
Katz index score of activities of daily living, for example, need help grooming			
0		1922 (65.3)	
1		272 (9.2)	
2		195 (6.6)	
3		107 (3.6)	
4		90 (3.2)	
5		169 (5.7)	
6		188 (6.4)	
Center for Epidemiological Studies Depression (CESD) scale	0–10		2.0(2.2)
Unhealthy days	0–30		8.4(12.2)
Cognitive function change (positive implies improving)	−.87–1.41	758	.09 (.16)
Diagnosis for any cancer <i>ICD-9</i> codes using Medicare claims data			
No (0)		1815 (61.5)	
Yes (1)		1138 (38.5)	
Income			
1. US\$0 to 4999		108 (3.9)	
2. US\$5000 to 9999		405(14.6)	
3. US\$10 000 to 14 999		488(17.6)	
4. US\$15 000 to 19 999		429(15.5)	
5. US\$20 000 to 24 999		345(12.4)	
6. US\$25 000 to 29 999		268 (9.7)	
7. US\$30 000 to 34 999		220 (7.9)	
8. US\$35 000 to 49 999		260 (9.4)	
9. US\$50 000 to 74 999		98 (3.5)	
10. >US\$75 000		143 (5.5)	
Never used hospice		1939 (65.6)	
Used hospice		1015 (34.4)	
Number of hospice admissions (n = 1015)			
1		944 (93.0)	

Variable	Range	n (%)	M (SD)
2		60 (5.9)	
>3		11 (11)	
Length of hospice stay in days			55.6(129.1)
1-14 days		514(51.3)	
15-180 days		397 (39.6)	
> 180 days		91 (9.1)	
Hospice users			
Hospitalization		420(41.4)	.46 (.68)
ICU/CCU		70 (6.9)	.07 (.37)
ED		88 (8.7)	.14 (.61)
Nonhospice users			
Hospitalization		1238 (63.9)	1.02(1.37)
ICU/CCU		353(18.2)	.22 (.58)
ED		1155(59.6)	.99(1.53)

Abbreviations: *ICD-9, International Classification of Diseases, Ninth Revision*; SD, standard deviation; ICU/CCU, intensive care unit/coronary care unit; ED, emergency department.

Table 2Logistic Regression Models Predicting Hospice Use Odds Ratio (95% CI; *P* Value).

	Model 1 (n = 1690)	Model 2 (n = 1692)	Model 3 (n = 1692)	Model 4 (n = 1692)
Neighborhood SES	1.06 (1.02-1.11; .004)	.99 (.93-1.05; .75)	1.05 (1.01-1.10; .01)	.98 (.92-1.04; .51)
Age at death	1.05 (1.04-1.06; .000)	1.05 (1.03-1.06; .000)	1.05 (1.04-1.07; .000)	1.05 (1.03-1.06; .000)
Education	.98 (.95-1.01; .40)	.99 (.95-1.01; .18)	.98 (.95-1.02; .49)	.97 (.94-1.01; .21)
Male	.94 (.76-1.17; .62)	.95 (.77-1.19; .66)	.86 (.69-1.08; .20)	.87 (.70-1.09; .24)
Black		.57(.40-.80; .001)		.55 (.39-78; .000)
Cognitive function change	.29 (.15-.57; .000)	.31 (.16-61; .000)	.24 (.12-.47; .000)	.24 (.12-.48; .000)
Unhealthy days	1.33 (1.03-1.72; .02)	1.30 (1.01-1.68; .04)	1.37 (1.06-1.78; .01)	1.35 (1.04-1.76; .02)
Cancer diagnosis			2.16 (1.74-2.67; .000)	2.18 (1.76-2.70; .000)
Income	1.09 (1.04-1.15; .000)	1.09 (1.03-1.15; .001)	1.08 (1.03-1.14; .002)	1.07 (1.02-1.13; .006)

Abbreviation; CI. confidence interval.

Table 3

Hospitalizations at the End of Life Using Poisson Regression (Scaled Pearson Chi-Square) Risk Ratio (95% CI; *P* Value).

	Model 1 (n = 2912)	Model 2 (n = 2927)	Model 3 (n = 2927)	Model 4 (n = 2927)
Age at death	.98 (.96-.99; .002)	.98 (.96-.99; .009)	.97 (.96-.99; .001)	.98 (.97-.99; .04)
Education	.96 (.93-.99; .006)	.97 (.94-1.00; .04)	.96 (.93-.95; .005)	.97 (.94-1.00; .04)
Male	.98 (.81-1.19; .88)	.99 (.81-1.21; .95)	.97 (.80-1.19; .81)	.97 (.79-1.20; .84)
Black		1.18 (.95-1.47; .12)		
Katz index of activities of daily living (scale 0-6)	.92 (.87-.97; .003)	.91 (.86-.96; .000)	.92 (.87-.96; .001)	.94 (.89-1.00; .06)
Medicare claims for cancer			1.10 (.91-1.34; .30)	
Ever used hospice				.53 (.40-.69; .000)

Abbreviation: CI. confidence interval.

Table 4

ICU/CCU at the End of Life Using Poisson Regression (Scaled Pearson Chi-Square) Risk Ratio (95% CI; *P* Value).

	Model 1 (n = 2935)	Model 2 (n = 2935)	Model 3 (n = 2935)	Model 4 (n = 2935)
Age at death	.96 (.94-.99; .02)	.97 (.94-1.00; .05)	.96 (.94-.99; .02)	.98 (.95-1.01; .23)
Education	.99 (.93-1.04; .71)	.99 (.93-1.05; .87)	.99 (.93-1.04; .72)	1.00 (.93-1.06; .98)
Male	1.10 (.73-1.68; .63)	1.15 (.73-1.69; .61)	1.15 (.73-1.69; .61)	1.06 (.67-1.66; .79)
Black		1.12 (.70-1.80; .61)		
Medicare claims for cancer			.95 (.62-1.45; .82)	
Ever used hospice				.38 (.20-71; .002)

Abbreviation: ICU/CCU, intensive care unit/coronary care unit; CI, confidence interval

Table 5

ED Visits at the End of Life Using Poisson Regression (Scaled Pearson Chi-square) Risk Ratio (95% CI; *P* Value).

	Model 1 (n = 2927)	Model 2 (n = 2927)	Model 3 (n = 2927)	Model 4 (n = 2927)
Age at death	.97 (.96-.99; .001)	.98 (.97-.99; .01)	.97 (.96-.99; .000)	.99 (.98-1.00; .60)
Education	.96 (.94-.99; .01)	.97 (.95-1.00; .10)	.96 (.94-.99; .01)	.99 (.96-1.01; .61)
Male	1.00 (.82-1.21; .99)	1.00 (.83-1.22; .92)	1.02 (.84-1.23; .81)	1.01 (.85-1.21; .86)
Black		1.24 (1.01-1.54; .03)		1.14 (.94-1.39; .17)
Katz index of activities of daily living (scale 0-6)	.92 (.88-.97; .002)	.92 (.87-.96; .001)	.91 (.87-.96; .000)	.99 (.94-1.04; .77)
Medicare claims for cancer			.80 (.66-.98; .03)	.87 (.73-1.04; .13)
Ever used hospice				.15(.11-.22; .000)

Abbreviation: ED, emergency department; CI, confidence interval.