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The Use of Inpatient Palliative Care Services In Patients With Metastatic Incurable Head and Neck Cancer

Carolyn L. Mulvey, B.S.¹, Thomas J. Smith, M.D.², and Christine G. Gourin, M.D., M.P.H.¹

¹Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University; Baltimore, MD

²Department of Oncology, Sidney Kimmel Comprehensive Cancer Center; Baltimore, MD

Abstract

Background—Substantial health care resources are used on aggressive end-of-life care, despite an increasing recognition that palliative care improves quality of life and reduces health care costs. We examined the incidence of palliative care encounters in inpatients with incurable head and neck cancer (HNCA) and associations with in-hospital mortality, length of hospitalization, and costs.

Methods—Data from the Nationwide Inpatient Sample for 80,514 HNCA patients with distant metastatic disease in 2001–2010 was analyzed using cross-tabulations and multivariate regressions.

Results—Palliative care encounters occurred in 4,029 cases (5%) and were significantly associated with age ≥ 80 years, female sex, self-pay pay or status, and prior radiation. Palliative care was significantly associated with increased in-hospital mortality and reduced hospital-related costs.

Conclusions—Inpatient palliative care consultation in terminal HNCA is associated with reduced hospital-related costs, but appears to be underutilized and restricted to the elderly, uninsured, and patients with an increased risk of mortality.

Keywords

palliative care; complications; head and neck neoplasms; costs; Nationwide Inpatient Sample

Introduction

A substantial amount of health care resources are used on aggressive end-of-life care, with 7% of the total Medicare budget spent in the last month of life alone.¹ These patterns of care can be improved with an integration of palliative care into end-of-life care, which improves

Address for correspondence: Christine G. Gourin, M.D., F.A.C.S., Johns Hopkins Outpatient Center, Department of Otolaryngology-Head and Neck Surgery, 601 N. Caroline Street Suite 6260, Baltimore, MD 21287, Phone: (410) 614-0609, Fax: (410) 614-8610, cgourin1@jhmi.edu.

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quality of life, patient and caregiver satisfaction, and reduces health care costs.² The National Comprehensive Cancer Network (NCCN) and National Consensus Project for Quality Palliative Care recommend that physicians discuss end-of-life planning with patients with incurable cancer and a life expectancy of less than 1 year.^{3,4} Patients who have discussed end-of-life care with their physician are more likely to choose palliation over aggressive care, defined as chemotherapy in the last 14 days of life, acute hospital-based care in the last 30 days of life, intensive care unit care in the last 30 days of life.⁵ Such patients are more likely to receive hospice care and have hospice care initiated earlier, and are more likely to die at home or in hospice care. Less aggressive care at the end-of-life is associated with better quality of life; however, fewer than 40% of patients have end-of-life discussions with their physicians.⁶

The goal of palliative care, according to NCCN guidelines, “is to anticipate, prevent, and reduce suffering” and such care “begins at diagnosis and should be delivered concurrently with disease-directed, life-prolonging therapies”.³ Palliative care is offered earlier in the disease process than hospice care and is given in addition to cancer treatment for physical and emotional symptom support. While palliative care services can be provided by the treating physician, increasingly, palliative care specialists work as part of a multidisciplinary team to coordinate care and make recommendations. Head and neck cancer (HNCA) causes significant morbidity, mortality, and unique end-of-life issues that necessitate the incorporation of palliative care. The majority of patients with advanced HNCA have significant pain. Airway complications, communication deficits, intolerance to oral intake, disfigurement, and psychosocial issues are among the other challenging palliative care issues that result from HNCA.⁷ Despite this need, there is a paucity of data regarding end-of-life and palliative care in HNCA. We sought to determine the incidence of palliative care consultations among patients hospitalized with a diagnosis of metastatic, incurable HNCA and the relationship between palliative care encounters and in-hospital morbidity and mortality, length of hospitalization, and costs.

Methods

A cross-sectional analysis of patients admitted with a diagnosis of oral cavity, laryngeal, hypopharyngeal, or oropharyngeal cancer who also had a diagnosis of distant metastatic disease was performed using discharge data from the Nationwide Inpatient Sample (NIS), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality (AHRQ). The NIS is the largest all-payer inpatient care database in the United States, containing data from approximately 8 million hospital stays each year from a stratified sample of 20% of non-federal U.S. hospitals from participating states.⁸ The NIS database provides information regarding the index hospital admission and includes patient demographic data, primary and secondary diagnoses, primary and secondary procedures, hospital characteristics, and inpatient and discharge mortality rates. The International Classification of Disease, 9th revision (ICD-9) codes were used to identify adult patients (≥ 18 years of age) with a diagnosis of a malignant oral cavity, laryngeal, hypopharyngeal, or oropharyngeal neoplasm for the years 2001 through 2010, as previously described.⁹ Patients who underwent a head and neck ablative procedure or neck dissection as previously described were excluded.⁹ Metastatic disease was identified using codes for secondary

malignant neoplasm of respiratory and digestive systems (197.0–197.8), intrathoracic lymph nodes (196.1), intraabdominal lymph nodes (196.2), and other specified sites (198.0–198.8). Patients with codes for secondary unspecified malignant neoplasm of cervical lymph nodes were excluded (196.0) because of inability to determine if this code represented terminal or curable disease.

Inpatient palliative care encounters were identified using the ICD-9 code for encounter for palliative care (V66.7), which includes end-of-life care, hospice care, and terminal care. The AHA Coding Clinic for ICD-9-CM, 1Q 1998, Volume 15(1):11 states the following: “Terms such as comfort care, end-of-life care, and hospice care are all synonymous with palliative care. These, or similar terms, need to be written in the record to support the use of code V66.7.”¹⁰ Radiation therapy was identified using codes for therapeutic radiotherapy including brachytherapy implantation (92.21, 92.22, 92.25, 92.27, 92.28, 92.29), and chemotherapy was coded using codes for injection, infusion or implantation of chemotherapeutic agent (99.25, 99.28, 99.29, 00.10). Prior irradiation was obtained from the codes for previous exposure to therapeutic or other ionizing radiation (V15.3). Comorbidity was graded using the Romano adaptation of the Charlson comorbidity index,^{11–13} excluding ICD-9 codes for the index cancer diagnosis from the solid tumor category. Cancer staging information is not available in the NIS, and as a result ICD-9 codes for metastases were excluded as these have not been shown to be a reliable surrogate for disease stage.¹⁴ Codes for specific comorbid illnesses were used to create categories for acute medical complications as previously described,⁹ as well as dehydration (276.51) weight loss (260, 261, 262, 263.0, 263.1, 263.2, 263.8, 263.9, 783.0, 783.2, 783.21, 783.22, 783.7, V85.0) and dysphagia (787.2, 787.20, 787.21, 787.22, 787.23, 787.24, 787.29, 438.82). Acute medical complications were derived from codes for acute cardiac events, acute pulmonary edema or failure, acute renal failure, acute hepatic failure, acute cerebrovascular events, sepsis, pneumonia, and urinary tract infection assigned at the time of hospital discharge. Intensive care unit (ICU) utilization was defined by codes for continuous invasive mechanical ventilation (96.7, 96.70, 96.71, 96.72) and cardiopulmonary resuscitation (99.6, 99.60, 99.61, 99.62, 99.63, 99.64, 99.69).

Palliative care consultation, chemotherapy, radiation therapy, in-hospital death, medical complications, ICU care, length of hospitalization and costs were examined as dependent variables. Independent variables included were age, sex, race, payer source (commercial or health maintenance organization, Medicare, Medicaid, self-pay, or other), comorbidity, nature of admission (emergent/urgent, or other), hospital ownership/control, hospital bedsize, hospital location (rural or urban), geographic region, hospital teaching status, and hospital volume. Hospital volume was defined by calculating the average annual number of HNCA patient admissions with distant metastatic disease per hospital and was stratified by quintiles. The average annual number of HNCA patient admissions with distant metastatic disease was obtained by calculating the mean of the number of admissions each year for each individual hospital, for the years in which that hospital admitted at least one HNCA cancer patient with distant disease. American Joint Commission on Cancer tumor stage, tumor grade, histological subtype, and outcome after discharge were not available from the NIS database.

Hospital-related charges for each index admission were converted to the organizational cost of providing care using cost to charge ratios for individual hospitals. Cost to charge ratios were calculated using information from the detailed reports by hospitals to the Centers for Medicare and Medicaid Services, providing an estimate of the all-payer inpatient cost-to-charge ratio by hospital.¹⁵ This ratio was multiplied by each patient's charge to obtain the cost per admission.¹⁶ All costs were adjusted for inflation based on U.S. Bureau of Labor Statistics indices, with results converted to 2012 USD.¹⁷ To obtain national cost estimates, all discharges were re-weighted to account for cases where cost estimates were missing.¹⁵

Data were analyzed using Stata 12 (StataCorp, College Station, TX). Associations between variables were analyzed using cross-tabulations and multivariate logistic regression modeling. Data were weighted and modified hospital and discharge weights to correct for changes in sampling over time were applied. Variance estimation was performed using procedures for survey data analysis with replacement. Strata with one sampling unit were centered at the population mean. Variables with missing data for more than 10% of the population were coded with a dummy variable to represent the missing data in regression analysis. The primary clinical endpoints were evaluated using multiple logistic regression analysis. Generalized linear regression modeling with a log link was used to analyze costs and length of stay because these variables were not normally distributed. This protocol was reviewed and approved by the Johns Hopkins Medical Institutions Institutional Review Board.

Results

There were 80,514 cases in 2001–2010 who met study criteria (Table 1). The majority of patients were male, white, with a mean age of 62 years (range, 18–100 years). In-hospital death occurred in 9,116 cases (11%) and a palliative care encounter was documented in 4,029 cases (5%). A palliative care encounter was more likely in white patients, females, patients older than 80 years of age, with private insurance or self-pay payor status, with an acute medical comorbidity, and with a history of prior radiation, but was less likely for patients who received chemotherapy or radiation therapy during admission. There was no association between the use a palliative care encounter and hospital characteristics (size, volume, location, ownership, teaching status, or region), or ICU care. Palliative care encounters were significantly associated with a higher incidence of inpatient death or discharge to a non-acute care facility.

Multiple logistic regression analysis of predictor variables associated with cancer-directed care is shown in Table 2. After controlling for all other variables, chemotherapy was significantly associated with a decreased likelihood of urgent or emergent admission, advanced age, comorbidity, or prior radiation, and was significantly more likely in patients with Medicaid, in urban locations, and increasing hospital volume. The use of radiation was significantly associated with a decreased likelihood of urgent or emergent admission or prior radiation, and was significantly more likely in urban locations, teaching hospitals, and increasing hospital volume. Palliative care during hospitalization was significantly associated with an increased likelihood of age greater than 80 years, female sex, self-pay payor status, and prior radiation, but was significantly less likely for patients with Medicare

or Medicaid. There was no significant association between type of admission, comorbidity, race, hospital characteristics or location and inpatient palliative care. Palliative care was significantly less likely in patients receiving chemotherapy (odds ratio [OR] 0.27, 95% confidence interval [CI] 0.18–0.38, $P<0.001$) or radiation (OR 0.60, 95% CI 0.37–0.97, $P=0.037$) during the same admission.

Multivariable logistic regression analysis of variables associated with short-term mortality, acute medical complications and ICU care showed a significant association between palliative care and short-term mortality (OR=4.89, 95% CI 4.02–5.94, $P<0.001$), after controlling for all other variables. There was no significant association between palliative care consultation and acute medical complications (OR 1.07, 95% CI 0.89–1.28, $P=0.423$) or ICU care (OR 1.20, 95% CI 0.87–1.65, $P=0.254$). However, there was a significant relationship between palliative care, chemotherapy administration, and acute medical complications, with a significantly increased likelihood of acute medical complications in patients receiving chemotherapy who also had palliative care involvement (OR 3.24, 95% CI 1.76–5.98, $P<0.001$). Chemotherapy and radiation administration were not significantly associated with an increase in acute morbidity or mortality.

Multivariate generalized linear regression analyses of independent variables predictive of length of hospital stay and hospital-related costs are shown in Table 3, with mean values representing the change in the value of the intercept mean. Medicaid insurance, comorbidity, black or Hispanic race, urban hospital location, and administration of chemotherapy or radiation were significantly associated with both increased length of hospitalization and hospital costs. Female sex, Medicare, self-pay payer status, and large hospital size were additionally associated with greater length of hospitalization. Palliative care was associated with significantly lower hospital-related costs but had no significant effect on length of hospitalization. There was a significant interaction between palliative care, chemotherapy administration, and costs, with a mean incremental increase in costs of \$6,161 ($\beta=0.4562$, 95% CI 0.1250–0.7875, $P=0.07$) in patients receiving chemotherapy who also had palliative care involvement.

Discussion

There has been an increasing trend of aggressive cancer treatment near the end of life despite a growing body of evidence that palliative care improves outcomes and reduces healthcare costs at the end of life.^{18–23} Patients with HNCA bear a particularly high burden of morbidity and mortality and have unique palliative care needs resulting from the effects of both the disease process and treatment.^{7, 24–27} Despite the need for specialized end-of-life care, few studies have examined palliative and end-of-life care among HNCA patients. We undertook this analysis to examine trends associated with the use of inpatient palliative care services among patients with metastatic HNCA.

In this study, among 80,514 hospital admissions for patients with metastatic HNCA, palliative care as evidenced by the V66.7 code was documented in only 5% of cases. Palliative care encounters were less likely among patients receiving chemotherapy or radiation during the hospital admission. Patients with palliative care encounters had

increased in-hospital mortality during the same admission, but incurred significantly lower hospital-related costs with no change in length of hospitalization. Of note, we could not determine if patients had a formal palliative care consultation done or not, as there is no “code” for that. Instead, we used the V66.7 code that is applied after discharge when coders search for words in the medical chart associated with hospice or palliative care.²⁸ To our knowledge, this is the first such use of this code to determine any potential use of palliative care. Given the extremely low rate of palliative care utilization at any time in patients with a similar disease - 8–9% for lung cancer patients and usually near the time of death,^{29,30} we think that the 5% use of the V66.7 code may well represent an overestimate of actual palliative care use.

In 2003, at the M.D. Anderson Cancer Center, a 400-bed cancer hospital, only 10 patients (2.5%) were admitted to the Palliative Care Inpatient Service.³¹ In a 982 bed German hospital in 2010, 6.9% and 9.1% of cancer patients over 65 years of age had palliative care needs.³² A point prevalence survey in 3 Australian hospitals showed that 35% were classifiable as “requiring a palliative approach” but only 22% of those patients were referred for palliative care – overall, a total of 7.7%.³³ A point prevalence study in Norway showed that 36% of all patients were classified as “palliative” as defined by “advanced, serious, chronic disease with limited life expectancy and symptom relief as the main goal of treatment”.³⁴ The V66.7 code used in our study is uniformly recognized as the only diagnosis code specifically associated with palliative care, but may be used differently by hospital raters of quality.³⁵ Regardless of methodology, these data show that the use of palliative care remains low in a disease with a high symptom burden.

In 2012, the American Society of Clinical Oncology published a provisional clinical opinion to guide the integration of palliative care into standard oncology practice at the time of metastatic cancer diagnosis.¹⁹ The NCCN also recommends early palliative care involvement as part of cancer care, and the Institute of Medicine’s Committee on Improving the Quality of Cancer Care stated that “a *primary* emphasis” should be placed on providing palliative care to advanced cancer patients.^{3,36} Along with growing acceptance of the importance of palliative care services, access to palliative care is improving. The general availability of inpatient palliative care teams at hospitals over 50 beds increased from 24.5% in 2000 to 65.7% in 2010, with 81% of hospitals over 300 beds having palliative care programs by 2010, the end of this study.³⁷ Despite these facts, the American Academy of Hospice and Palliative Care Medicine (AAHPM) task force reported an acute shortage of palliative care physicians as recently as 2010, suggesting that lack of availability remains an issue.³⁸ We did observe an increase in the use of the V66.7 code during the time of our study, from 3.2% of cases in 2001 to 10.1% of cases in 2010, demonstrating a temporal trend of increasing utilization of inpatient palliative care services and suggesting an increase in hospital-based palliative care programs; it may also reflect an increasing awareness of the V66.7 code. Overall however, our study suggests that palliative care remains underutilized, as only 5% of the patients in our study had evidence of palliative care involvement during inpatient hospital admission even after controlling for hospital size. As this study was confined to inpatients with incurable disease, these data suggest that palliative care services are not adequately being utilized to serve terminal HNCA patients who could most benefit.

The association between palliative care encounters and death during the same hospitalization suggests that inpatient palliative care consultation occurs late in the course of illness when patients begin to deteriorate medically and are close to death. A study by Earle and colleagues¹⁸ reported that among patients who received hospice care, hospice care was initiated in the last three days of life in an increasing proportion of patients during a four-year period of time. In a study of Medicare patients enrolled in hospice, almost half died within 14 days of enrollment,³⁹ and a study of HNCA patients reported a mean time-to-death after hospice initiation of 19.5 days.²⁴ Dy et al⁴⁰ have reported that hospice utilization in Medicare patients was not associated with changes in the utilization of hospital services in the last year of life except in nursing home residents, and in chronically disabled patients, hospice utilization was not associated with a decrease in inhospital deaths, which may be due to substantial resource investments and greater intensity of care. Our findings support the observation made by Earle et al¹⁸ that despite an increase in palliative care utilization, in many cases, palliative care and hospice services are used to manage death *at* the time of death, rather than for palliation during a more substantial end-of-life period.

Patients receiving palliative care services in this study incurred significantly lower hospital costs. This finding is consistent with a substantial body of evidence demonstrating that palliative care and end-of-life discussions significantly lower costs of care.^{6,19,21,22,41–45} We found that patients undergoing chemotherapy or radiation therapy were less likely to have a palliative care encounter, with the exception of patients undergoing chemotherapy who sustain an acute medical complication. Not surprisingly, chemotherapy and radiation were also associated with longer lengths of stay and increased in-hospital costs. The inverse relationship between palliative care encounters and cancer-directed therapies may be due to patient or physician preferences or a belief that anticancer treatment is not compatible with advance care planning discussions, even in patients in whom the future is predictable. The relationship may also be related to availability of services, as local availability of hospice or palliative care services has been shown to be associated with less aggressive care.¹⁸ While chemotherapy may be used for palliative purposes, an overwhelming majority of patients with incurable cancer believe that the chemotherapy treatments they are receiving may be curative.⁴⁶ Chemotherapy at the end of life in patients with terminal cancer results in minimal or no survival benefit and contributes to disproportionate health-care spending at the end of life.^{47,48}

There are several limitations to the use of hospital discharge data, which may influence our findings. The NIS database provides no follow-up data beyond the index admission and is limited to a 30-day postoperative window, and contains no information on stage of disease, grade, subtype, or long-term survival. Thus a meaningful analysis of long-term outcomes is not possible from the available data. While comorbidity scores were used for risk classification, the ability to adequately control for case mix is limited when discharge diagnoses from administrative databases are used. Another potential limitation is that the cost analysis was based on hospital-related charges, adjusted for institutional expense-to-revenue ratios, and did not include physician-related costs or services provided outside of the hospital, as these data are not contained in the NIS database.

We could not determine the availability of palliative care consultative services at the respective hospitals during this time period. As mentioned, we were unable to determine if patients underwent a formal palliative care consultation; beyond the use of the V66.7 code, the only way to determine the incidence of palliative care consultations using administrative data would be to link the CPT code for an inpatient consultation to the specialty of the consultation physicians. However, the AAHPM reports that there are fewer than 5000 board certified palliative care physicians,³⁸ suggesting the possibility that in some cases the physicians providing inpatient palliative care consultations may not be board-certified palliative care physicians, resulting in underestimation of this type of care. As the NIS is limited to ICD-9 codes only, such analysis cannot be performed.

Nevertheless, these data do demonstrate that inpatient palliative care encounters are uncommon in patients with terminal HNCA and are more common in patients who die in the hospital. Palliative care for patients with terminal HNCA is associated with reduced hospital-related costs, but appears to be underutilized and restricted to the elderly, uninsured, and patients with an increased risk of mortality. Increased use of palliative care services is needed to ensure that such care is used to accomplish the goal of palliation of disease symptoms rather than being used to manage death and complications.

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Table 1

Demographic characteristics.

	All Patients (N=80,514)	No palliative care encounter (N=76,485)	Palliative care encounter (N=4,029)	P value
Primary Site				0.0220
Oral Cavity	22.9%	22.6%	27.3%	
Larynx	30.6%	30.8%	27.1%	
Hypopharynx	7.4%	7.4%	6.7%	
Oropharynx	39.1%	39.2%	38.9%	
Age Group				0.0224
40 years	3.3%	3.3%	3.8%	
40–64 years	56.4%	56.6%	54.5%	
65–80 years	34.4%	34.4%	33.3%	
>80 years	5.9%	5.7%	8.4%	
Race				0.0201
White	56.8%	54.4%	62.3%	
Black	13.9%	14.0%	12.2%	
Hispanic	6.4%	6.5%	5.8%	
Asian or Pacific Islander	1.4%	1.4%	1.8%	
Native American	0.5%	0.5%	0.4%	
Other	1.9%	1.9%	1.6%	
Unknown	21.1%	21.3%	15.9%	
Sex				0.0179
Male	74.5%	74.7%	70.5%	
Female	25.5%	25.3%	29.5%	
Payor				<0.0001
Private	42.7%	28.7%	33.3%	
Medicare	20.8%	43.1%	35.4%	
Medicaid	28.9%	21.1%	16.0%	
Self-pay	3.5%	3.4%	5.3%	
No Charge	0.6%	0.6%	0.8%	
Other	3.4%	3.1%	9.2%	

	All Patients (N=80,514)	No palliative care encounter (N=76,485)	Palliative care encounter (N=4,029)	P value
Nature of Admission				0.0824
Elective	24.6%	24.8%	21.1%	
Emergency/Urgent	75.4%	75.2%	78.9%	
Comorbidity				0.0570
0	54.9%	54.6%	59.6%	
1	29.2%	29.3%	27.2%	
2	10.1%	10.2%	8.4%	
3	5.8%	5.9%	4.8%	
Prior radiation				<0.0001
No	94.7%	95.0%	89.9%	
Yes	5.3%	5.0%	10.1%	
In-hospital radiation				0.0012
No	93.5%	93.3%	97.3%	
Yes	6.5%	6.7%	2.7%	
Chemotherapy				<0.0001
No	86.8%	83.0%	97.7%	
Yes	16.3%	17.0%	4.9%	
Hospital Volume Quintile				0.2841
Very low	20.5%	20.5%	21.7%	
Low	19.4%	19.5%	18.1%	
Intermediate	19.2%	19.1%	20.2%	
High	20.6%	20.4%	23.0%	
Very high	20.3%	20.5%	16.0%	
Hospital Bedsize				0.2795
Small	11.46	11.7%	9.6%	
Medium	22.0%	21.9%	24.7%	
Large	66.4%	66.4%	65.7%	
Hospital Teaching Status				0.9194
Non-teaching hospital	44.1%	44.1%	43.8%	
Teaching hospital	55.9%	55.9%	56.2%	
Hospital Ownership/Control				0.5859

	All Patients (N=80,514)	No palliative care encounter (N=76,485)	Palliative care encounter (N=4,029)	P value
Government, nonfederal	20.1%	20.0%	22.6%	
Private, nonprofit	70.2%	70.3%	67.7%	
Private, for profit	9.7%	9.7%	9.7%	
Geographic Region				0.8546
Northeast	21.2%	21.2%	20.9%	
Midwest	24.2%	24.3%	22.3%	
South	38.4%	38.4%	40.2%	
West	16.2%	16.1%	16.6%	
Hospital location				0.6318
Rural	10.9%	10.9%	11.6%	
Urban	89.1%	89.1%	88.4%	
Medical comorbidities				
Acute cardiac event	12.1%	12.1%	10.3%	0.1320
Acute pulmonary edema/failure	9.0%	8.8%	12.3%	0.0023
Acute cerebrovascular event	1.0%	1.0%	6.1%	0.0374
Acute renal failure	4.9%	4.8%	6.1%	0.1303
Acute hepatic failure	0.1%	0.1%	0.3%	0.3072
Pneumonia	21.6%	21.5%	23.1%	0.3008
Sepsis	5.1%	5.1%	5.1%	0.9165
Urinary tract infection	4.8%	4.8%	4.5%	0.7116
Weight loss	18.2%	18.1%	20.1%	0.2117
Dysphagia	12.7%	12.8%	12.4%	0.7579
Dehydration	9.2%	9.2%	10.3%	0.3327
ICU care				
Mechanical ventilation	5.8%	5.7%	6.9%	0.1858
Cardiopulmonary resuscitation	0.2%	0.2%	0.3%	0.6090
Disposition				<0.0001
Routine	42.0%	43.5%	14.0%	
Short-term hospital care	2.4%	2.4%	1.4%	
Other facility	18.3%	18.0%	24.0%	
Home health care	25.1%	25.2%	24.4%	

	All Patients (N=80,514)	No palliative care encounter (N=76,485)	Palliative care encounter (N=4,029)	P value
AMA	0.7%	0.6%	0.6%	
Died in hospital	11.3%	10.1%	34.7%	
Alive, disposition unknown	0.2%	0.2%	0.9%	

Table 2

Multivariate logistic regression analysis of variables associated with cancer-directed care.

	Odds Ratio (95% CI)		
	Chemotherapy	Radiation	Palliative care encounter
Admission type			
Elective admission	Ref	Ref	Ref
Urgent/emergent admission	0.33 (0.26–0.41)	0.78 (0.65–0.94)	1.22 (0.96–1.56)
Age			
Age 40 years	Ref	Ref	Ref
Age 41–64 years	0.79 (0.61–1.02)	1.09 (0.75–1.59)	0.98 (0.63–1.52)
Age 65–80 years	0.55 (0.42–0.72)	0.91 (0.60–1.37)	1.60 (0.94–2.74)
Age >80 years	0.29 (0.19–0.44)	1.03 (0.62–1.71)	2.41 (1.35–4.31)
Sex			
Male	Ref	Ref	Ref
Female	1.01 (0.89–1.16)	0.98 (0.82–1.17)	1.20 (1.00–1.45)
Payor status			
Private insurance	Ref	Ref	Ref
Medicare	1.07 (0.90–1.28)	1.05 (0.83–1.33)	0.49 (1.00–1.45)
Medicaid	1.26 (1.00–1.59)	1.11 (0.87–1.42)	0.71 (0.55–0.91)
Self-pay, other	1.01 (0.79–1.29)	1.12 (0.83–1.50)	1.87 (1.36–2.58)
Comorbidity			
Comorbidity score 0	Ref	Ref	Ref
Comorbidity score 1	0.77 (0.68–0.88)	0.84 (0.72–1.00)	0.92 (0.77–1.10)
Comorbidity score 2	0.54 (0.43–0.67)	0.99 (0.76–1.30)	0.77 (0.57–1.05)
Comorbidity score 3	0.62 (0.49–0.80)	0.97 (0.73–1.29)	0.84 (0.58–1.22)
Race			
White	Ref	Ref	Ref
Black	1.00 (0.82–1.23)	1.10 (0.85–1.41)	0.79 (0.60–1.04)
Hispanic	1.70 (1.30–2.21)	0.93 (0.70–1.24)	0.74 (0.47–1.17)
Other	1.33 (0.94–1.88)	1.12 (0.69–1.80)	0.82 (0.53–1.25)
Teaching hospital			

	Odds Ratio (95% CI)		
	Chemotherapy	Radiation	Palliative care encounter
Non-teaching hospital	Ref	Ref	Ref
Teaching hospital	1.13 (0.78–1.63)	1.56 (1.20–2.03)	1.07 (0.78–1.48)
Location			
Rural	Ref	Ref	Ref
Urban location	1.69 (1.12–2.54)	2.12 (1.30–3.47)	0.91 (0.67–1.23)
Geographic Region			
Northeast	Ref	Ref	Ref
Midwest	0.72 (0.41–1.27)	1.07 (0.53–2.14)	1.13 (0.75–1.70)
South	0.57 (0.36–0.90)	0.67 (0.47–0.96)	1.09 (0.76–1.55)
West	0.77 (0.50–1.20)	0.67 (0.47–1.00)	1.07 (0.72–1.58)
Hospital bedsize			
Small	Ref	Ref	Ref
Medium	1.30 (0.88–1.92)	1.48 (0.98–2.23)	1.32 (0.90–1.93)
Large	1.03 (0.70–1.53)	1.81 (1.24–2.64)	1.23 (0.86–1.76)
Hospital Ownership/Control			
Government, nonfederal	Ref	Ref	Ref
Private, nonprofit	1.05 (0.77–1.44)	1.02 (0.72–1.43)	0.84 (0.63–1.13)
Private, for profit	1.14 (0.76–1.72)	1.15 (0.70–1.90)	0.77 (0.47–1.25)
Hospital Volume Quintile			
Very low	Ref	Ref	Ref
Low	1.98 (1.50–2.60)	1.35 (0.96–1.91)	0.86 (0.63–1.16)
Intermediate	2.60 (1.90–3.57)	1.56 (1.07–2.25)	0.93 (0.67–1.29)
High	3.90 (2.69–5.66)	1.54 (1.03–2.29)	1.01 (0.69–1.49)
Very high	3.42 (1.91–6.12)	1.92 (1.09–3.36)	0.68 (0.38–1.18)
Prior radiation			
No prior radiation	Ref	Ref	Ref
Prior radiation	0.68 (0.51–0.90)	0.60 (0.37–0.97)	2.03 (1.55–2.65)

BOLD: p<0.05 vs. reference category

Table 3

Generalized linear regression analysis of length of stay and hospital costs.

Length of hospitalization				Costs	
	Estimate (95% CI)	Mean (days)	Estimate (95% CI)	Mean (USD)	
<i>Intercept</i>	1.7186 (1.5086–1.9286)	7.3	9.44047 (9.265–9.5930)	\$13,506	
<i>Admission type</i>					
Elective admission	Ref	Ref	Ref	Ref	Ref
Urgent/emergent admission	0.0445 (–0.0644–0.1535)	0.3	0.0100 (–0.0533–0.0734)	\$135	
<i>Age</i>					
Age 40 years	Ref	Ref	Ref	Ref	Ref
Age 41–64 years	–0.0878 (–0.1926–0.0169)	–0.6	–0.1337 (–0.2443–0.0231)	–\$1,807	
Age 65–80 years	–0.0635 (–0.1761–0.0490)	–0.5	–0.1408 (–0.2585–0.0232)	–\$1,902	
Age >80 years	–0.0323 (–0.1565–0.0918)	–0.2	–0.1851 (–0.3157–0.0546)	–\$2,501	
<i>Sex</i>					
Male	Ref	Ref	Ref	Ref	Ref
Female	0.0480 (0.0044–0.0915)	0.3	0.0060 (–0.0367–0.0487)	\$81	
<i>Payer status</i>					
Private insurance	Ref	Ref	Ref	Ref	Ref
Medicare	0.0800 (0.0282–0.1318)	0.6	0.0092 (–0.0463–0.0648)	\$124	
Medicaid	0.2429 (0.1821–0.3037)	1.8	0.1113 (0.0468–0.1758)	\$1,503	
Self-pay, other	0.1342 (0.0637–0.2047)	1.0	0.0329 (–0.0431–0.1090)	\$444	
<i>Comorbidity</i>					
Comorbidity score 0	Ref	Ref	Ref	Ref	Ref
Comorbidity score 1	0.1558 (0.1170–0.1945)	1.1	0.1635 (0.1242–0.2027)	\$2,208	
Comorbidity score 2	0.2263 (0.1636–0.2890)	1.6	0.2540 (0.1878–0.3202)	\$3,430	
Comorbidity score 3	0.2391 (0.1654–0.3128)	1.7	0.3025 (0.2250–0.3801)	\$4,087	
<i>Race</i>					
White	Ref	Ref	Ref	Ref	Ref
Black	0.1785 (0.1172–0.2397)	1.4	0.1230 (0.0632–0.1827)	\$1,738	
Hispanic	0.2091 (0.0713–0.3470)	1.7	0.1486 (0.0561–0.2410)	\$2,143	
Other	0.0463 (–0.0520–0.1447)	0.3	0.0643 (–0.0435–0.1722)	\$895	

	Length of hospitalization			Costs		
	Estimate (95% CI)	Mean (days)	Estimate (95% CI)	Mean (USD)		
Teaching hospital						
Non-teaching hospital	Ref	Ref	Ref	Ref	Ref	
Teaching hospital	-0.0962 (-0.2371-0.0447)	-0.7	0.0252 (-0.0564-0.1070)	\$341		
Location						
Rural	Ref	Ref	Ref	Ref	Ref	
Urban location	0.1747 (0.1026-0.2468)	1.3	0.2340 (0.1558-0.3122)	\$3,161		
Geographic Region						
Northeast	Ref	Ref	Ref	Ref	Ref	
Midwest	-0.3169 (-0.4691-0.1647)	-2.3	-0.2355 (-0.3261-0.1448)	-\$3,181		
South	-0.2331 (-0.3890-0.0772)	-1.7	-0.3281 (-0.4184-0.2379)	-\$4,432		
West	-0.2410 (-0.3929-0.0772)	-1.7	-0.0458 (-0.1437-0.0520)	-\$619		
Hospital bedsize						
Small	Ref	Ref	Ref	Ref	Ref	
Medium	0.0212 (-0.0538-0.0963)	0.2	-0.1012 (-0.2220-0.0194)	-\$1367		
Large	0.1258 (0.0554-0.1961)	0.9	-0.0242 (-0.1447-0.0962)	\$327		
Hospital Ownership/Control						
Government, nonfederal	Ref	Ref	Ref	Ref	Ref	
Private, nonprofit	-0.0311 (-0.0976-0.0353)	-0.3	-0.1094 (-0.1722-0.0466)	-\$1,478		
Private, for profit	0.004 (-0.0806-0.0955)	0.1	0.0414 (-0.0924-0.1752)	\$559		
Hospital Volume Quintile						
Very low	Ref	Ref	Ref	Ref	Ref	
Low	-0.0147(-0.0787-0.0492)	-0.1	0.0296 (-0.0442-0.1034)	\$399		
Intermediate	0.0160 (-0.0576-0.0897)	0.1	0.0344 (-0.0725-0.1414)	\$465		
High	0.0015 (-0.0947-0.0978)	0	0.0428 (-0.0734-0.1592)	\$579		
Very high	0.0295 (-0.1917-0.2507)	0.2	0.1312 (-0.0145-0.2480)	\$1,773		
Chemotherapy						
No	Ref	Ref	Ref	Ref	Ref	
Yes	0.1643 (0.0727-0.2559)	1.2	0.2525 (0.1883-0.3166)	\$3,410		
Radiation						
No	Ref	Ref	Ref	Ref	Ref	

	Length of hospitalization			Costs		
	Estimate (95% CI)	Mean (days)		Estimate (95% CI)	Mean (USD)	
Yes	0.4189 (0.3219–0.5158)	3.0		0.4411 (0.3526–0.5296)	\$5,957	
<i>ICU care</i>						
No	Ref	Ref		Ref	Ref	
Yes	0.5795 (0.5103–0.6487)	5.5		0.9212 (0.8569–0.9856)	\$19,323	
<i>Palliative care encounter</i>						
NO	Ref	Ref		Ref	Ref	
Yes	0.0338 (–0.0520–0.1197)	0.3		–0.2382 (–0.3307–0.1456)	–\$3,395	