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Authors

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ORIGINAL RESEARCH

End-of-Life Healthcare Use of Medicare Patients with Melanoma Based on Patient Characteristics and Year of Death

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Introduction: Many cancer patients receive overly intensive care at end-of-life (EOL). There is limited knowledge about care received by patients dying with melanoma. We assessed healthcare use during EOL, patient characteristics associated with differences in care, and how healthcare use changed over time.

Methods: We used the Surveillance, Epidemiology, and End Results-Medicare database to identify melanoma patients aged 65 years and older at diagnosis between 2000 and 2009, and who died by December 31, 2010. We included patients enrolled in Medicare part A and B six-months before diagnosis and not in managed care for the last 30 days of life. We examined use patterns during the last month of life.

Results: Among 9099 patients dying with melanoma, 5% had two or more emergency department visits, 3% had two or more hospitalizations, and 5% had one stay in the intensive care unit during their last month of life; 7.5% died in the hospital, and 2% received chemotherapy during their last two weeks of life. Multivariable analysis revealed that patients who were married, male, or with a higher comorbidity burden received higher intensity EOL care. Temporal analysis revealed a doubling in the number of patients with multiple hospitalizations (4% vs 2%), emergency department visits (6% vs 3%), and care in the intensive care unit (7% vs 3%) between 2001 and 2010.

Conclusions: Patients with melanoma in the United States are receiving EOL care that meets or exceeds benchmarks. They are also increasing their healthcare use during EOL.

Keywords: melanoma, end-of-life care, cancer, healthcare use, Medicare

Overly intensive care at end-of-life (EOL) does not improve survival^{1,2} and harms patients and families.^{3,4} In a series of seminal papers, Earle and others worked with patients, oncologists, and other stakeholders to define markers that would indicate overly intensive care and poor quality EOL care.⁵⁻⁷ Indicators of inappropriately intense care included frequent hospitalization and/or emergency department (ED) visits, admission to the intensive care unit (ICU), receipt of chemotherapy at EOL, and dying in the hospital. Benchmarks were established based on observational studies and have since been accepted by the National Quality

Forum as markers of quality EOL care.⁸ However, little is known about EOL care received by patients dying with melanoma, despite the high prevalence and increasing incidence of the disease.⁹

National studies of patients dying from other malignancies revealed significant differences in the intensity of EOL care based on treatment region, race, age, gender, rurality, marital status, underlying comorbidities, and sociodemographic characteristics.^{7,10-16} One prior study which included patients with both non-small-cell and small-cell lung cancer found healthcare utilization at end-of-life correlated with the underlying malignancy.¹⁷ Only a few studies looked at EOL care received by patients with melanoma. These studies were either smaller samples and/or did not include the full range of EOL care measures recognized as important quality

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markers. Hillner and others reported a consecutive series of cases treated at one cancer center that had incomplete EOL data. They found relatively infrequent hospitalizations and low rates of dying in the hospital.¹⁸ Another study described high rates of chemotherapy, hospitalization, and dying in the hospital for melanoma patients in France.¹⁹ In the Surveillance, Epidemiology, and End Results (SEER)-Medicare database, the economic burden for EOL care was high for patients dying with melanoma between 1991 and 1996.²⁰ Finally, Huo and others described rates of hospice, surgery, radiation therapy, and chemotherapy for patients with metastatic melanoma. They found that surgery and hospice use increased over time, with stable rates of chemotherapy and radiation therapy.²¹ We recently reported that rates of hospice enrollment increased over time for patients dying with melanoma but remained under accepted quality benchmarks. We also found notable differences in hospice receipt based on patient characteristics.²³ However, none of these studies used national data to fully characterize EOL care, including hospitalizations, ED visits, and ICU admissions. Although some studies reported increasing rates of healthcare use at EOL for other diseases and malignancies, they did not assess whether this trend also occurs for melanoma.^{11,24,25}

Overall, EOL care for patients dying with melanoma has been relatively understudied compared with other malignancies. Understanding these differences is important to designing interventions that successfully improve the quality of EOL care. We sought to identify the intensity of EOL care received by older patients dying with melanoma, describe patient characteristics associated with higher rates of healthcare use, and define how EOL care for melanoma patients has changed over time.

METHODS

Study design and data sources

Our study design was a retrospective cohort analysis using data from the linkage of the Surveillance, Epidemiology, and End Results (SEER) registries with Medicare claims data.²⁸ An estimated 97% of incident cases are captured by cancer registries within SEER regions²⁷ that represent the US population.²⁸ SEER registries include data on age at diagnosis, sex, race/ethnicity, marital status, and date and cause of death for each reported malignancy.²⁶ Cause of death is determined by information on

the death certificate.²⁶ Sociodemographic data, including education, income and rurality, are assigned to cases at the Census tract-level based on the 2000 Census. Medicare data include claims for hospitalizations, ED visits, ICU stays, and chemotherapy administration for patients enrolled in fee-for-service Medicare (both Part A and Part B). Periodically, SEER and Medicare data are linked for research purposes, with a match rate of 94%.²⁹ Our data included claims from January 1, 1999 through December 31, 2010 for melanoma cancer cases diagnosed between 2000 and 2009. Approval was obtained from the IRB at Maine Medical Center. SEER-Medicare data are de-identified and do not require informed consent.

Cohort definition

The cohort included patients diagnosed with pathologically confirmed melanoma and age 65 and older between 2000 and 2009 (inclusive) while living in a SEER area. Patients were enrolled in Medicare A and B for six months before diagnosis to calculate a Charlson Comorbidity Score. To obtain complete data on resource use, we included only patients who were enrolled in Medicare A and B for the last 30 days of life. We excluded 365 patients without pathologically confirmed disease or disease diagnosed at time of death, as well as 58,814 patients who did not die from cancer during the period of observation (before December 31, 2010). In the cohort, 9,099 patients remained available for analysis. Death certificate data is imprecise,²⁶ so we included all melanoma patients who died of any cancer to maximize our statistical power. We then performed a sensitivity analysis on the subset of patients who had melanoma definitively identified as a cause of death (n = 4,780).

Patient characteristics

Patients were categorized based on years of age at diagnosis (65-69, 70-74, 75-79, 80-84, ≥85). Race was defined as black, white, and "other" (Hispanic, Asian, Native American, or Other). Marital status was defined as married (included domestic partners) or not married. The American Joint Committee on Cancer classification, as reported in the SEER records, were used to determine disease stage at the time of diagnosis. Rurality was categorized into the following groups of population density: ≥250,000, 20,000-249,999, 2500-19,999, <2500. US census data for median household income and educational attainment were used as proxies for socioeconomic status. State Buy-In, which indicates

whether the state contributes to a beneficiary's Medicare premiums, was included as a proxy for an individual's lower socioeconomic status.³⁰ Charlson Comorbidity Score was calculated on all patients using claims submitted during the six months before diagnosis.³¹

Outcomes

For the analysis, five outcomes accepted as markers for high quality EOL care for cancer patients were used.^{5,8,32} Three outcomes are related to healthcare use in the last 30 days of life: ≥ 2 ED visits, ≥ 2 hospitalizations, and any ICU stay. The time period for receipt of chemotherapy was the last 14 days. We also examined inpatient deaths and changes in each of the healthcare use outcomes over the study period.

Statistical analysis

All data were analyzed using SAS 9.3 (SAS Institute). We used chi-square tests and student's t-tests to compare proportions and continuous variables as appropriate. Separate logistic regression models were developed for each of the five outcomes to obtain odds ratios (ORs) for predictors of interest. The models included the following predictors: age (categorical), gender, tumor stage at diagnosis, race, marital status, Charlson Comorbidity Score, rurality, and census tract variables for median household income and education.

RESULTS

Cohort description

The SEER-Medicare database contained 136,969 cases of melanoma diagnosed between 2000 and 2009. Of these, 69,572 were >65 years old at the time of diagnosis and were enrolled in Medicare A and B for six months before diagnosis (necessary to calculate the Charlson Comorbidity Score). Another 60,473 were excluded because they did not have pathologically confirmed melanoma before time of death, were still alive at the end of the study period, died of a cause other than cancer, or were not enrolled in fee-for-service Medicare during their last month of life. The final cohort contained 9,099 patients.

Most patients were 75 years old or older (65%), male (69%), married or had a domestic partner (64%), white (98%), lived in a densely populated area (73%), and came from census tracts with a median household income over \$30,000 (88%)

(Table 1). Nine percent of the cohort received State Buy-In. Fourteen percent of the cohort had a Charlson Comorbidity Score of two or higher.

Intensity of EOL care analyses

Analysis of health care use revealed that 5% of patients had ≥ 2 ED visits, 3% had ≥ 2 hospitalizations, and 5% had an ICU admission during their last month of life (Table 2). Two percent of the patients received chemotherapy in the last two weeks of life, and 8% died in the hospital.

We noticed differences in the types of patients who received more intensive care at EOL (Table 2). Patients 85 years old and older were less likely to receive overly intensive care at EOL on all measures, though these differences were small. Patients with a Charlson Comorbidity Score of ≥ 2 at the time of diagnosis were more likely to have ED visits (7% vs 5%, $P < .0001$), hospitalizations (4% vs 3%, $P = .002$), and ICU stays (8% vs 5%, $P < .0001$) at EOL compared to patients with fewer comorbidities. They were also more likely to die in the hospital (9% vs 7%, $P = .001$). Males were more likely than females to have higher healthcare use at EOL, as indicated by higher rates of ED visits (6% vs 4%, $P = .002$) and hospitalizations (3% vs 2%, $P = .007$). Patients residing in more rural areas were less likely to receive chemotherapy. Finally, there were differences based on sociodemographic characteristics: State Buy-In was associated with a lower rate of in-hospital death (5% vs 8%, $P = .01$), and residing in a census tract with lower rates of high school completion was associated with higher rates of ED visits (6% vs 4%, $P = .04$).

Multivariable analysis

Multivariable models revealed that differences in EOL care persisted based on gender, age, and marital status after adjusting for other factors (Table 3). Male patients were more likely to have ≥ 2 ED visits (OR 1.33; 95% CI 1.04 to 1.71) and ≥ 2 hospitalizations (OR 1.55; 95% CI 1.10 to 2.19) during EOL compared with female patients. Older patients were less likely to receive chemotherapy compared with the youngest age group (OR 0.46; 95% CI 0.22 to 0.95). Patients with higher Charlson Comorbidity Scores at the time of diagnosis were more likely to have higher healthcare use on all measures except chemotherapy (Table 3).

Table 1. Characteristics of Patients (n=9099)

Characteristic	Number	Percent
Age group, years		
66-69	1319	14%
70-74	1876	21%
75-79	2199	24%
80-84	2014	22%
85 ≤	1691	19%
Gender		
Female	2839	31%
Male	6260	69%
Race		
White	8892	98%
Black	78	1%
Other	116	1%
Married		
No	2780	36%
Yes	4882	64%
Stage at Diagnosis		
Not staged/ missing	2549	28%
In situ	1231	13%
Local	2819	31%
Regional	1252	14%
Distant	1248	14%
Charlson Comorbidity Index		
0-1	7860	86%
2 ≤	1239	14%
Urban/rural residence		
250,000 ≤	6669	73%
20,000-249,999	1501	17%
2500-19999	732	8%
<2500	196	2%
State Buy-in at death		
No	8279	91%
Yes	820	9%
Education for census tract		
>20% fewer than 12 yrs	2764	32%
10-20% fewer than 12 yrs	2912	33%
0-10% fewer than 12 yrs	3031	35%
Median income of zip code for census tract		
≤\$30,000	991	12%
>\$30,000	7457	88%

Table 2. Unadjusted Intensity of Care According to Patient Baseline Characteristics Among Decedents (n=9099)[§]

	≥ 2 ED Visits in Last Month n (%)	P Value	Chemotherapy in Last 2 Weeks n (%)	P Value	≥ 2 Hospitalizations in Last Month n (%)	P Value	ICU Stay Within Last Month n (%)	P Value	Died in Hospital n (%)	P Value
Overall	462 (5%)		168 (2%)		265 (3%)		494 (5%)		681 (8%)	
Benchmark [§]	≤ 4%		≤ 10%		≤ 4%		≤ 4%		< 17%	
Age group, years		0.03		<0.0001		0.003		0.03		0.0002
66-69	59 (5%)		33 (3%)		35 (3%)		65 (5%)		74 (6%)	
70-74	120 (6%)		51 (3%)		69 (4%)		114 (6%)		160 (9%)	
75-79	116 (5%)		48 (2%)		78 (4%)		139 (6%)		199 (9%)	
80-84	96 (5%)		22 (1%)		54 (3%)		104 (5%)		143 (7%)	
85 ≤	71 (4%)		14 (1%)		29 (2%)		72 (4%)		105 (6%)	
Gender		0.002		0.41		0.007		0.25		0.07
Female	114 (4%)		47 (2%)		62 (2%)		142 (5%)		191 (7%)	
Male	348 (6%)		121 (2%)		203 (3%)		352 (6%)		490 (8%)	
Race	NR	0.79	NR	0.13	NR	0.94	NR	0.02	NR	0.63
Married		0.74		0.02		0.64		0.11		0.09
No	144 (5%)		37 (1%)		81 (3%)		132 (5%)		185 (7%)	
Yes	243 (5%)		104 (2%)		132 (3%)		275 (6%)		377 (8%)	
Stage at Diagnosis		0.09		0.001		0.07		0.003		0.002
Not staged/ missing	120 (5%)		41 (2%)		72 (3%)		146 (6%)		204 (8%)	
In situ	79 (6%)		37 (3%)		51 (4%)		92 (8%)		118 (10%)	
Local	127 (5%)		36 (1%)		71 (3%)		125 (4%)		176 (6%)	
Regional	69 (6%)		23 (2%)		33 (3%)		67 (5%)		84 (7%)	
Distant	67 (5%)		31 (3%)		38 (3%)		64 (5%)		99 (8%)	
Charlson Comorbidity Index		<0.0001		0.29		0.002		<0.0001		0.001
0-1	343 (5%)		144 (2%)		199 (3%)		373 (5%)		529 (7%)	
2 ≤	119 (7%)		24 (2%)		66 (4%)		121 (8%)		152 (9%)	
Urban/Rural Residence		0.27		0.03		0.10		0.93		0.50
250,000 ≤	332 (5%)				197 (3%)		359 (5%)		494 (7%)	
20,000 to 249,999	90 (6%)		NR		37 (3%)		85 (6%)		115 (8%)	
2500 to 19,999	31 (4%)				20 (3%)		38 (5%)		52 (7%)	
Less than 2500	NR				11 (6%)		12 (6%)		20 (10%)	
State Buy-In at death		1.00		0.47		0.60		0.05		0.01
No	420 (5%)		156 (2%)		244 (3%)		462 (6%)		638 (8%)	
Yes	42 (5%)		12 (2%)		21 (3%)		32 (4%)		43 (5%)	
Education for census tract		0.04		0.13		0.15		0.75		0.07
>20% fewer than 12 yrs	156 (6%)		41 (2%)		83 (3%)		158 (6%)		232 (8%)	
10-20% fewer than 12 yrs	156 (5%)		55 (2%)		99 (3%)		153 (5%)		219 (8%)	
0-10% fewer than 12 yrs	129 (4%)		67 (2%)		77 (3%)		166 (6%)		206 (7%)	
Median income of zip code for census tract, tertiles		0.60		0.04		0.35		1.00		0.99
>\$30,000	373 (5%)		149 (2%)		225 (3%)		410 (6%)		567 (8%)	
≤\$30,000	54 (6%)		NR		24 (2%)		55 (6%)		76 (8%)	

Cells with n < 11 are suppressed per SEER-Medicare policy. ED, emergency department; ICU, intensive care unit; NR, no result.

Table 3. Multivariable Adjusted Intensity of Care According to Patient Baseline Characteristics Among Decedents (n=9099), ORs (95% CI)^Ω

	≥2 ED Visits in Last Month of Life	Received Chemotherapy <14 days Before Death	>2 Hospitalizations in Last Month of Life	ICU Stay Within Last Month of Life	Died in Hospital
Age group, years					
66-69	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
70-74	1.46 (1.04, 2.06)	1.22 (0.73, 2.04)	1.41 (0.89, 2.22)	1.28 (0.90, 1.81)	1.61 (1.18, 2.21)
75-79	1.10 (0.78, 1.56)	1.05 (0.62, 1.76)	1.24 (0.79, 1.97)	1.30 (0.92, 1.82)	1.64(1.20, 2.23)
80-84	0.91 (0.63, 1.32)	0.56 (0.30, 1.04)	0.93 (0.57, 1.53)	0.92 (0.63, 1.33)	1.26 (0.91, 1.76)
85 ≤	0.70 (0.46, 1.06)	0.46 (0.22, 0.95)	0.58 (0.33, 1.05)	0.91 (0.61, 1.35)	1.20 (0.85, 1.71)
Gender					
Female	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
Male	1.33 (1.04, 1.71)	1.00 (0.67, 1.48)	1.55 (1.10, 2.19)	1.07 (0.84, 1.36)	1.13 (0.92, 1.38)
Race					
White	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
Black	0.52 (0.13, 2.16)	1.15 (0.15, 8.65)	1.16 (0.28, 4.89)	0.83 (0.26, 2.70)	1.34 (0.57, 3.19)
Other	1.18 (0.54, 2.60)	2.16 (0.77, 6.07)	0.68 (0.16, 2.79)	0.17 (0.02, 1.20)	0.77 (0.33, 1.77)
Married					
No	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
Yes	0.84 (0.66, 1.06)	1.40 (0.93, 2.12)	0.71 (0.52, 0.96)	1.06 (0.84, 1.35)	1.07 (0.87, 1.31)
Stage at diagnosis					
Not staged/ missing	0.76 (0.53, 1.10)	0.46 (0.27, 0.78)	0.86 (0.53, 1.39)	0.91 (0.65, 1.29)	0.81 (0.61, 1.09)
In situ	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
Local	0.76 (0.53, 1.08)	0.37 (0.22, 0.64)	0.72 (0.45, 1.16)	0.68 (0.48, 0.96)	0.63 (0.47, 0.85)
Regional	0.94 (0.64, 1.39)	0.60 (0.34, 1.06)	0.83 (0.49, 1.41)	0.84 (0.57, 1.24)	0.71 (0.51, 0.99)
Distant	0.85 (0.58, 1.26)	0.76 (0.45, 1.31)	0.91 (0.54, 1.53)	0.82 (0.56, 1.21)	0.84 (0.61, 1.16)
Charlson Comorbidity Index					
0-1	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
2≤	1.99 (1.54, 2.57)	0.88 (0.55, 1.44)	1.63 (1.14, 2.33)	1.89 (1.46, 2.43)	1.78 (1.43, 2.23)
Urban/rural residence					
250,000 ≤	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
20,000 to 249,999	1.21 (0.93, 1.59)	0.62 (0.36, 1.08)	0.74 (0.48, 1.14)	1.18 (0.90, 1.56)	0.95 (0.74, 1.22)
2500 to 19,999	0.68 (0.42, 1.09)	0.73 (0.32, 1.63)	0.96 (0.54, 1.69)	1.09 (0.73, 1.65)	0.97 (0.68, 1.39)
< 2500	1.27 (0.65, 2.49)	NR	2.32 (1.12, 4.78)	1.61 (0.86, 3.00)	1.48 (0.86, 2.56)
Education for census tract					
>20% fewer than 12 yrs	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
10-20% fewer than 12 yrs	0.94 (0.71, 1.24)	1.29 (0.77, 2.14)	1.24 (0.85, 1.80)	0.86 (0.65, 1.13)	0.86 (0.68, 1.09)
0-10% fewer than 12 yrs	0.78 (0.58, 1.06)	1.32 (0.79, 2.21)	0.81 (0.54, 1.24)	0.89 (0.67, 1.19)	0.76 (0.59, 0.98)
Median income of zip code for census tract					
>\$30,000	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent	1.00 Referent
≤ \$30,000	1.03 (0.71, 1.48)	0.81 (0.37, 1.75)	0.78 (0.45, 1.34)	0.93 (0.65, 1.35)	0.80 (0.58, 1.11)

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Ω Odds ratios presented in each column are the result of separate logistic regression models for each outcome.

Sensitivity analysis

Given the imprecise nature of death certificate data,²⁶ our primary analysis included all patients who died of cancer. Sensitivity analysis with the cohort of patients with melanoma specified as the cause of death revealed similar results in direction and magnitude. However, some of the findings were not statistically significant due to reduced power from a smaller sample size.

Temporal trends

Over time, we observed a doubling in the rates of patients having ≥ 2 ED visits (3% of those who died in 2001 vs 6% in 2010, P trend = .0005) and in having ≥ 2 hospitalizations (2% of those who died in 2001 vs 4% in 2010, P trend = .007) (Figure 1). More than twice as many patients who died in 2010 had an ICU stay compared to those who died in 2001 (7% vs 3%; P trend < .0001). There were no temporal changes in rates of in-hospital death or receipt of chemotherapy during the study period.

DISCUSSION

Our study is the first to use national data of patients with melanoma to describe EOL care received using accepted indicators of quality of care.^{5-8,32} We found modest differences in healthcare use based on sex, marital status, and comorbidities. Overall, patients dying with melanoma met or exceeded the accepted benchmarks for late chemotherapy (2% vs benchmark of $\leq 10\%$), hospitalizations (3% vs benchmark of $\leq 4\%$), and dying in the hospital (8% vs benchmark of $< 17\%$).⁶ In contrast, we found a slightly higher rate of ED visits (5% vs benchmark of $\leq 4\%$) and receipt of ICU care (5% vs benchmark of $\leq 4\%$) during EOL. We also observed a trend of increasingly intensive care over time. By the last year of our study, the rate of ICU care reached nearly twice the accepted benchmark. These findings complement and extend our prior finding that 40% of melanoma patients received hospice care, of which 17% were enrolled within three days of death.

Our results extend the current understanding of EOL care received by patients dying with melanoma from a national perspective. A recent study also used the SEER-Medicare database to characterize receipt of chemotherapy, surgery, and radiation therapy at EOL for patients diagnosed with stage IV melanoma. We did not limit our cohort based

on stage at diagnosis. Similar to our findings, they observed that older and unmarried patients were less likely to receive chemotherapy.²¹ Another study looked at EOL care received by patients with melanoma and found relatively infrequent hospitalizations at EOL. However, this study used a series of consecutive cases treated at a referral cancer center and lacked complete data on as many as 40% of patients who received EOL care closer to home.¹⁸ A French study found much higher intensity EOL care than we observed, including as many as 20% of patients being hospitalized continuously during their last month of life. The difference in intensity may be due to cultural differences between France and the US, as well as the availability of hospice services.²⁰ Another study described EOL care received by melanoma patients in the 20% Medicare Denominator file and included all patients dying with poor-prognosis cancers. They noted much higher rates of healthcare use on all measures than we observed.¹⁰

Our study extends previous findings on the intensity of EOL care for patients dying with melanoma by using national data and including more years and wider inclusion criteria. These data improve the generalizability of our findings. Furthermore, our analysis included State Buy-In, an individual marker of low socioeconomic status. Our study included multiple indicators of quality EOL care that were not included in any prior national study for melanoma patients. The time-period included in our analysis also revealed how EOL care received by melanoma patients is changing over time.

We found multiple patient characteristics that were associated with slightly higher healthcare use at EOL for patients dying with melanoma, including male sex and being married. Although no prior studies commented on the association of these characteristics in melanoma patients, studies of other cancers found similar patterns.^{7,10-11,15} A recent study showed that male patients were less likely to prefer palliative care, defined as care focusing on “quality of life” and not “cure.” These data suggest that patient preferences may be driving the observed differences.¹⁶ Other studies linked psychological and personality characteristics, some of which may be more common among men, to EOL preferences.³³ Similar to the gender difference, prior work suggests that married patients may prefer more intensive care.¹⁵

Older age is associated with lower rates of chemotherapy administration, as we observed.^{21,23,34,35} Possible explanations include increased toxicity of chemotherapy for older patients,³⁶ a recognition of a decrease in likelihood of benefit,³⁷ or different preferences for care.³⁸ We found that patients with a higher burden of comorbid illnesses were more likely to have ED visits, hospitalizations, or an ICU stay at EOL and to die in the hospital. These findings support prior studies of other malignancies,^{7,11,41,42} which may be related to patients with comorbid diseases having different preferences for EOL care or hospices having greater difficulty managing sicker patients.^{39,40}

We found that rates of healthcare use during EOL increased over time for all measures except chemotherapy administration and dying in the hospital. These rates were observed in studies of other malignancies^{7,11,41,42} and included other causes of death.^{24,25} Interestingly, we recently showed increases in hospice care over time, which we would expect to decrease measures of healthcare use during EOL.²³ It is likely that receipt of hospice care is impacting the rate of in-hospital death most directly, for which we and others have not seen an increase.^{26,27} The reasons behind these increases in burdensome care are unknown and warrant further study. Notably, although we observed increases in EOL healthcare use that surpass many of the benchmarks, the rates remained substantially below those reported by studies of other malignancies.^{2,11,43}

Our analysis has several limitations. This study relies on claims data, so we do not have clinical data that might explain the observed differences in EOL care. We cannot assess to what extent our findings reflect patients' or providers' preferences or are related to differential access to care. Our primary analysis was on all patients who died of cancer, which may include melanoma patients who died from a different malignancy or may have missed patients who died from melanoma-related complications that were not identified on their death certificate. Sensitivity analysis with those who died definitively of melanomas revealed similar trends. As a result of our large sample sizes, some of the comparisons were statistically significant despite small differences that may not be clinically meaningful.

The study period used for this analysis was before immunotherapy was used widely to treat melanoma. While immunotherapies have improved the survival of some patients with melanoma, we do not know if they alter the experiences of patients dying with melanoma. In fact, one recent study found increased variations in care after the advent of bevacizumab for lung cancer.¹³ Immunotherapy is generally better tolerated, which may increase the number of patients receiving chemotherapy or starting a new chemotherapeutic regimen at EOL. Furthermore, experts are concerned that the availability of immunotherapies has increased prognostic uncertainty, which may delay conversations about the goals of care and ultimately lead to more aggressive care at EOL.^{44,45} In addition, although these benchmarks are endorsed by the National Quality Forum and used in the literature, they may need to be updated with the changes in cancer care since their inception, such as the increased integration of palliative medicine. Finally, while the SEER registry represents the US population, we cannot comment on the entire Medicare population because we are limited to patients residing in the SEER areas.²⁶

CONCLUSIONS

Our study adds to the increasing evidence base that some patients receive more intensive and non-beneficial care at EOL, and that this problem is worsening over time. Additional research is needed to better understand what drives this trend. Receipt of inappropriately intensive EOL care may be related to prognostication challenges,⁴⁶⁻⁴⁸ physician reticence in discussing prognosis with patients,^{49,50} and/or how prognosis and the benefits of intensive EOL care are presented to patients.⁵⁰ Earlier access to palliative-care clinicians and support for improved communication between melanoma patients and their physicians may decrease inappropriately intense EOL care, as shown for other malignancies.⁵¹⁻⁵⁴ These services could be targeted to populations most likely to receive overly intensive EOL care. Our study demonstrates a need to better understand how to improve the quality of, and decrease nonbeneficial, EOL care.

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