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End-of-Life Care Intensity among Adolescent and Young Adult Cancer Patients in Kaiser Permanente Southern California

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Abstract

Importance—Cancer is the leading disease-related cause of death among adolescents and young adults (AYAs), but little is known about the care that AYA patients with cancer receive at the end of life (EOL).

Objective—To evaluate the intensity of EOL care among AYA cancer patients.

Design—Cross-sectional study using cancer registry and electronic health record data.

Setting—Kaiser Permanente Southern California (KPSC), an integrated health care delivery system.

Participants—663 AYA patients with either (1) stage I-III cancer and evidence of cancer recurrence or (2) stage IV cancer at diagnosis who received care in KPSC and died in the years 2001–2010. Patients were eligible if they were aged 15–39 at death.

Main Outcome Measures—Chemotherapy use in the last 14 days of life, intensive care unit (ICU) care in the last 30 days of life, more than one emergency room (ER) visit in the last 30 days of life, hospitalization in the last 30 days of life, and a composite measure of medically intensive EOL care comprising any of the aforementioned measures.

Results—11% of patients (72/663) received chemotherapy within 14 days of death. In the last 30 days of life, 22% of patients (144/663) were admitted to the ICU; 22% (147/663) had >1 ER visit; and 62% (413/663) were hospitalized. Overall, 68% (449/663) of subjects received at least one medically intensive EOL care measure.

Conclusions and Relevance—Most AYA patients receive at least one form of medically intensive EOL care. These findings suggest the need to better understand EOL care preferences and decision-making in this young population.

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Introduction

Adolescent and young adult (AYA) cancer patients, defined by the National Cancer Institute as those aged 15–39, experience cancer at a unique life stage, when their peers are on a trajectory of identity formation and establishment of a life path through education, employment, and the development of social and family ties. Patients in this wide age range share the experience of a cancer diagnosis during a time of major social, developmental, and psychological transitions. For those who experience cancer as a terminal illness, the contrast with their life expectations and the experiences of their peer group is particularly great.

Previous work has called for comprehensive attention to medical and psychosocial needs for AYA cancer patients at the end of life.[1–4] Yet we know very little about the end-of-life care that these young patients receive. Existing work has focused on the development of tools for end-of-life care planning,[5, 6] on psychological distress,[7–9] and on understanding adolescent patients' wishes as they make cancer treatment decisions.[10] In addition, a single-center study in France evaluated care among 45 AYA cancer decedents and found high rates of symptoms and aggressive measures.[11] However, we do not know how generalizable this work is to other centers or to young people in the US. The development of optimal tools for end-of-life care delivery in this population will depend on a better understanding of the care such patients receive.

Earle and colleagues have developed a set of end-of-life care measures focused on care intensity in the last month of life [12–14] and proposed benchmarks for optimal end-of-life care, suggesting that intensive end-of-life care should be rare. Adult patients who recognize that they are dying usually do not wish to receive aggressive measures at the end of life. [15] However, young people may feel differently about the tradeoffs that are worthwhile for another day. As a result, rates of aggressive end-of-life care in AYA patients should be considered less normative, or reflective of a “right” rate of intensive measures, and more as a window into what is likely to be a complex story about patient preferences, clinician feelings and behavior, and end-of-life decision-making in this group of young patients.

We used health care utilization data linked to cancer registry information to identify a cohort of decedents aged 15–39 who received cancer care within Kaiser Permanente Southern California, a multicenter health plan and care delivery system that serves 3.7 million patients in California, and died between the years 2001 and 2010. Rates of intensive end-of-life care measures, including late life chemotherapy, hospitalizations, emergency room visits, and intensive care unit care, were evaluated, along with patient factors associated with use of intensive measures at the end of life.

Methods

This study used linked cancer registry and electronic health record data within the Kaiser Permanente Southern California (KPSC) health plan to capture data on end-of-life care among AYA decedents with cancer. KPSC is an integrated managed care organization that provides comprehensive health services to approximately 3.7 million racially/ethnically and socioeconomically diverse members who are broadly representative of residents in Southern

California. [16] KPSC maintains a number of clinical databases, including membership, diagnosis, procedures, pharmacy/infusions, utilization, outside claims, and cancer registry, all linkable with a unique member identifier. The KPSC's Surveillance, Epidemiology and End Result (SEER)-affiliated cancer registry contains data on all patients who were diagnosed and/or treated for a new cancer since 1988. Quality of the cancer registry data is assured by the SEER standard and is audited by SEER staff on a regular basis. KPSC's pediatric oncology patients receive care within network, such that electronic health records are available across the AYA population.

The IRBs for KPSC and the Dana-Farber Cancer Institute approved this study, and requirements for consent were waived.

Cohort formation

In order to evaluate end-of-life care in the AYA population, we sought to identify a cohort of patients who died anticipated deaths, such that end-of-life care planning would have been appropriate. Unanticipated deaths due to treatment toxicity and non-cancer-related deaths, while important, may offer less opportunity for prospective end-of-life care planning; as such, our goal was to exclude such deaths whenever possible. To identify patients who died anticipated deaths, we used KPSC's cancer registry and other electronic health records to form two retrospective cohorts of decedents who had either (1) stage IV cancer at diagnosis, such that prognosis was limited from the time of diagnosis, or (2) stage I–III (nonmetastatic) disease at diagnosis, with evidence of cancer recurrence before death (Figure 1).

The stage IV cohort included KPSC patients who (1) had stage IV cancer at diagnosis according to KPSC's cancer registry; (2) died between the years 2001–2010; (3) were aged 15–39 at death; (4) were diagnosed at least 30 days prior to death, such that end-of-life care indicators were evaluable; and (5) were enrolled in the health plan during the month of death, such that end-of-life care indicators could be found in available records. The cohort was formed using individual patient-level data from KPSC, including cancer diagnosis and stage; dates of birth, diagnosis, and death; and health plan enrollment dates.

The stage I–III cohort identified patients with early stage disease at diagnosis and evidence of cancer recurrence; patients were eligible for inclusion if they (1) had stage I–III or non-staged cancer at diagnosis according to KPSC's cancer registry; (2) died between the years 2001–2010; (3) were aged 15–39 at death; (4) were diagnosed at least 30 days prior to death, such that end-of-life care indicators were evaluable; (5) were enrolled in the health plan during the month of death; and (6) had one of two possible indicators of cancer recurrence, either (a) new metastases, as indicated by ICD-9 codes for secondary malignant neoplasm of other organs, 197.0–197.8, 198.0–198.82, 198.89,[17] or (b) receipt of more than one chemotherapy regimen, as indicated by chemotherapy administration with a gap of >90 days between episodes of administration, a method previously used in SEER-Medicare to ascertain recurrence.[18]

Cohort validation

In order to validate our methods of patient ascertainment, we performed in-depth medical record review for 111 cohort patients, including 54 patients with stage IV disease and 57

patients with stage I-III disease and recurrence, to ensure that our selection strategy appropriately identified patients who died anticipated deaths. For ease of review, patients were selected for in-depth medical record review if they died during the era in which electronic physician notes were available at KPSC (year 2007 and beyond). Records were selected at random, and medical record review was performed by two authors (KC and OS) after training (by JWM and CRC), using an abstraction instrument developed for this study. Review was limited to the last 30 days of life. Patients were considered to have died anticipated deaths if the record included specific references in the last 30 days of life to a poor prognosis, incurable or progressive cancer, or end-of-life care planning including hospice. Statements relating to this determination were abstracted in full for review by the study team; final assignments were by consensus based on abstracted statements.

Data ascertainment

Descriptive data was collected from the health plan's electronic health records and registry data, including dates of birth, diagnosis, and death; gender; race/ethnicity; census block education and income level; cancer type; and stage at diagnosis. Previously developed measures of end-of-life care intensity [12, 13, 19] were adapted for use in KPSC's electronic health records; measures included chemotherapy within 14 days of death; intensive care unit care within 30 days of death; more than 1 emergency room visit within 30 days of death; and hospitalization within 30 days of death.

Statistical analysis

Data on the prevalence of intensive end-of-life care were generated as the percentage of decedents experiencing each end-of-life care measure. A summary measure indicating receipt of any of the four measures of intensive end-of-life care was also calculated. Chi-squared tests were used to compare differences in the proportion of patients receiving each measure according to cohort (stage IV versus stage I-III with recurrence). Logistic regression was used to examine associations between the different forms of intensive end-of-life care. Log binomial regression was used to evaluate associations between receipt of intensive end-of-life care and patient characteristics, such as age at diagnosis and death, patient race/ethnicity, and diagnosis, presented as prevalence ratios. Due to poor model convergence, relationships between ICU care and associated factors were evaluated using Poisson regression. Bivariate analyses evaluated associations between each measure and patient characteristic; adjusted models were adjusted for all other patient characteristics. Analyses were performed for each intensive end-of-life care measure and for our summary measure of receipt of any intensive end-of-life care. Data are shown for the summary measure and for ICU care in the last 30 days of life, as a relatively rare event that signifies high intensity care. Results using other intensive end-of-life measures are available as supplemental tables (see eTables 1, 2, and 3 in the Supplement).

Results

We identified 663 patients aged 15-39 at death who died between the years 2001-2010 after receiving cancer care in KPSC (Table 1), and who met our criteria for patients likely to have died anticipated deaths. The cohort included 282 patients with stages I-III disease and

evidence of cancer recurrence, and 381 patients with stage IV disease at diagnosis. A limited medical record review performed in 111 cohort patients confirmed the presence of statements in the medical record indicating that death was anticipated in 98% (109/111). Half of cohort patients were non-Hispanic white; 11% were black, with 29% Hispanic and 11% identified as Asian/other. The most common cancer diagnosis was gastrointestinal cancer (17%); other common diagnoses included breast cancer (15%), genitourinary cancers (11%), leukemia (14%), and lymphoma (10%).

In the combined cohort, comprised of patients with stage I–III cancer with recurrence and patients with stage IV cancer, 11% of patients received chemotherapy within 14 days of death (Table 2). 22% received care in the intensive care unit and 22% had more than one visit to the emergency room in the last 30 days of life. A majority of patients (62%) were hospitalized in the last month of life, with slightly higher rates of late life hospitalizations among stage IV cancer patients (66%) than among stage I–III/recurrence patients (58%, $P=.04$). Overall, 68% of patients received at least one of the aforementioned measures of intensive end-of-life care, again with slightly higher rates among stage IV patients (71% stage IV versus 63% stage I–III/recurrence, $P=.03$). 30% of patients received only one intensive measure at the end of life; 29% received two. Only 1% of patients received all four forms of intensive end-of-life care. Several intensive measures were correlated; patients who were hospitalized within the last month of life were more likely to receive chemotherapy in the last 14 days of life (OR 2.29, 95% CI 1.29–4.10) and ICU care (OR 5.66, 95% CI 3.35–9.55) and >1 ER visit (OR 13.44, 95% CI 6.70–26.96) in the last month of life. ICU care was also associated with higher odds of chemotherapy use (OR 2.11, 95% CI 1.25–3.57). ER visits were not associated with chemotherapy use (OR 1.19, 95% CI .68–2.11) or ICU care (OR 1.35, 95% CI .88–2.07), however.

After adjustment for other clinical and patient characteristics, patients who had bone/soft tissue cancers (RR 0.41, 95% CI 0.24–0.72, $P=0.0019$, relative to leukemias) or breast cancer (RR .50, 95% CI .26–.95, $P=.04$) were less likely to receive care in the ICU in the last month of life, as were patients who lived in a higher income census tract (RR .59, 95% CI .38–.93, $P=.02$). Asian patients received slightly more ICU care in adjusted models (RR 1.57, 95% CI 1.03–2.39, $P=.04$). Age and year of death were not associated with late life ICU care. When factors associated with receipt of any intensive measure were evaluated, bone/soft tissue cancer (adjusted prevalence ratio APR 0.60, 95% CI 0.38–0.96, $P=.03$, relative to leukemia) and gastrointestinal cancer (APR 0.77, 95% CI 0.63–0.94, $P=.01$, relative to leukemia) were associated with lower use of intensive end-of-life care.

Conclusions

More than two-thirds of the young cancer patients we studied received at least one form of intensive end-of-life care. Rates of intensive measures among AYA patients exceed proposed desirable benchmarks among older adults,[13] which include, for example, <10% of patients using chemotherapy in the last 14 days of life, <4% of patients with more than one emergency room visit in the last month of life, and <4% admitted to the intensive care unit in the last month of life. In addition, rates among AYA patients exceed actual use of the emergency room and intensive care unit by Medicare decedents with advanced cancer in the

last month of life, both of which are received by fewer than 10% of patients.[14] However, our population received inpatient care at rates similar to those reported in the elderly; recent data suggests that more than 60% of Medicare cancer patients are hospitalized in the last month of life, rates comparable to those we have seen.[19] Although population-based pediatric data for the measures we have used are somewhat limited, previous work outside the US also notes widespread use of aggressive measures among children with cancer at the end of life, suggesting that use of intensive measures may extend to the youngest patients as well.[20, 21]

The real question, which may be more important than aggregate rates of intensive measures, is how end-of-life decision-making unfolded for the individual patients we studied. What did these patients understand about their illness and prognosis? What kind of care did they want? How much were these patients willing to tolerate in order to prolong life? And, given our knowledge that young people may base their decisions on the needs of their loved ones, [10] who else were these patients considering as they made choices for care? Although adult patients who know they are dying usually do not want to receive aggressive care,[15] which is associated with poorer quality of life near death,[22, 23] we do not know whether AYA patients feel the same way. High rates of intensive measures in this population may not be a failure of communication or palliative care, but instead could be indicative of very different values for end-of-life care in these young people as compared with older adults.

Intensive end-of-life measures were correlated, suggesting that use of one form of intensive care, such as chemotherapy, can lead to a need for others, such as hospital and ICU care. However, some correlation is explained by variable construction, as with ICU care, which is also considered in-hospital care. In other cases, correlations represent linked processes of care, such as ER visits that precede hospitalizations.

We found few measured patient characteristics that were reliably associated with use of intensive measures, with the exception of cancer type. The presence of some relatively weak associations combined with the number of relationships tested also suggests that such findings might be best considered exploratory. Nonetheless, patients with bone/soft tissue cancers and gastrointestinal cancers used intensive measures at the end of life less than patients with leukemia, similar to findings reported previously.[24] This may reflect the poorer prognoses of sarcomas and gastrointestinal cancers from diagnosis, especially for patients diagnosed with advanced stage disease. Patients with leukemia may also experience more rapid progression from the time of relapse, as well as symptoms such as bleeding that may be more likely to lead to emergency and inpatient care, even when such care is used primarily for palliative purposes. Also of note, some findings in our population differed from those reported in older adults,[12, 25] especially the lack of changes in care intensity over time and the lack of pronounced racial and ethnic differences in care intensity.

Of note, just as in older adults, in whom the Earle measures of intensive end-of-life care were originally used,[12, 13] these measures have important limitations. Most importantly, we do not know the intent of the care delivered. As noted above, emergency room visits and hospitalizations may have been used for symptom palliation when supportive care services already in place were insufficient to manage challenging symptoms. In addition, these

measures were defined retrospectively from the time of death, whereas care is delivered prospectively. Prognostication is difficult, and clinicians and patients are not always able to reliably recognize when death is likely to occur and make plans for care accordingly. Finally, these measures incorporate a global perception that high rates of aggressive care are undesirable, but they do not account for preferences of individual patients. This last issue, as we have noted, is likely to be particularly salient to dying young people.

AYAs are likely to experience many different, and highly individual, influences as they make end-of-life decisions. This wide age range includes teens whose parents make decisions on their behalf and young adults who may consider the feelings of partners and their own young children, across a background of wide differences in educational attainment, personal life stage, employment, and financial independence. Although we do not fully know how their decision-making priorities differ from older adults, previous work suggests that AYAs are especially interested issues of legacy and the emotional lives of those they leave behind,[10, 26] but may be less invested in planning for use of medical treatments,[26] an issue which could in part underlie our findings. Although we did not find notable differences in use of intensive measures by age, more nuanced data could help us to understand ways decision-making processes differ across the age spectrum and in turn influence treatment goals. Similarly, the setting of care delivery and availability of age-appropriate hospice and palliative services may also dictate the care that is possible.

Predicting mortality for AYA patients can also be challenging; providers may therefore be more likely to favor life-prolonging measures in the setting of clinical uncertainty. Providers may also have different perspectives about when it is appropriate to use end-of-life interventions for AYA patients, and provider practice with respect to prognosis discussions and end-of-life care planning is also likely to vary, just as it does for physicians of older adults.[27] While our data did not allow us to explore this issue, end-of-life conversations can return the focus of care for dying young patients to individual needs and preferences, and thus offer an opportunity to optimize patient-centeredness of care at the end of life.

Our data sources had inherent limitations. We could not capture care received by dually insured patients outside of the KPSC network, and therefore may have underestimated aspects of end-of-life care for some patients. However, even if care outside of the network were a significant contributor to findings, we would expect actual rates of intensive end-of-life care to be even higher than those we have found, which are already striking. In addition, we could not capture patient-level data on education and income, and similarly were not able to evaluate other end-of-life care measures such as use of hospice care because data on hospice care could not be readily assessed electronically. Data on use of surgical interventions and duration of chemotherapy would offer added insight into care patterns and should be prioritized in future work. Finally, although our findings reflect care in a large cohort of patients who received care at a number of institutions in Southern California, they are limited to insured patients at select institutions and may not reflect care for the wider US population, including the poor and uninsured. Nonetheless, our cohort exceeds that of any existing study on end-of-life care in AYA patients and includes substantial racial and ethnic diversity. As such, our study offers important insights into the care of these young patients as they approach death.

We identified high rates of intensive end-of-life care, especially hospitalizations, among AYA cancer patients in the KPSC health care system. Available data offered limited ability to identify which patients are at high risk for such care. Almost certainly, there is more to this story. In particular, we do not know how many patients recognized their poor prognosis and yet elected to receive life-prolonging care, a choice that would differentiate these young patients from older adults. However, our data provide a starting point for understanding patterns of care and ultimately defining optimal end-of-life care in this young population. Ongoing work should focus on understanding end-of-life care needs and preferences in this young population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Lie H. Chen and Chun R. Chao had full access to the data in the study and take full responsibility for the integrity of the data and the accuracy of data analysis.

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Intensity of EOL among AYA with Cancer

Figure 1.
Cohort selection.

Table 1

Characteristics of the study cohort: patients with stage I–III disease and recurrence, and patients with stage IV disease (N=663).

Characteristic	Patients with stage I–III disease and recurrence (N=282)		Patients with stage IV disease (N=381)		All patients (N=663)	
	Number of patients	%	Number of patients	%	Number of patients	%
Age at death						
15–24	46	16	87	23	133	20
25–34	94	33	131	34	225	34
35–39	142	50	163	43	305	46
Male gender	111	39	192	50	303	46
Race/ethnicity						
Non-Hispanic white	149	53	181	48	330	50
Black	26	9	44	12	70	11
Hispanic	83	29	110	29	193	29
Asian/Other	24	9	46	12	70	11
Year of cancer diagnosis						
Prior to 2000	55	20	32	8	87	13
2000–2004	130	46	165	43	295	44
2005–2010	97	34	184	48	281	42
Year of death						
2001–2004	114	40	152	40	266	40
2005–2007	93	33	106	28	199	30
2008–2010	75	27	123	32	198	30
Years between cancer diagnosis and death						
0–1 years	66	23	199	52	265	40
> 1–2 years	69	24	98	26	167	25

Characteristic	Patients with stage I–III disease and recurrence (N=282)		Patients with stage IV disease (N=381)		All patients (N=663)	
	Number of patients	%	Number of patients	%	Number of patients	%
>2 years	147	52	84	22	231	35
Cancer type						
Leukemia	0	0	92	24	92	14
Lymphoma	21	7	46	12	67	10
Bone/soft tissue	16	6	9	2	25	4
Gastrointestinal	30	11	83	22	113	17
Genitourinary	37	13	37	10	74	11
Breast	73	26	27	7	100	15
Lung	5	2	34	9	39	6
Bruin	34	12	10	3	44	7
Other	66	23	43	11	109	16
Stage at diagnosis						
I–III	282	100	0	0	282	43
IV	0	0	381	100	381	57
Household income level, median for census tract						
<\$40,000/year	64	23	72	19	136	21
\$40–65,000/year	108	38	176	46	284	43
>\$65,000/year	109	39	132	35	241	36
Education (% with a college degree within census tract)						
<25%	172	61	226	59	398	60
25–49%	82	29	115	30	197	30
>=50%	27	10	39	10	66	10

Table 2

Prevalence of intensive EOL care measures.

	Full cohort, N (%)	Stage I–III with recurrence, N (%)	Stage IV, N (%)	P value*
Chemotherapy within 14 days of death	72 (11%)	31 (11%)	41 (11%)	0.93
ICU within 30 days of death	144 (22%)	54 (19%)	90 (24%)	0.17
>1 ER visit within 30 days of death	147 (22%)	61 (22%)	86 (23%)	0.77
Hospitalization within 30 days of death	413 (62%)	163 (58%)	250 (66%)	0.04
Any of above	449 (68%)	178 (63%)	271 (71%)	0.03
Receipt of 1 intensive measure	200 (30%)	77 (27%)	123 (32%)	0.17
Receipt of 2 intensive measures	191 (29%)	75 (27%)	116 (30%)	0.28
Receipt of 3 intensive measures	54 (8%)	22 (8%)	32 (8%)	0.78
Receipt of all 4 intensive measures	8 (1%)	4 (1%)	4 (1%)	0.67

* Determined using the Chi square test for the difference in proportions between stage I–III and stage IV

Table 3

Factors associated with ICU care within 30 days of death.

Characteristic	Raw percentage		Bivariate Poisson regression		Multivariate Poisson regression (adjusted for all other factors)	
	N (%) who had ICU care within 30 days of death	P value	RR (95% CI)	P value	RR (95% CI)	P value
Age at death	n	%				
15–24	39	29	Reference		Reference	
25–34	46	20	0.70 (0.48, 1.01)	0.06	0.74 (0.50, 1.09)	0.13
35–39	59	19	0.66 (0.47, 0.94)	0.02	0.82 (0.56, 1.21)	0.32
Male gender	73	24	1.22 (0.92, 1.63)	0.17	1.04 (0.76, 1.42)	0.82
Race						
Non-Hispanic white	63	19	Reference		Reference	
Black	17	24	1.27 (0.80, 2.03)	0.32	1.25 (0.77, 2.02)	0.37
Hispanic	45	23	1.22 (0.87, 1.71)	0.25	1.10 (0.78, 1.55)	0.60
Asian/Other	19	27	1.42 (0.91, 2.22)	0.12	1.57 (1.03, 2.39)	0.04
Year of cancer diagnosis						
Prior to 2000	12	14	0.52 (0.30, 0.92)	0.02	0.63 (0.29, 1.34)	0.23
2000–2004	58	20	0.75 (0.55, 1.01)	0.06	0.80 (0.50, 1.30)	0.38
2005–2010	74	26	Reference		Reference	
Year of death						
2001–2004	43	16	Reference		Reference	
2005–2007	58	29	1.80 (1.27, 2.56)	0.0009	1.54 (0.99, 2.39)	0.05
2008–2010	43	22	1.34 (0.92, 1.97)	0.13	1.02 (0.56, 1.84)	0.96
Years between diagnosis and death						
0–1 years	69	26	Reference		Reference	
> 1–2 years	30	18	0.69 (0.47, 1.01)	0.06	0.72 (0.49, 1.05)	0.09

Characteristic	Raw percentage		Bivariate Poisson regression		Multivariate Poisson regression (adjusted for all other factors)	
	N (%) who had ICU care within 30 days of death	P value	RR (95% CI)	P value	RR (95% CI)	P value
>2 years	45	19	0.75 (0.54, 1.04)	0.09	1.01 (0.66, 1.55)	0.97
Cancer type						
Leukemia	31	34	Reference		Reference	
Lymphoma	22	33	0.97 (0.62, 1.52)	0.91	0.96 (0.61, 1.52)	0.87
Bone/soft tissue	4	16	0.47 (0.18, 1.22)	0.12	0.52 (0.20, 1.34)	0.18
Gastrointestinal	15	13	0.39 (0.23, 0.68)	0.0009	0.41 (0.24, 0.72)	0.0019
Genitourinary	14	19	0.56 (0.32, 0.98)	0.04	0.70 (0.39, 1.25)	0.23
Breast	13	13	0.39 (0.22, 0.69)	0.0014	0.50 (0.26, 0.95)	0.04
Lung	6	15	0.46 (0.21, 1.01)	0.05	0.49 (0.22, 1.08)	0.08
Brain	12	27	0.81 (0.46, 1.42)	0.46	1.03 (0.54, 1.95)	0.94
Other	27	25	0.74 (0.48, 1.14)	0.17	0.85 (0.52, 1.39)	0.52
Stage at diagnosis						
I–III	54	19	Reference		Reference	
IV	90	24	1.23 (0.91, 1.67)	0.17	1.10 (0.76, 1.59)	0.60
Income level, median for census tract						
<\$40,000/year	41	30	Reference		Reference	
\$40–65,000/year	62	22	0.72 (0.52, 1.01)	0.06	0.74 (0.52, 1.05)	0.09
>\$65,000/year	41	17	0.56 (0.39, 0.82)	0.003	0.59 (0.38, 0.93)	0.02
Education (% with a college degree within census tract)						
<25%	93	23	Reference		Reference	
25–49%	42	21	0.91 (0.66, 1.26)	0.58	1.08 (0.76, 1.54)	0.66
≥50%	9	14	0.58 (0.31, 1.10)	0.10	0.84 (0.42, 1.68)	0.62

Table 4

Factors associated with receipt of any intensive end-of-life care.

Characteristic	Raw percentage; N (%) who received any intensive EOL care		Bivariate log binomial regression		Multivariate log binomial regression (adjusted for all other factors)	
	N	%	PR (95% CI)	P value	PR (95% CI)	P value
Age at death						
15–24	92	69	Reference		Reference	
25–34	154	68	0.98 (0.85, 1.13)	0.77	1.03 (0.88, 1.19)	0.74
35–39	203	67	0.97 (0.84, 1.11)	0.62	1.03 (0.88, 1.21)	0.72
Male gender	209	69	1.04 (0.93, 1.15)	0.50	1.09 (0.96, 1.23)	0.17
Race						
Non-Hispanic white	211	64	Reference		Reference	
Black	51	73	1.15 (0.98, 1.35)	0.08	1.08 (0.91, 1.30)	0.38
Hispanic	140	73	1.12 (1.00, 1.26)	0.05	1.12 (0.98, 1.28)	0.10
Asian/other	47	67	1.06 (0.89, 1.27)	0.50	1.04 (0.86, 1.25)	0.70
Years of cancer diagnosis						
Prior to 2000	46	53	0.75 (0.61, 0.92)	0.01	0.76 (0.56, 1.04)	0.09
2000–2004	201	68	0.96 (0.87, 1.07)	0.47	0.94 (0.78, 1.13)	0.50
2005–2010	202	72	Reference		Reference	
Years at death						
2001–2004	172	65	Reference		Reference	
2005–2007	136	68	1.03 (0.91, 1.17)	0.62	0.95 (0.80, 1.12)	0.52
2008–2010	141	71	1.08 (0.95, 1.22)	0.24	0.99 (0.79, 1.24)	0.92
Years between cancer diagnosis and death						
0–1 years	198	75	Reference		Reference	

Characteristic	Raw percentage; N (%) who received any intensive EOL care	Bivariate log binomial regression			Multivariate log binomial regression (adjusted for all other factors)		
	N	%	PR (95% CI)	P value	PR (95% CI)	P value	
>1–2 years	113	68	0.91 (0.80, 1.03)	0.12	0.93 (0.81, 1.07)	0.30	
>2 years	142	61	0.82 (0.73, 0.93)	0.002	0.92 (0.78, 1.09)	0.33	
Cancer type							
Leukemia	71	77	Reference		Reference		
Lymphoma	48	72	0.93 (0.78, 1.12)	0.46	0.95 (0.78, 1.15)	0.58	
Bone/soft tissue	11	44	0.56 (0.36, 0.89)	0.01	0.60 (0.38, 0.96)	0.03	
Gastrointestinal	68	60	0.78 (0.65, 0.94)	0.01	0.77 (0.63, 0.94)	0.01	
Genitourinary	53	72	0.93 (0.78, 1.11)	0.43	1.01 (0.83, 1.22)	0.94	
Breast	68	68	0.87 (0.73, 1.03)	0.11	1.00 (0.80, 1.24)	0.97	
Lung	29	74	0.95 (0.77, 1.18)	0.64	0.98 (0.77, 1.25)	0.86	
Brain	28	64	0.81 (0.63, 1.04)	0.10	0.85 (0.66, 1.10)	0.23	
Other	73	67	0.86 (0.72, 1.01)	0.07	0.91 (0.76, 1.09)	0.30	
Stage at diagnosis							
I–III	178	63	Reference		Reference		
IV	271	71	1.14 (1.03, 1.27)	0.02	1.06 (0.93, 1.21)	0.38	
Income level, median for census tract							
<\$40,000/year	98	72	Reference		Reference		
\$40–65,000/year	188	66	0.92 (0.81, 1.05)	0.24	0.98 (0.85, 1.13)	0.78	
>\$65,000/year	161	67	0.92 (0.80, 1.05)	0.22	1.03 (0.89, 1.19)	0.72	
Education (% with a college degree within census tract)							
<25%	274	69	Reference		Reference		
25–49%	132	67	0.98 (0.87, 1.10)	0.74	0.94 (0.83, 1.08)	0.39	
>=50%	41	62	0.90 (0.73, 1.09)	0.28	0.93 (0.75, 1.16)	0.51	