

Sociodemographic Disparities and Tumor-Specific Variation in High Intensity End-of-Life Care Among Patients with Metastatic Solid Cancer

Harry Obeng

h.a.obeng@wustl.edu

Washington University in St. Louis

Sana Saif Ur Rehman

Washington University School of Medicine, United States

Priscilla Kabutey

Washington University School of Medicine, United States

Research Article

Keywords:

Posted Date: August 25th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9622657/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Purpose

To evaluate the prevalence and independent predictors of aggressive end-of-life (EOL) care among patients with metastatic solid tumors hospitalized within 30 days of death, and to examine variation by tumor type, sociodemographic factors, and specific interventions.

Methods

We conducted a retrospective cohort study using the Florida State Inpatient Database (2016–2023). Adult hospitalizations with metastatic solid tumors occurring within 30 days of death were included. Aggressive EOL care was defined as receipt of ≥ 1 of the following interventions: mechanical ventilation, cardiopulmonary resuscitation, dialysis, extracorporeal membrane oxygenation, tracheostomy, chemotherapy, or radiotherapy. Multivariable logistic regression was used to identify independent predictors, adjusting for demographics, income quartile, rurality, insurance, comorbidity burden (van Walraven score), and year. Tumor-specific variation and intervention frequencies were also assessed.

Results

Among 33,994 hospitalizations, 14,530 (42.8%) involved aggressive EOL care. Younger age, male sex, Black race, lower income, Medicaid insurance, and higher comorbidity burden were independently associated with higher odds of aggressive care. Patients aged ≥ 75 years had substantially lower odds compared with those aged 18–49 years. Significant variation was observed across tumor types. Mechanical ventilation and chemotherapy were the most frequent contributors, and multiple interventions commonly co-occurred.

Conclusion

Aggressive EOL care is common among terminal hospitalizations in metastatic cancer and varies by demographic, socioeconomic, and clinical factors. These findings highlight disparities and opportunities to promote goal-concordant care.

Background

Cancer ranks as the second most common cause of death globally, responsible for roughly one out of every six deaths worldwide.¹ Although there has been considerable progress made in cancer treatments during the last two decades, high-intensity cancer care at the end of life still represents a major public health problem.² High-intensity end-of-life (EOL) care, which includes high-intensity hospital use, life-

supporting treatments, and cancer treatments that occur close to death, represents a preventable defect in patient-centered care and is recognized by the National Quality Forum (NQF) and the American Society of Clinical Oncology (ASCO) as an indicator of poor quality of care.³ In addition, receiving these treatments may indirectly contribute to a lower quality of life by delaying access to higher-quality care, such as hospice and palliative care.⁴ Temel et al found that the early integration of palliative care with standard oncologic care in metastatic non-small cell lung cancer patients increased survival by two months, improved quality of life and mood, and reduced the aggressiveness of the care at the end of life.⁵

One of the most commonly used and supported measures of high-intensity end-of-life care is hospitalization in the last 30 days of life, reflecting the clinical setting where the full range of high-intensity interventions is most frequently administered.^{2,6} The hospitalizations that happen in the final 30 days of life represent an extremely high-stakes period for decision-making in life-sustaining and cancer-directed therapies. Although these interventions are clinically important, the prevalence and factors associated with high-intensity interventions in these terminal hospitalizations remain incompletely characterized across adult age groups and cancer types. Studies focusing on specific tumor subtypes, such as metastatic head and neck cancer, have found that approximately 35% of terminally hospitalized patients received one or more forms of high-intensity EOL interventions.⁷ Socioeconomic and demographic disparities further complicate the picture. Studies have shown that among Medicare patients with advanced cancer, Black patients experience more emergency room visits and hospitalizations, longer lengths of stay, increased likelihood of ICU admission, and more in-hospital deaths than White patients.⁸ These disparities persist even after adjustment for clinical and hospital-level confounders, pointing to the influence of structural inequities, differential patient-provider communication, cultural attitudes toward life-sustaining treatment, and historical medical mistrust among minority communities.

Previous studies have largely focused on single tumor types or on Medicare/Medicaid populations, limiting their applicability to the broader hospitalized metastatic population. Additionally, the relative impact of specific life-sustaining interventions versus cancer-directed therapies on overall high-intensity care in inpatients has not been systematically quantified. Furthermore, independent predictors of high-intensity EOL care that account simultaneously for clinical and sociodemographic factors are needed to identify high-risk subgroups and guide targeted quality improvement initiatives.

This study addresses these gaps by examining the prevalence and independent predictors of high-intensity EOL care among patients with metastatic solid tumors hospitalized within the last 30 days of life. We further assess variation in high-intensity care by tumor type, characterize socioeconomic and demographic disparities in EOL care intensity, and quantify the specific contributions of life-sustaining and cancer-directed interventions to the composite high-intensity care outcome. These findings are intended to inform efforts to align inpatient oncologic care with the goals and values of patients approaching the end of life.

Methods

Data Source and Study Design

We conducted a retrospective cohort study using the Florida State Inpatient Database (SID), a component of the Healthcare Cost and Utilization Project (HCUP) maintained by the Agency for Healthcare Research and Quality.⁹ The SID captures all inpatient discharges from nonfederal acute care hospitals within participating states and includes patient demographics, diagnoses, procedures, discharge disposition, payer information, and hospital characteristics. Because SID represents a census of hospitalizations within the state rather than a sample, weighting was not applied.

Study Population

We identified adult patients (aged ≥ 18 years) with metastatic solid tumors using International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis codes indicating distant metastatic disease. Hematologic malignancies were excluded to focus on solid tumors with advanced disease. We further restricted the cohort to hospitalizations occurring within 30 days of death, defined using discharge disposition and mortality indicators available within SID. The analysis was done at the patient level, derived from hospitalizations (admission-level), with each row representing a unique patient.

Exposure and Covariates

Patient-level covariates included age, sex, race/ethnicity, primary payer, median household income quartile by ZIP code, and rural versus urban residence based on the National Center for Health Statistics urban–rural classification. Age was categorized as 18–49, 50–64, 65–74, and ≥ 75 years. Income quartiles were grouped according to HCUP-provided ZIP Code–level median household income classification. Rurality was dichotomized as urban (NCHS categories 1–4) versus rural (categories 5–6). Insurance status was categorized as Medicare, Medicaid, private insurance, self-pay, no charge, or other. Comorbidity burden was quantified using the Elixhauser Comorbidity Index, calculated from secondary diagnosis codes and summarized using the van Walraven weighted score. Tumor type was classified based on principal cancer diagnosis codes and grouped into major solid tumor categories (e.g., lung, gastrointestinal, breast, genitourinary, prostate, and other solid tumors).

Outcome Definition

The primary outcome was high-intensity end-of-life care during hospitalization. High-intensity care was defined as receipt of at least one life-sustaining or cancer-directed intervention during the hospitalization, identified using ICD-10-PCS procedure codes. These interventions included mechanical ventilation, cardiopulmonary resuscitation (CPR), dialysis, extracorporeal membrane oxygenation

(ECMO), tracheostomy, chemotherapy administration, and radiotherapy. Procedure codes were identified across all procedure fields and summarized at the patient level, such that receipt of any qualifying procedure during hospitalizations within the last 30 days of life was classified as present. A binary composite variable was created to indicate the presence of any high-intensity intervention. Secondary outcomes included the individual components of high-intensity care to quantify their relative contribution to the composite outcome.

Statistical Analysis

The prevalence of high-intensity end-of-life care was calculated among patients within 30 days of death. Continuous variables were summarized using medians with interquartile ranges or means with standard deviations as appropriate, and categorical variables were summarized using frequencies and percentages. Baseline characteristics were compared between patients with and without high-intensity care using chi-square tests for categorical variables and t-tests or Wilcoxon rank-sum tests for continuous variables.

To identify independent predictors of high-intensity end-of-life care, we constructed multivariable logistic regression models including age category, sex, race/ethnicity, income quartile, rurality, primary payer, comorbidity burden (van Walraven score), and calendar year of hospitalization (modeled as a categorical variable). Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were reported

To assess variation by tumor type, tumor category was included in secondary multivariable models, with lung cancer specified as the reference group. This model adjusted for the same demographic, socioeconomic, insurance, temporal, and comorbidity covariates as the primary analysis.

To quantify the contribution of specific life-sustaining and cancer-directed interventions to the composite high-intensity care outcome, we restricted analyses to patients who received high-intensity care. Within this subgroup, we calculated the frequency and proportion of each intervention, including mechanical ventilation, cardiopulmonary resuscitation, dialysis, extracorporeal membrane oxygenation, tracheostomy, chemotherapy, and radiotherapy. We further examined the distribution of the number of interventions received per patient and described the relative composition of interventions among patients receiving multiple procedures. These results were displayed using stacked bar visualizations to illustrate the intensity and combination of interventions. All statistical tests were two-sided, and a p-value < 0.05 was considered statistically significant. Analyses were performed using R version 5.4.1.

Results

A total of 33,994 patients were included in the final analytic cohort, of which 14,530 (42.7%) received high-intensity EOL care. Baseline characteristics stratified by receipt of high-intensity care are shown in Table 1. The median length of stay was longer among patients receiving high-intensity care compared to those who did not (6.0 days [IQR 2.0–11.0] vs. 4.0 days [IQR 2.0–9.0], $p < 0.001$), as was the median van Walraven comorbidity score (22.0 [IQR 17.0–28.0] vs. 21.0 [IQR 16.0–26.0], $p < 0.001$). Age was inversely

associated with high-intensity care. Patients aged 75 and older comprised 36% of the no high-intensity care group but only 27% of the high-intensity care group, whereas younger patients aged 18–49 were disproportionately represented in the high-intensity group (9.1% vs. 6.6%, $p < 0.001$). Male sex was modestly more common in the high-intensity care group (54% vs. 52%, $p < 0.001$).

Significant racial disparities were observed. Black patients comprised 22% of the high-intensity care group compared with 13% of the no high-intensity care group, while White patients were less represented in the high-intensity group (60% vs. 66%, $p < 0.001$). A similar pattern was seen with income patients in the lowest income quartile constituting 38% of high-intensity care cases versus 33% of the comparison group, while the highest income quartile was underrepresented (7.9% vs. 9.0%, $p < 0.001$). Rurality did not differ significantly between groups ($p = 0.11$). Regarding primary payer, Medicaid-insured patients were more common in the high-intensity care group (10% vs. 7.7%, $p < 0.001$). The distribution of hospitalizations across calendar years differed modestly between groups with patients that received high-intensity care rising from 11% in 2016 to 13% in 2020–2023 ($p < 0.001$).

Table 1
Baseline Characteristics of Patients with Metastatic Solid Tumors Hospitalized Within 30 Days of Death,
Stratified by High-Intensity End-of-Life Care

Characteristic	No High-Intensity Care N = 19,464	High-Intensity Care N = 14,530	p-value
Age			
18–49	1,282 (6.59%)	1,317 (9.06%)	< 0.001
50–64	5,280 (27.13%)	4,565 (31.42%)	
65–74	5,947 (30.55%)	4,686 (32.25%)	
75+	6,955 (35.73%)	3,962 (27.27%)	
Sex			
Male	10,172 (52.26%)	7,883 (54.25%)	< 0.001
Female	9,292 (47.74%)	6,647 (45.75%)	
Race/Ethnicity			
White	12,669 (65.92%)	8,635 (59.77%)	< 0.001
Black	2,588 (13.47%)	3,208 (22.21%)	
Hispanic	3,486 (18.14%)	2,056 (14.23%)	
Asian/Pacific Islander	238 (1.24%)	198 (1.37%)	
Native American	25 (0.13%)	23 (0.16%)	
Other	305 (1.59%)	269 (1.86%)	
Household Income Quartile			
0–25th percentile	6,492 (33.36%)	5,459 (37.57%)	< 0.001
26–50th percentile	6,668 (34.26%)	4,878 (33.57%)	
51–75th percentile	4,558 (23.42%)	3,046 (20.96%)	
76–100th percentile	1,746 (8.97%)	1,147 (7.89%)	
Rurality			
Urban	18,562 (95.37%)	13,909 (95.73%)	0.110
Rural	902 (4.63%)	621 (4.27%)	
Primary Payer			

Characteristic	No High-Intensity Care N = 19,464	High-Intensity Care N = 14,530	p-value
Age			
Medicare	11,457 (58.87%)	8,733 (60.10%)	< 0.001
Medicaid	1,498 (7.70%)	1,500 (10.32%)	
Private	4,053 (20.82%)	3,189 (21.95%)	
Self-pay	332 (1.71%)	268 (1.84%)	
No charge	62 (0.32%)	58 (0.40%)	
Other	2,062 (10.59%)	782 (5.38%)	
Length of Stay, days — Median (IQR)	4.0 (2.0–9.0)	6.0 (2.0–11.0)	< 0.001
Year			
2016	2,485 (12.77%)	1,617 (11.13%)	< 0.001
2017	2,593 (13.32%)	1,697 (11.68%)	
2018	2,434 (12.51%)	1,751 (12.05%)	
2019	2,321 (11.93%)	1,755 (12.08%)	
2020	2,077 (10.67%)	1,918 (13.20%)	
2021	2,412 (12.39%)	1,922 (13.23%)	
2022	2,751 (14.14%)	1,952 (13.43%)	
2023	2,391 (12.28%)	1,918 (13.20%)	
van Walraven Score — Median (IQR)	21.0 (16.0–26.0)	22.0 (17.0–28.0)	< 0.001

¹ n (%); Median (Q1, Q3)

² Pearson's chi-squared test; Wilcoxon rank-sum test

Percentages may not sum to 100% due to rounding. IQR = interquartile range.

Predictors of High-Intensity End-of-Life Care

Results of the multivariable logistic regression analysis are presented in Table 2. Age was inversely and independently associated with high-intensity EOL care. Compared to patients aged 18–49, those aged

50–64 (OR 0.83, 95% CI 0.76–0.91), 65–74 (OR 0.66, 95% CI 0.60–0.73), and 75 and older (OR 0.48, 95% CI 0.43–0.53) had progressively lower odds of receiving high-intensity care (all $p < 0.001$). Female sex was also independently associated with lower odds of high-intensity care (OR 0.87, 95% CI 0.83–0.91, $p < 0.001$).

Significant racial disparities were identified. Black patients had 64% higher odds of receiving high-intensity EOL care compared to White patients (OR 1.64, 95% CI 1.54–1.74, $p < 0.001$), while Hispanic patients had lower odds (OR 0.84, 95% CI 0.79–0.89, $p < 0.001$). No statistically significant difference was observed for Asian/Pacific Islander or Native American patients, though the latter group had wide confidence intervals reflecting limited sample size. Higher household income was independently associated with lower odds of high-intensity care across all quartiles relative to the lowest income group, with ORs ranging from 0.93 (26–50th percentile, 95% CI 0.88–0.98, $p = 0.006$) to 0.87 (76–100th percentile, 95% CI 0.80–0.95, $p = 0.002$). Rural residence was similarly associated with lower odds of high-intensity care (OR 0.87, 95% CI 0.78–0.97, $p = 0.011$).

Compared to Medicare, private insurance (OR 0.79, 95% CI 0.73–0.85, $p < 0.001$), self-pay (OR 0.77, 95% CI 0.64–0.91, $p = 0.003$), and Medicaid (OR 0.89, 95% CI 0.81–0.97, $p = 0.012$) were each associated with lower odds of high-intensity care. The "Other" payer category demonstrated the strongest negative association (OR 0.45, 95% CI 0.41–0.49, $p < 0.001$), likely reflecting a heterogeneous group including unclassified government payers. Greater comorbidity burden, as measured by the van Walraven score, was independently associated with higher odds of high-intensity care on a per-point basis (OR 1.02, 95% CI 1.01–1.02, $p < 0.001$). Regarding temporal trends, high-intensity care increased significantly during 2020 relative to 2016 (OR 1.41, 95% CI 1.29–1.54, $p < 0.001$), with persistently elevated odds through 2023 (OR 1.22, 95% CI 1.12–1.33, $p < 0.001$), suggesting a durable shift in EOL care intensity following the COVID-19 pandemic.

Table 2
Multivariable Logistic Regression: Predictors of High-Intensity End-of-Life Care Among Patients with Metastatic Solid Tumors Hospitalized Within 30 Days of Death

Characteristic	OR	95% CI	p-value
Age (ref: 18–49)			
50–64	0.83	0.76–0.91	< 0.001
65–74	0.66	0.60–0.73	< 0.001
75+	0.48	0.43–0.53	< 0.001
Sex (ref: Male)			
Female	0.87	0.83–0.91	< 0.001
Race/Ethnicity (ref: White)			
Black	1.64	1.54–1.74	< 0.001
Hispanic	0.84	0.79–0.89	< 0.001
Asian/Pacific Islander	1.15	0.95–1.40	0.145
Native American	1.31	0.74–2.34	0.352
Other	1.23	1.04–1.46	0.015
Household Income Quartile (ref: 0–25th percentile)			
26–50th percentile	0.93	0.88–0.98	0.006
51–75th percentile	0.88	0.82–0.93	< 0.001
76–100th percentile	0.87	0.80–0.95	0.002
Rurality (ref: Urban)			
Rural	0.87	0.78–0.97	0.011
Primary Payer (ref: Medicare)			
Medicaid	0.89	0.81–0.97	0.012
Private	0.79	0.73–0.85	< 0.001
Self-pay	0.77	0.64–0.91	0.003
No charge	0.85	0.59–1.23	0.392
Other	0.45	0.41–0.49	< 0.001
Year (ref: 2016)			
2017	1.00	0.91–1.09	0.962

Characteristic	OR	95% CI	p-value
Age (ref: 18–49)			
2018	1.10	1.00–1.20	0.042
2019	1.14	1.05–1.25	0.003
2020	1.41	1.29–1.54	< 0.001
2021	1.20	1.10–1.31	< 0.001
2022	1.08	0.99–1.18	0.085
2023	1.22	1.12–1.33	< 0.001
van Walraven Comorbidity Score (per 1-point increase)			
van Walraven score	1.02	1.01–1.02	< 0.001

OR = odds ratio; CI = confidence interval. Estimates derived from multivariable logistic regression. Bold p-values indicate statistical significance at $\alpha = 0.05$.

Reference categories shown in section headers. van Walraven score modeled as a continuous variable.

Tumor Type-Adjusted Predictors of High-Intensity End-of-Life Care

After adjustment for tumor type, the associations observed in the primary model remained largely unchanged (Table 3). Black race remained the strongest predictor of high-intensity EOL care (OR 1.67, 95% CI 1.57–1.78, $p < 0.001$), and the inverse associations with older age, female sex, higher income, rural residence, and private insurance were preserved with minimal attenuation. With respect to tumor type, using lung cancer as the reference, several diagnoses were independently associated with significantly lower odds of high-intensity care. Prostate cancer had the strongest inverse association (OR 0.45, 95% CI 0.32–0.62, $p < 0.001$), followed by bladder (OR 0.61, 95% CI 0.41–0.90, $p = 0.014$), breast (OR 0.63, 95% CI 0.51–0.78, $p < 0.001$), pancreatic (OR 0.68, 95% CI 0.60–0.76, $p < 0.001$), and liver cancers (OR 0.75, 95% CI 0.63–0.89, $p = 0.001$). Gynecologic cancer approached but did not reach conventional statistical significance (OR 0.84, 95% CI 0.71–1.00, $p = 0.050$). Colorectal, head and neck, kidney, and other solid tumors did not differ significantly from lung cancer in odds of high-intensity care.

Table 3
Multivariable Logistic Regression Adjusted for Tumor Type:
Predictors of High-Intensity End-of-Life Care Among
Patients with Metastatic Solid Tumors Hospitalized Within
30 Days of Death

Characteristic	OR	95% CI	p-value
Age (ref: 18–49)			
50–64	0.83	0.76–0.91	< 0.001
65–74	0.66	0.60–0.73	< 0.001
75+	0.48	0.43–0.53	< 0.001
Sex (ref: Male)			
Female	0.87	0.83–0.91	< 0.001
Race/Ethnicity (ref: White)			
Black	1.67	1.57–1.78	< 0.001
Hispanic	0.85	0.79–0.90	< 0.001
Asian/Pacific Islander	1.17	0.96–1.42	0.116
Native American	1.34	0.75–2.39	0.319
Other	1.25	1.06–1.48	0.010
Household Income Quartile (ref: 0–25th percentile)			
26–50th percentile	0.93	0.88–0.98	0.011
51–75th percentile	0.88	0.83–0.94	< 0.001
76–100th percentile	0.88	0.80–0.95	0.003
Rurality (ref: Urban)			
Rural	0.87	0.78–0.97	0.015
Primary Payer (ref: Medicare)			
Medicaid	0.89	0.81–0.98	0.016
Private	0.79	0.74–0.85	< 0.001
Self-pay	0.77	0.65–0.92	0.004
No charge	0.86	0.59–1.24	0.421
Other	0.45	0.41–0.49	< 0.001
Year (ref: 2016)			

Characteristic	OR	95% CI	p-value
Age (ref: 18–49)			
2017	0.99	0.91–1.08	0.834
2018	1.09	1.00–1.19	0.065
2019	1.14	1.04–1.25	0.004
2020	1.40	1.28–1.53	< 0.001
2021	1.20	1.09–1.31	< 0.001
2022	1.07	0.98–1.17	0.118
2023	1.21	1.11–1.33	< 0.001
van Walraven Comorbidity Score (per 1-point increase)			
van Walraven score	1.02	1.01–1.02	< 0.001
Tumor Type (ref: Lung)			
Bladder	0.61	0.41–0.90	0.014
Breast	0.63	0.51–0.78	< 0.001
Colorectal	0.91	0.81–1.02	0.095
Gynecologic	0.84	0.71–1.00	0.050
Head & Neck	1.08	0.76–1.55	0.657
Kidney	1.11	0.90–1.38	0.329
Liver	0.75	0.63–0.89	0.001
Other Solid	1.00	0.93–1.06	0.880
Pancreas	0.68	0.60–0.76	< 0.001
Prostate	0.45	0.32–0.62	< 0.001

OR = odds ratio; CI = confidence interval. Estimates derived from multivariable logistic regression adjusted for tumor type.

Lung cancer serves as the reference category for tumor type. van Walraven score modeled as a continuous variable.

Statistical significance at $\alpha = 0.05$.

Variation in High-Intensity End-of-Life Care by Tumor Type

Adjusted predicted probabilities of composite high-intensity EOL care varied meaningfully across tumor types (Fig. 1). Lung cancer carried the highest predicted probability at 54% (95% CI 0.50–0.57), comparable to head and neck (54%, 95% CI 0.45–0.63), kidney (56%, 95% CI 0.50–0.62), and other solid tumors (54%, 95% CI 0.51–0.57). In contrast, prostate cancer demonstrated the lowest adjusted probability at 34% (95% CI 0.27–0.43), followed by bladder (41%, 95% CI 0.32–0.51), breast (42%, 95% CI 0.37–0.48), and pancreatic cancers (44%, 95% CI 0.40–0.48). Colorectal and gynecologic cancers occupied an intermediate range at 51% (95% CI 0.47–0.55) and 49% (95% CI 0.44–0.54), respectively. All probabilities were estimated at a common covariate profile (White race, age 18–49, Medicare insurance, lowest income quartile, urban residence, 2016, and mean comorbidity and length of stay) ensuring that the observed variation reflects tumor type independently of patient-level characteristics.

The individual procedures contributing to the composite high-intensity care outcome are detailed in Online Resource 1. Among the 14,530 patients who received high-intensity care, mechanical ventilation was by far the most prevalent intervention, occurring in 85.1% of cases. CPR was the second most common procedure (26.3%), followed by dialysis (15.0%) and tracheostomy (1.9%). Radiotherapy was administered to 0.9% of patients, while ECMO was rare (0.1%). Notably, chemotherapy was not recorded in any patient hospitalization within this cohort, suggesting that cancer-directed systemic therapy was not a driver of high-intensity classification in this inpatient population.

Among patients who received high-intensity care (Fig. 2), the majority received a single intervention ($n = 10,686$), with substantially fewer receiving two ($n = 3,447$), three ($n = 387$), four ($n = 9$), or five concurrent interventions ($n = 1$), indicating that while high-intensity care was common, it was predominantly driven by isolated rather than cumulative intervention. The proportion of patients by number of interventions per patient is shown in Online Resource 2.

Discussion

This study examined the prevalence and independent predictors of high-intensity EOL care among patients with metastatic solid tumors hospitalized within 30 days of death using the Florida State Inpatient Database (SID) from 2016 to 2023. Nearly 43% of patients received high-intensity EOL care, with mechanical ventilation and CPR emerging as the dominant interventions. Significant independent predictors included younger age, Black race, lower income, Medicaid insurance, higher comorbidity burden, and increasing calendar year. Substantial variation in adjusted predicted probability of high-intensity care was observed across tumor types, with primary kidney cancer patients carrying the highest predicted probability and prostate cancer patients the lowest.

The 42.7% prevalence of high-intensity EOL care observed in this cohort is consistent with, though somewhat lower than, rates reported in prior national studies. Among patients with metastatic lung cancer using NIS data from 1998 to 2014, the proportion receiving ICU-level care during terminal hospitalizations rose from 13.3% to 27.9%¹⁰, suggesting that our finding of a 42.7% composite rate across all solid tumor types incorporating mechanical ventilation, CPR, dialysis, ECMO, tracheostomy,

and radiotherapy reflects both a broader composite definition and a more contemporary statewide cohort. The absence of chemotherapy in any hospitalization within this cohort warrants acknowledgment. This likely reflects both the inpatient administrative coding practices of the Florida SID and the clinical reality that, in a terminally hospitalized population, inpatient palliative care encounters were significantly associated with decreased inpatient chemotherapy use, invasive surgical procedures, and ICU admissions.¹¹ The finding that most patients (73.5%) received only a single high-intensity intervention further indicates that composite high-intensity care in the inpatient setting is primarily driven by discrete, episode-level interventions rather than cumulative treatment escalation.

The inverse relationship between age and high-intensity EOL care that was identified in this study aligns with prior research. In a prospective cohort study of 600 solid metastatic cancer patients, it was determined that increasing age was independently predictive of lower odds of high-intensity EOL care.¹² Among Medicare patients with advanced lung cancer, younger age was a significant predictor of ICU use in the last 6 months of life after adjusting for other relevant factors.¹⁰ The lower odds for EOL care in patients aged 75 years or older compared to those aged 18 to 49 years (OR 0.48) may be explained by the higher likelihood of advance directive completion or goals of care discussions in the former group prior to terminal hospitalization. However, it is not clear whether this relationship represents differing patient preferences by age group or differing discussions of treatment options with families of younger versus older patients. The former has clear implications for ensuring that EOL care is goal-concordant in all age groups.

The 64–67% higher odds of high-intensity EOL care among Black patients relative to White patients, which persisted after adjustment for tumor type, income, insurance, comorbidity, and rural residence, represents one of the most striking findings of this study. This result is concordant with a substantial body of prior literature. Black patients diagnosed with terminal cancer have greater odds of ICU and emergency department admissions, and those with lung cancer are more likely to undergo mechanical ventilation, with these disparities operating in a context where physicians offer less information about diagnosis, prognosis, and treatment to Black patients, creating conditions for care that is discordant with patient values.¹³ The drivers of this disparity are multifactorial. High-intensity care received by Black patients has been attributed to cultural preferences, religious beliefs, lack of trust in the medical profession, a higher likelihood of requesting life-extending treatments, and hospital-level variation in quality.¹⁴ Improving EOL care quality for Black patients will require not only earlier integration of palliative care, but culturally informed communication strategies, advance care planning initiatives tailored to communities with high levels of medical mistrust, and systemic efforts to address racial bias in prognostic communication. Lower neighborhood income and Medicaid insurance status were also linked with higher-intensity care. Previous research has documented socioeconomic gradients in EOL care intensity, suggesting that social vulnerability factors may affect the site and nature of care received near death.¹⁵

The differential in the level of end-of-life care based on the tumor type could be due to various factors, including the course of illness and treatment options that are usually offered to patients with different types of cancer.¹⁶ Grendarova et al reported that patients with breast and gynecologic cancer had greater tendencies toward end-of-life chemotherapy compared to other tumor types, while patients with gastrointestinal cancer had lower use of radiotherapy near the end of life.¹⁶ Other studies have reported that there are differences in end-of-life care measures, including the use of high-intensity end-of-life care measures, among patients with different types of cancer, with lung cancer patients exhibiting the highest rates of end-of-life care measures compared to patients with other types of cancer.¹⁷ These observations are consistent with our study, which reported significant variations in end-of-life care based on tumor types in terms of prevalence and adjusted odds, underscoring the need for tumor-specific strategies in palliative care planning and clinical decision-making.

High-intensity EOL care increased significantly from 2016 to 2020 (OR 1.41), with persistently elevated odds through 2023. This temporal spike coincides with the onset of the COVID-19 pandemic and likely reflects several converging mechanisms. Cancer patients hospitalized during the pandemic faced a markedly different care environment: patients with cancer were at higher risk of severe COVID-19 and its complications, including ICU admission and need for mechanical ventilation, which may have driven increased use of life-sustaining interventions not reflective of baseline EOL care preferences.¹⁸ Simultaneously, disruptions to outpatient oncology and palliative care services, restricted family visitation limiting surrogate decision-making, and overburdened systems may have reduced the probability of timely goals-of-care discussions. The persistence of elevated odds beyond 2020 through 2021 and 2023 suggests a durable shift in EOL care patterns in Florida that warrants ongoing surveillance.

Implications

Hospitalization within the last 30 days of life is a key period to reassess prognosis and align care with patient values. Early palliative care integration in the course has been demonstrated to improve quality of life and reduce the likelihood of high-intensity end-of-life care in metastatic cancer patients.⁵ Our study supports the need to adopt effective approaches to advance care planning, especially in socioeconomically disadvantaged and minority patients who may be more likely to receive high-intensity end-of-life care.

Limitations

The Florida State Inpatient Database (SID) is an administrative dataset and is subject to limitations inherent to ICD-10 coding, including potential misclassification of diagnoses and procedures. In addition, the dataset lacks important clinical variables such as performance status, patient-stated goals of care, functional trajectory, and advance directive status, all of which may influence the intensity of end-of-life (EOL) care. Our analysis classified hospitalizations occurring within 30 days of death as representing potential high-intensity EOL care; however, some hospitalizations in this period may have been

precipitated by acute, potentially reversible conditions rather than anticipated terminal decline. Procedures were identified across all available procedure fields and summarized at the patient level across hospitalizations, which may not fully capture the timing or clinical context of interventions. The absence of chemotherapy in this cohort likely reflects coding practices within inpatient administrative data and should not be interpreted as evidence that cancer-directed therapy was absent from care near the end of life. Finally, Florida's demographic composition, including a relatively large elderly population, substantial Hispanic representation, and significant racial diversity, may limit the generalizability of these findings to other states or regions.

Conclusions

In this analysis of about 34,000 patients with metastatic solid tumors hospitalized within 30 days of death in the Florida State Inpatient Database from 2016 to 2023, high-intensity end-of-life (EOL) care was observed in 42.7% of patients and was driven predominantly by mechanical ventilation and cardiopulmonary resuscitation. Younger age, Black race, lower neighborhood income, and Medicare coverage were independently associated with a higher likelihood of receiving high-intensity EOL care. Substantial variation across tumor types was observed, with patients with prostate cancer consistently receiving less aggressive EOL care and those with lung cancer experiencing higher rates of intensive interventions. Rates of high-intensity care increased during the later study years, particularly after 2020, suggesting possible shifts in inpatient EOL care patterns during the COVID-19 era. These findings highlight the need for improved integration of palliative care, culturally responsive advance care planning, and targeted quality improvement efforts to better align end-of-life care with patient preferences in hospitalized populations.

Abbreviations

The following abbreviations are used in this manuscript:

EOL – End of Life

NQF- National Quality Forum

SID- State Inpatient Database

CPR- Cardiopulmonary Resuscitation

ECMO- Extracorporeal Membrane Oxygenation

ICU- Intensive Care Unit

Declarations

Funding No funds, grants, or other support were received. Financial Interests The authors declare they have no financial interests. Clinical trial number: not applicable Author Contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Harry Obeng and Priscilla Kabutey. The first draft of the manuscript was written by Harry Obeng and all authors commented on previous versions of the manuscript. The study was supervised by Sana Said Ur Rehman. All authors read and approved of the final manuscript. Ethics Approval The study used de-identified Healthcare Cost and Utilization Project (HCUP) data and was deemed not to involve activities that are subject to Institutional Review Board (IRB) oversight by the Washington University in St. Louis IRB. IRB approval was therefore not required. All methods were carried out in accordance with relevant institutional guidelines and regulations and the Healthcare Cost and Utilization Project (HCUP) Data Use Agreement. Consent To Participate This study used de-identified, administrative data and did not involve direct interaction with human participants. Informed consent was therefore not required. Consent To Publish Not applicable. The manuscript does not include any identifiable individual participant data. Data Availability Statement The data used in this study are available from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Database (SID) for Florida. This data is subject to a data use agreement and is not publicly available. Researchers may obtain access through the HCUP Central Distributor upon completion of the required training and data use agreements. The authors are not permitted to share the data.

References

1. Perry LM, Wash LE, Horswell R, et al. Racial Disparities in End-of-Life Care between Black and White Adults with Metastatic Cancer. *J Pain Symptom Manage*. 2021;61(2):342–349.e1. doi:10.1016/j.jpainsymman.2020.09.017
2. Ma Z, Li H, Zhang Y, et al. Prevalence of aggressive care among patients with cancer near the end of life: a systematic review and meta-analysis. *eClinicalMedicine*. 2024;71:102561. doi:10.1016/j.eclinm.2024.102561
3. Falchook AD, Dusetzina SB, Tian F, Basak R, Selvam N, Chen RC. Aggressive End-of-Life Care for Metastatic Cancer Patients Younger Than Age 65 Years. *JNCI J Natl Cancer Inst*. 2017;109(9):dix028. doi:10.1093/jnci/dix028
4. Chemotherapy Use, Performance Status, and Quality of Life at the End of Life | Oncology | JAMA Oncology | JAMA Network. Accessed February 28, 2026. <https://jamanetwork.com/journals/jamaoncology/fullarticle/2398177>
5. Temel JS, Greer JA, Muzikansky A, et al. Early Palliative Care for Patients with Metastatic Non–Small-Cell Lung Cancer. *N Engl J Med*. 2010;363(8):733–742. doi:10.1056/NEJMoa1000678
6. Koroukian SM, Douglas SL, Vu L, et al. Incidence of Aggressive End-of-Life Care Among Older Adults With Metastatic Cancer Living in Nursing Homes and Community Settings. *JAMA Netw Open*. 2023;6(2):e230394. doi:10.1001/jamanetworkopen.2023.0394

7. Aggressive Inpatient Care at the End of Life for Patients With Head and Neck Cancer - Fereydooni - Head & Neck - Wiley Online Library. Accessed February 28, 2026.
<https://onlinelibrary.wiley.com/doi/full/10.1002/hed.70166>
8. Brown CE, Engelberg RA, Sharma R, et al. Race/Ethnicity, Socioeconomic Status, and Healthcare Intensity at the End of Life. *J Palliat Med*. 2018;21(9):1308–1316. doi:10.1089/jpm.2018.0011
9. Central Distributor SID Availability of Data Elements by year – 2016. Accessed March 4, 2026.
<https://hcup-us.ahrq.gov/db/state/siddist/siddistvarnote2016.jsp>
10. Mrad C, Abougergi MS, Daly B. One Step Forward, Two Steps Back: Trends in Aggressive Inpatient Care at the End of Life for Patients With Stage IV Lung Cancer. *J Oncol Pract*. 2018;14(12):e746-e757. doi:10.1200/JOP.18.00515
11. Is inpatient chemotherapy overutilized? *J Clin Oncol*. Accessed February 28, 2026.
https://ascopubs.org/doi/10.1200/JCO.2020.38.29_suppl.215
12. Malhotra C, Bundoc F, Chaudhry I, et al. A prospective cohort study assessing aggressive interventions at the end-of-life among patients with solid metastatic cancer. *BMC Palliat Care*. 2022;21(1):73. doi:10.1186/s12904-022-00970-z
13. Jawed A, Comer AR. Disparities in end-of-life care for racial minorities: a narrative review. *Ann Palliat Med*. 2024;13(2):30921–30321. doi:10.21037/apm-23-459
14. Dierfeldt D, Knopf K, Jackson L. Racial Disparities at the End of Life. *Am Fam Physician*. 2021;104(4):346–347.
15. Deeb S, Chino FL, Diamond LC, et al. Disparities in Care Management During Terminal Hospitalization Among Adults With Metastatic Cancer From 2010 to 2017. *JAMA Netw Open*. 2021;4(9):e2125328. doi:10.1001/jamanetworkopen.2021.25328
16. Grendarova P, Sinnarajah A, Trotter T, Card C, Wu JSY. Variations in intensity of end-of-life cancer therapy by cancer type at a Canadian tertiary cancer centre between 2003 and 2010. *Support Care Cancer*. 2015;23(10):3059–3067. doi:10.1007/s00520-015-2676-y
17. Panjwani L. At End of Life, Aggressive Cancer Treatment Often Eclipses Recommended Palliative Care | CURE. March 4, 2026. Accessed March 4, 2026. https://www.curetoday.com/view/at-end-of-life-aggressive-cancer-treatment-often-eclipses-recommended-palliative-care?utm_source=chatgpt.com
18. Salunke AA, Nandy K, Pathak SK, et al. Impact of COVID – 19 in cancer patients on severity of disease and fatal outcomes: A systematic review and meta-analysis. *Diabetes Metab Syndr*. 2020;14(5):1431–1437. doi:10.1016/j.dsx.2020.07.037

Figures

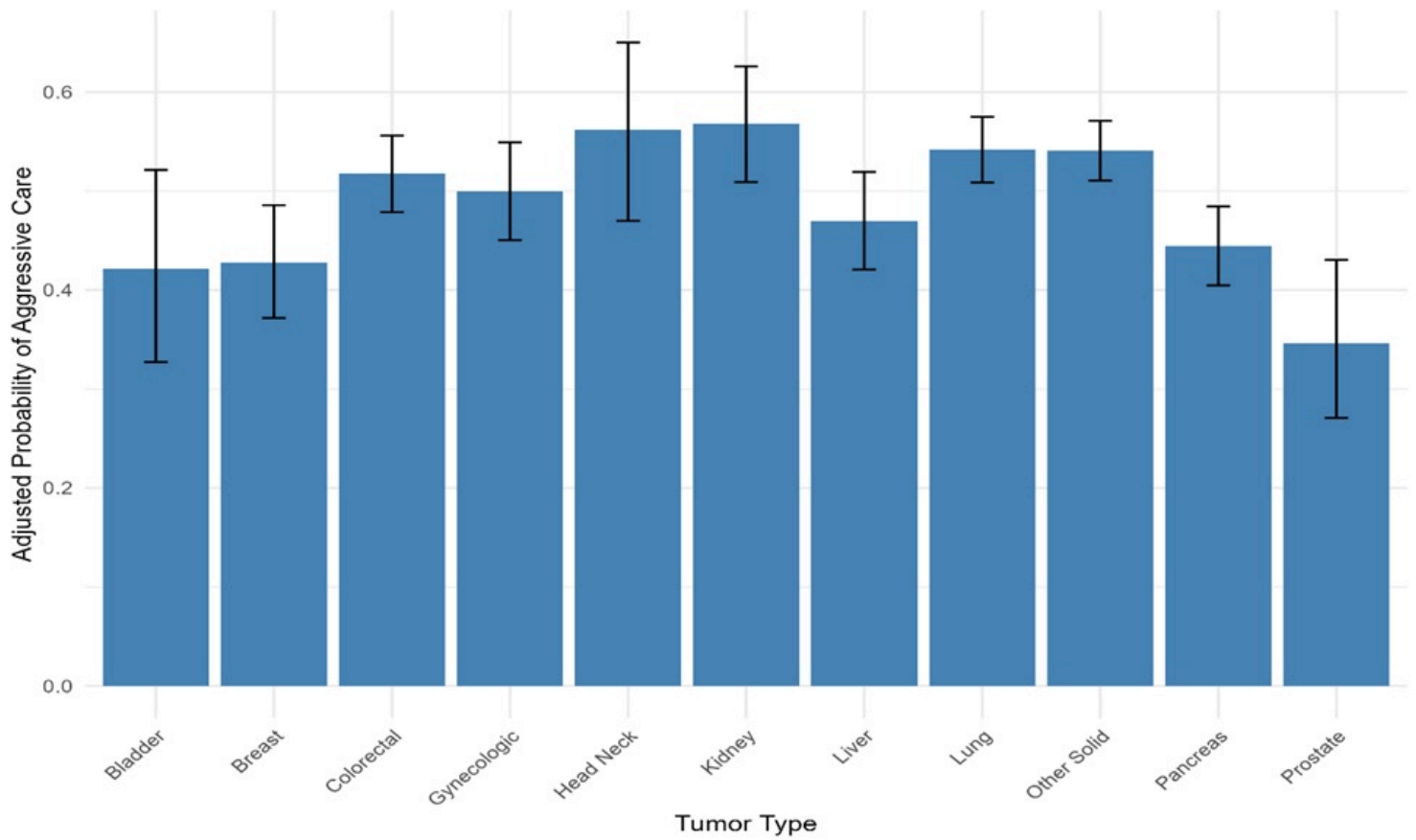


Figure 1

Adjusted Probability of High Intensity End-of-Life Care by Tumor Type

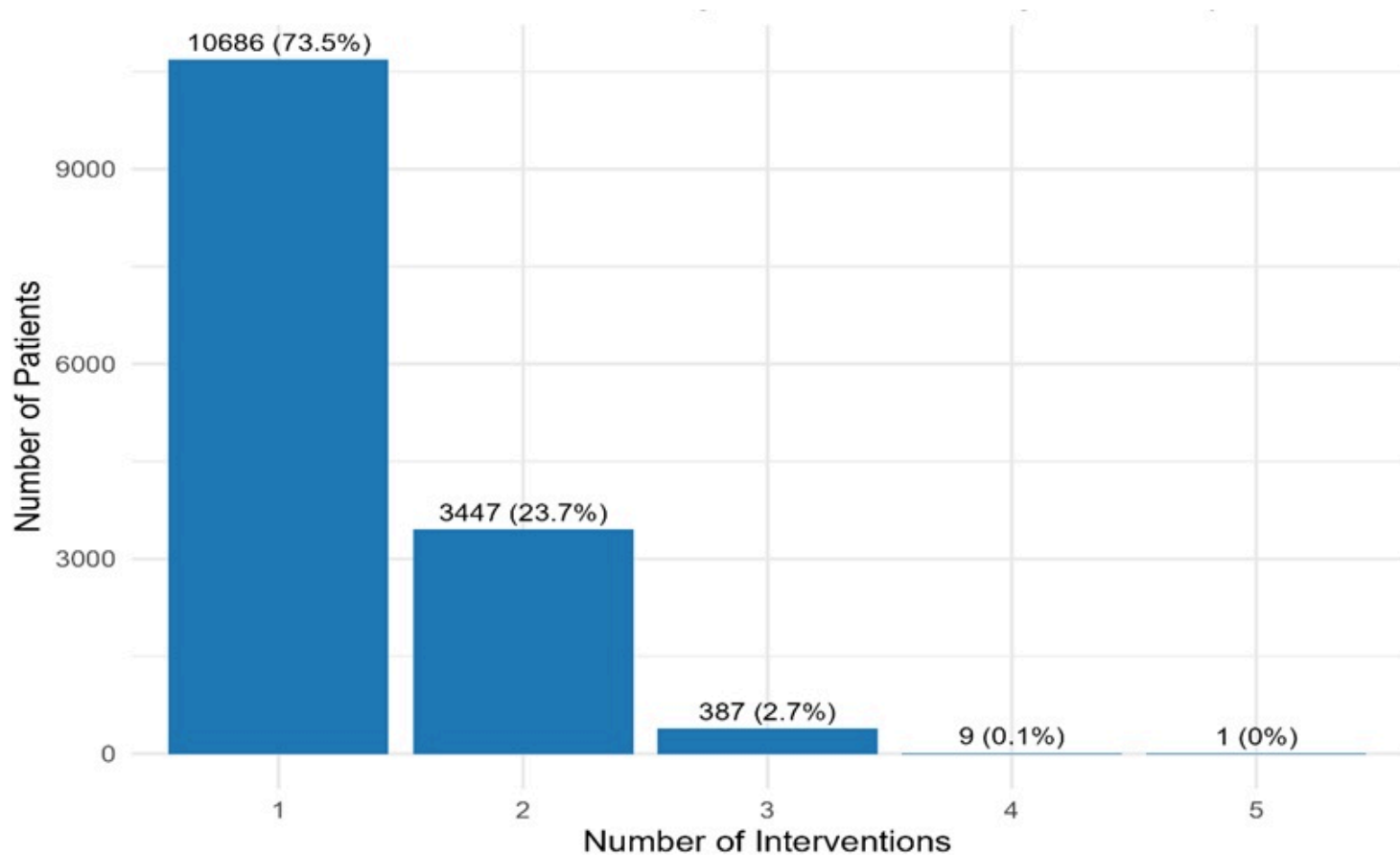


Figure 2

Distribution of the Number of Interventions Among Admissions With High-Intensity End-of-Life Care

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [ESM2.jpg](#)
- [SupplementalFile1.docx](#)
- [SupplementalFile2.docx](#)