High-Intensity End-of-Life Care Among Patients With GI Cancer in Puerto Rico: A Population-Based Study

Karen J. Ortiz-Ortiz, DrPH, MPH1;2; Guillermo Tortolero-Luna, MD, PhD1; Carlos R. Torres-Cintrón, MPH3; Diego E. Zavala-Zegarra, PhD3; Axel Gierbolini-Bermúdez, MA4; and María R. Ramos-Fernández, MD, MSc5

QUESTION ASKED: What are the predictors and patterns of high-intensity end-of-life (EoL) care among patients with GI cancer in Hispanics living in Puerto Rico?

SUMMARY ANSWER: This study confirmed that a high proportion (54.5%) of patients with GI cancer receive aggressive EoL care. Significant associations between aggressive EoL care and sex, age group, insurance, stage at diagnosis, and survival time were observed (P < .05).

WHAT WE DID: Using the Puerto Rico Central Cancer Registry-Health Insurance Linkage Database (PRCCR-HILD), we identified EoL care intensity indicators and examined factors associated with aggressive EoL care among Puerto Ricans diagnosed with GI cancer between 2009 and 2016.

WHAT WE FOUND: The study showed that women, patients ≥ 65 years of age, patients enrolled in Medicaid, patients dually eligible for both Medicare and Medicaid, and patients who survived > 1 year were less likely to receive aggressive EoL care. We found that 11.0% received chemotherapy in the last 14 days, 17.3% had > 1 hospitalization, 9.3% were in intensive care unit, 18.0% had > 1 emergency room visit, 39.3% died in an acute care setting, and 8.6% received life-extending procedures. Subanalysis showed an extremely low percentage (20.3%) of patients 21-64 years of age receiving hospice care compared with other studies with similar populations.

BIAS, CONFOUNDING FACTORS: First, the use of claims data collected for reimbursement purposes has inherent limitations (eg, coding errors). Second, EoL decision-making information such as preferences or experiences related to the patient, family, and physician is unavailable. Third, we were unable to analyze hospice data from Medicare patients since the PRCCR-HILD database does not provide this information.

REAL-LIFE IMPLICATIONS: Our findings support the urgent need to improve EoL care in Puerto Rico. The PRCCR-HILD database revealed that improving the quality of life of patients with cancer and their families must be prioritized. The high proportion of aggressive care, low hospice utilization, and the low number of palliative care specialists are indicative of the poor quality of health services received by this population. This study provides insight into the complex process of EoL care and how different factors interact at different levels.

CORRESPONDING AUTHOR
Karen J. Ortiz-Ortiz, DrPH, MPH, Division of Cancer Control and Population Sciences, University of Puerto Rico Comprehensive Cancer Center, PO Box 363027, San Juan, Puerto Rico 00936-3027; e-mail: karen.ortiz@upr.edu.
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PURPOSE High-intensity care with undue suffering among patients with cancer at the end of life (EoL) is associated with poor quality of life. We examined the pattern and predictors of high-intensity care among patients with GI cancer in Puerto Rico.

METHODS This population-based study of data from the Puerto Rico Central Cancer Registry-Health Insurance Linkage Database examined patients with GI cancer who died between 2009 and 2017. EoL care intensity indicators include the following services in the last month before death: emergency room (ER) visits, hospitalizations, intensive care unit (ICU) admissions, life-extending procedures, death in an acute care setting, and the use of chemotherapy in the last 14 days. We used logistic regression models to examine factors associated with EoL care.

RESULTS Four thousand six hundred twenty-nine patients with GI cancer were included in the analysis. We found that 11.0% of patients received chemotherapy, 17.3% had ≥1 hospitalization, 9.3% were in the ICU, 18.0% had ≥1 ER visit, 39.3% died in an acute care setting, and 8.6% received life-extending procedures. A compound indicator of the aggressiveness of care showed that 54.5% of patients had at least one of the selected aggressive indicators. The multivariable model showed that female patients, patients ≥60 years of age, patients enrolled in Medicaid, patients dually eligible for both Medicare and Medicaid, and patients who survived >1 year were less likely to receive aggressive EoL care.

CONCLUSION Our findings support the urgent need to improve EoL care in Puerto Rico. Further studies are warranted to fully understand EoL care in patients with cancer in Puerto Rico.

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BACKGROUND High-intensity care with undue suffering at the end of life (EoL) is associated with poor quality of life and a higher economic burden. To enhance the quality of life of patients nearing death, healthcare delivery should focus on pain and symptom management instead of prolonging life.1 Overly aggressive cancer treatment during EoL may be an indicator of poor quality of care. For example, although chemotherapy use among terminally ill patients with cancer could be beneficial in some cases, most of the time, it is highly toxic and confers no quality-of-life benefit.1 Conversely, timely hospice care can decrease avoidable measures such as emergency room (ER) visits, hospital admissions, intensive care unit (ICU) admissions, and the use of life-extending procedures.2-4

Despite progress made toward improving the quality of EoL care in the United States, a growing body of evidence shows disparities among groups within the population.5 Inadequate EoL care among patients with cancer has been documented in the United States and other countries.6-14 In the United States, African American and Hispanic populations, male patients, those with low socioeconomic status, and younger patients tend to have more aggressive EoL care and less hospice care.5,10,15-18 Although few studies have evaluated the effect of health insurance, patients enrolled in Medicaid experience more aggressive EoL care.19

Although national patterns of aggressiveness of EoL care are well documented in the mainland United States, to the best of our knowledge, the patterns in Puerto Rico have not yet been studied. The
Commonwealth of Puerto Rico is the largest US territory, with over 3.2 million people of whom 99% self-identify as Hispanic. In terms of income and poverty level, 44% of the Puerto Rican population lives below the federal poverty line (13% in the United States).20 Despite unfavorable economic conditions, recent estimates indicate that only 6% do not have healthcare coverage, and approximately 50% of the population have Medicaid coverage (20% in the United States).21 More than four million Puerto Ricans live in the mainland United States, constituting the second-largest Hispanic population. In the last decade, migration from Puerto Rico to mainland United States increased rapidly because of the island’s economic crisis and recent natural disasters.22,23

In Puerto Rico, GI cancers are a major health burden. GI cancers account for 22% of all cancer diagnoses and represent 32% of all cancer deaths.24 Although few studies focus on GI cancers, findings show a high-intensity EoL care among patients with these types of cancer.25-29 Patients with GI cancers tend to have severe EoL complications such as GI bleeding, obstruction, malnourishment, and unmanaged pain.25,30-32 The literature supports that palliative care significantly reduces high-intensity EoL care in patients with GI cancer.26,33

For the first time, we examined the pattern and predictors of high-intensity care among patients with GI cancer in Puerto Rico. This population-based study analyzes a homogeneous Hispanic population that shares a cultural background and language, with high health insurance coverage, < 65 and ≥ 65 years of age.

METHODS

Data Source

We used data from the Puerto Rico Central Cancer Registry-Health Insurance Linkage (PRCCR-HILD), which links health insurance claim data to patients reported to the Puerto Rico Central Cancer Registry (PRCCR). The PRCCR has been part of the National Program of Cancer Registries (NPCR) since 1997. The PRCCR uses the North American Association of Central Cancer Registries’ standards for coding data with case ascertainment comparable to the US registries.34

PRCCR contains demographic and clinical information for each cancer case, whereas health insurance companies supplied files on member enrollment, claims (including pharmacy), and providers. PRCCR-HILD contains information for approximately 90% of Puerto Rico’s cancer cases from 2008 to 2016. The database includes beneficiaries from the principal health insurance carriers and government health plans. Claims from the health insurance databases were linked using a deterministic match similar to the one used by SEER-Medicare.34 This study was approved by the Institutional Review Board of the University of Puerto Rico’s Comprehensive Cancer Center (#2020-02-21).

Cohort Definition

We queried the PRCCR-HILD database for patients diagnosed with GI cancer between January 1, 2009, and December 31, 2016, as defined by the International Classification of Diseases for Oncology, 3rd edition (ICD-O-3), codes C150-C249, excluding lymphomas and sarcomas (histology codes ≥ 8,800). The study cohort consisted of patients with a recorded date of death, who died of cancer between 2009 and 2017, and who were enrolled the month before death. We excluded patients with more than one cancer diagnosis, patients with stage unknown, and patients who died within 30 days of diagnosis.

Dependent Variables

Claims-based indicators of EoL cancer care intensity were selected based on the literature.1,11,12,35-37 We included the use of chemotherapy in the last 14 days (oral and intravenous) and the following services in the last month (30 days) before death: ≥ 1 ER visit, > 1 ER visit, ≥ 1 hospitalization, > 1 hospitalization, hospitalization of > 14 days, ≥ 1 ICU admission, and death in an acute setting. We also included life-extending procedures (cardiopulmonary resuscitation, feeding tube placement, and insertion of a breathing tube for assisted ventilation) in the last month (30 days) before death, which are questionable for patients with advanced cancer that have a short life expectancy and therefore, such measures are unlikely to increase their survival or improve their quality of life.12,38

In addition, we constructed a compound indicator of the aggressiveness of care to reflect the occurrence of at least one of the following events: chemotherapy use in the last 14 days, > 1 ER visits, > 1 hospitalization or > 14 days of hospital stay, ≥ 1 ICU admission, the use of at least one life-extending procedure, and death in an acute setting. Since we did not have hospice data for Medicare patients, we restricted hospice services use (home, inpatient, or within a skilled nursing facility) to patients with private insurance and Medicaid for ages 21-64 years as recommended care.

Independent Variables

Sociodemographic variables at death were sex, age group (< 60, 60-69, 70-79, and ≥ 80 years), and marital status (married or not married). Clinical variables were primary site and stage at diagnosis. We also included health insurance type (private, Medicaid, Medicare, or dually eligible for both Medicare and Medicaid [Medicare/Medicaid]), year of death (2009-2011, 2012-2014, and 2015-2017), and time from cancer diagnosis to death (≤ 12 months or > 12 months).

Statistical Analyses

We used descriptive statistics and frequency analyses to describe the study population and the variables of interest. We used logistic regression models to examine factors
RESULTS
Cohort Characteristics
A total of 4,629 patients with GI cancer met the inclusion criteria and were included in the analyses. Appendix Table A1 (online only) presents the characteristics of the study population. Nearly half of the eligible patients were ≥ 70 years of age (48.7%), 57.4% were male, and 42.6% died during the period 2012-2014. 13.0% of patients were enrolled in private insurance, 32.7% in Medicaid, 26.1% in Medicare, and 28.2% in Medicare/Medicaid. In terms of the stage at diagnosis, most patients with GI cancer were diagnosed at a distant stage (38.3%), whereas 24.7% were at a localized stage.

EoL Care Indicators
Table 1 shows the indicators of EoL intensity cancer care during the last month of life. We found that 18.7% were hospitalized > 14 days, 17.3% were hospitalized more than once, and 9.3% were in the ICU. The proportion of patients who had at least one ER visit was 46.9%, whereas 18.0% had > 1 ER visit. Overall, 1,820 patients (39.3%) died in an acute care setting, whereas 396 patients (8.6%) received life-extending procedures and 11% received chemotherapy within 14 days of death. Concerning the aggressiveness of care compound indicator, 2,524 (54.5%) patients had at least one of the aggressive indicators.

The association between aggressive EoL care and patient characteristics is shown in Table 2. The bivariate analysis shows associations between aggressive EoL care and sex, age group, insurance, stage at diagnosis, and survival time (P < .05). Analysis stratified by age showed that 64.9% of patients < 60 years of age had a higher proportion of aggressive EoL care, whereas 41.0% of patients ≥ 80 years of age experienced aggressive EoL care. When we examined the time from cancer diagnosis to death, 57.9% of patients who survived ≤ 12 months underwent aggressive EoL care, compared with 49.5% in the group of patients who survived for over 1 year (P < .0001).

Multivariable Analyses
Table 3 shows the unadjusted and adjusted regression model estimates for aggressive EoL care. The likelihood ratio statistical test did not show significant interaction terms (P > .05). The multivariable model showed that female patients were less likely to receive aggressive EoL care than male ones (adjusted odds ratio [AOR] 0.82; 95% CI, 0.73 to 0.92; P = .001) and patients ≥ 60 years of age were less likely to have aggressive EoL care than patients < 60 years of age (P < .01). In addition, aggressive EoL care was less likely in patients enrolled in Medicaid (AOR 0.72; 95% CI, 0.59 to 0.88; P = .001) and Medicare/Medicaid (AOR 0.72; 95% CI, 0.58 to 0.89; P = .002) compared with patients enrolled in private insurance. Finally, patients who survived > 12 months were less likely to receive aggressive EoL care than patients who survived ≤ 12 months (AOR 0.66; 95% CI, 0.58 to 0.75; P < .001).

In the hospice use subanalysis for privately insured and Medicaid patients 21 to 64 years of age, 293 (20.3%) received hospice services in the last month of life. Of those enrolled in hospice, 11.6% were enrolled within the last three days before death and 34.5% within seven days before death (data not shown). The use of aggressive EoL care within the last month of life was lower (30.7%) among patients receiving hospice care than those without (73.3%). Patients not receiving hospice care in the last month of life were 6.3-times (AOR 6.33; 95% CI, 4.75 to 8.43; P < .001) more likely to receive aggressive EoL care than those receiving hospice care (data not shown). We found significant differences between aggressive EoL care and the duration of hospice care (P < .001). Aggressive EoL care was observed in 73.5% of patients enrolled within the last three days before death, 31.5% of those enrolled between 3 to 30 days before death, and 11.1% of patients enrolled more than 30 days before death (data not shown).

DISCUSSION
This study confirms the high proportion (54.3%) of patients with GI cancer who receive high-intensity care at EoL. Compared to the study by Merchant et al25 on patients with GI cancer, we found higher rates of aggressive EoL care among Puerto Rican patients, particularly in ER visit (46.9% vs 45.9%), ≥ 1 hospitalization (62.0% vs 49.3%), ≥ 1 ICU admission (9.3% vs 6.3%), and chemotherapy use in the last 14 days before death (11.0% vs 8.2%). Nonetheless, we found a lower proportion of patients dying in an acute setting (39.3% vs 44.6%). We also found a higher proportion of patients using high-intensity care in terms of chemotherapy, hospitalizations, and ER visits than other studies. 11,12,19,25,39,40

These findings suggest that many patients with cancer in Puerto Rico could have inadequate management of symptoms and higher emotional distress at the EoL. Although further research is needed to better understand the EoL decision-making process, the high-intensity care observed could be the result, in part, of lower hospice care use. The subanalysis showed a concerning low percentage (20.3%) of patients 21-64 years of age receiving hospice care compared with other studies on similar populations where hospice care use was between 24% and 39%. 10,41,42

In addition, the local context could explain these patterns.
Puerto Rico is essentially a Hispanic population with a high poverty rate level, with high insurance coverage, but with a specialist physician’s shortages crisis, mainly in palliative medicine. Cultural values could greatly influence the higher use of aggressive care and the low rates of hospice use among Hispanics, including living as long as possible, being family-centered, not talking directly about EoL care, secrecy about prognosis, and religion and faith systems that could influence hospice decisions and experiences among the Hispanic population. The shortage of physicians specializing in palliative care could be a critical factor influencing the higher use of aggressive care and the low rates of hospice. In Puerto Rico, approximately 20 physicians specialize in adult palliative care. Furthermore, a survey among Puerto Rico emergency physicians found a high percentage reported a lack of training in palliative care (40%) and access to palliative care specialists (81%).

When we assess the factors associated with high-intensity care, consistent with previous studies, we found that female patients were less likely to receive high-intensity care than their male counterparts. These patterns could be related to the fact that males are less likely to be in hospices, have early hospice enrollment, and receive palliative care. Furthermore, several studies evaluating sex-based differences in EoL care agree that provider communication is an important factor. Patients who had EoL discussions had less healthcare expenditures, less use of intensive care interventions, and less physical distress. Female patients reported significantly more EoL discussions with healthcare professionals and had a more accurate awareness of their medical condition than men.

We observed that increased age decreased the odds of receiving aggressive EoL care. Traditionally, younger age is one of the stronger predictors associated with aggressive EoL care. This could be attributable to the differences in patient’s preferences or physician behaviors. One explanation related to patient’s preferences is that to live longer and avoid pain to their families, younger patients are more likely to allow aggressive EoL care. Physicians tend to provide more life-prolonging treatments to younger patients than older ones, suggesting that they are more motivated to save the lives of younger patients.

We found that Medicaid and Medicare/Medicaid patients were less likely to receive aggressive EoL care than patients enrolled in private insurance. However, Guadagnolo et al reported higher use of aggressive EoL care among Medicare and Medicare/Medicaid patients compared with Medicare beneficiaries. The Medicaid program in Puerto Rico is delivered as a managed care plan model with a capitated structure; however, most private insurance is delivered through a fee-for-service model. Patients in a managed care model with a capitation structure could have less incentive to receive higher-intensity EoL care than those with a fee-for-service plan. Further studies are required to determine whether insurance structure and incentives contribute to these patterns.

Our study found differences in EoL care patterns between patients surviving ≤12 months and patients surviving >12 months after their cancer diagnosis. Patients who died soon after their diagnosis have more high-intensity EoL care than those who live longer. This pattern could be related to the lack of advance care planning discussions in patients with shorter survival. Patients with longer survival tend to have earlier EoL care discussions. Patients who died soon after their diagnosis were more engaged in their cancer treatment processes than those with longer survival. Another possible explanation is that patients who survive longer were more likely to enroll in hospice. Patients enrolled in hospice have less aggressive EoL care than those who did not.

### Table 1. High-Intensity Care Indicators at EoL

| Indicator                                | Yes Freq. | Yes %  | No Freq. | No %  |
|------------------------------------------|-----------|--------|----------|-------|
| Chemotherapy (last 14 days)              | 510       | 11.0   | 4,119    | 89.0  |
| ≥ 1 hospitalization                      | 2,872     | 62.0   | 1,757    | 38.0  |
| > 1 hospitalization                      | 801       | 17.3   | 3,828    | 82.7  |
| > 14 LOS                                 | 865       | 18.7   | 3,764    | 81.3  |
| ICU admission                            | 431       | 9.3    | 4,198    | 90.7  |
| ≥ 1 ER visit                             | 2,173     | 46.9   | 2,456    | 53.1  |
| > 1 ER visit                             | 835       | 18.0   | 3,794    | 82.0  |
| Death in an acute care setting           | 1,820     | 39.3   | 2,809    | 60.7  |
| Life-extending procedures                | 396       | 8.6    | 4,233    | 91.5  |
| Aggressive EoL indicator                 | 2,524     | 54.5   | 2,105    | 45.5  |

Abbreviations: EoL, end of life; ER, emergency room; ICU, intensive care unit; LOS, length of stay.
subanalysis results showed a higher proportion of patients receiving hospice care among patients who survived > 12 months than those who survived ≤ 12 months.

The present study has some limitations. First, the use of claims data collected for reimbursement purposes has inherent limitations. For example, it could be subject to coding errors. Second, EoL decision-making information such as preferences or experiences related to the patient, family, and physician is unavailable. Third, we could not analyze hospice data from Medicare patients since the PRCCR-HILD database does not include this information. Nevertheless, we analyzed the use of hospice care among patients with private insurance and Medicaid. Another possible limitation is that the study population only included patients with GI cancer, limiting the generalizability of the results to other types of cancer. Finally, comparisons with other studies must be made with caution since many definitions and different population characteristics exist across studies. Nonetheless, this population-based study allowed us to examine the patterns of EoL care for patients in Puerto Rico, a Hispanic population with a high poverty rate. In addition, this study evaluated different types of health insurance, not only Medicare and Medicaid, and also a population younger than 65 years of age.

In conclusion, this study uncovered a significant gap in providing adequate care delivery in this phase of cancer care. It is well known that patients who receive EoL high-intensive care are more likely to have a poor quality of life and undergo avoidable suffering. Analogously, patients who receive hospice care, palliative care, and have discussions related to advanced planning tend to improve the quality of life at EoL. Nevertheless, the concept

| TABLE 2. Association Between Aggressiveness of EoL Care and Patient Characteristics |
|---|---|---|---|---|
| Characteristic | Yes | | No | |
| | Freq. | Row % | Freq. | Row % | P | Sig |
| Sex | | | | | | |
| Male | 1,523 | 57.3 | 1,135 | 42.7 | < .0001 | *** |
| Female | 1,001 | 50.8 | 970 | 49.2 | | |
| Age group at death | | | | | < .0001 | *** |
| < 60 | 691 | 64.9 | 374 | 35.1 | | |
| 60-69 | 774 | 59.1 | 536 | 40.9 | | |
| 70-79 | 690 | 51.0 | 663 | 49.0 | | |
| ≥ 80 | 369 | 41.0 | 532 | 59.1 | | |
| Year of death | | | | | .794 | |
| 2009-2011 | 593 | 55.0 | 485 | 45.0 | | |
| 2012-2014 | 1,065 | 54.0 | 909 | 46.1 | | |
| 2015-2017 | 866 | 54.9 | 711 | 45.1 | | |
| Insurance | | | | | < .0001 | *** |
| Private | 384 | 63.7 | 219 | 36.3 | | |
| Medicaid | 862 | 56.9 | 653 | 43.1 | | |
| Medicare/Medicaid | 636 | 48.8 | 667 | 51.2 | | |
| Medicare | 642 | 53.2 | 566 | 46.9 | | |
| Stage at diagnosis | | | | | .426 | |
| Localized | 612 | 53.6 | 530 | 46.4 | | |
| Regional | 925 | 53.9 | 791 | 46.1 | | |
| Distant | 987 | 55.7 | 784 | 44.3 | | |
| Survival time | | | | | < .0001 | *** |
| ≤ 12 mo | 1,600 | 57.9 | 1,163 | 42.1 | | |
| > 12 mo | 924 | 49.5 | 942 | 50.5 | | |

Abbreviations: EoL, end of life; ER, emergency room; ICU, intensive care unit.

*P < .1, **P < .05, ***P < .01.

*EoL aggressive care included at least one of the following: use of chemotherapy in the last 14 days or in the last month of life, > 1 ER visits, > 1 hospitalization, or > 14 days of length of stay, at least one ICU admission, use of at least one of life-extending procedures, and death in acute setting.
of death brings with it personal views, religious beliefs, sociocultural perceptions, and legal challenges, especially among the Hispanic population. For healthcare providers, EoL care is a complex process where physicians rely on estimates based on their patient’s prognosis and may fail to realize the exact time frame in which EoL is approaching.6

The high proportion of patients with aggressive EoL care and low hospice use suggests that patients with cancer in Puerto Rico have more unmet needs, inadequate pain management, and lower quality of life at EoL. This scenario underscores the need to promote tailored interventions focused on increasing hospice care in this population. It is crucial to assess the personal, family, community, provider, and health system factors that facilitate or hinder the best quality of care at EoL to improve patients’ experiences near death. Initiatives to increase the number of palliative medicine specialists and improve palliative care training among healthcare providers can improve EoL care in this population. Further studies are warranted to understand EoL care in patients with cancer among Puerto Rico’s Hispanic population.

**TABLE 3.** Predictors of Aggressiveness of EoL Care

| Characteristic            | Unadjusted Model |                | AOR  | 95% CI                |          | adjusted | AOR  | 95% CI                |          |
|---------------------------|------------------|----------------|------|-----------------------|----------|----------|------|-----------------------|----------|
|                           |                  |                |      | Sig                   |          |          |      | Sig                   |          |
| Sex                       |                  |                |      |                       |          |          |      |                       |          |
| Male                      | 1.00             | —              |      | —                     |          | 1.00     | —              |          |                       |          |
| Female                    | 0.77             | 0.68 to 0.87   | <.0001| ***                   | 0.82     | 0.73 to 0.92| .001 | ***                   |          |
| Age group at death        |                  |                |      |                       |          |          |      |                       |          |
| < 60                      | 1.00             | —              |      | —                     |          | 1.00     | —              |          |                       |          |
| 60-69                     | 0.78             | 0.66 to 0.92   | .004 | ***                   | 0.77     | 0.65 to 0.92| .004 | ***                   |          |
| 70-79                     | 0.56             | 0.48 to 0.66   | <.0001| ***                   | 0.54     | 0.45 to 0.66| <.0001| ***                   |          |
| ≥ 80                      | 0.38             | 0.31 to 0.45   | <.0001| ***                   | 0.36     | 0.29 to 0.44| <.0001| ***                   |          |
| Year of death             |                  |                |      |                       |          |          |      |                       |          |
| 2009-2011                 | 1.00             | —              |      | —                     |          | 1.00     | —              |          |                       |          |
| 2012-2014                 | 0.96             | 0.83 to 1.11   | .575 |                       | 1.09     | 0.93 to 1.28| .270 |                       |          |
| 2015-2017                 | 1.00             | 0.85 to 1.16   | .962 |                       | 1.17     | 0.99 to 1.38| .060 | *                      |          |
| Insurance                 |                  |                |      |                       |          |          |      |                       |          |
| Private                   | 1.00             | —              |      | —                     |          | 1.00     | —              |          |                       |          |
| Medicaid                  | 0.75             | 0.62 to 0.92   | .004 | ***                   | 0.72     | 0.59 to 0.88| .001 | ***                   |          |
| Medicare/Medicaid         | 0.54             | 0.45 to 0.66   | <.0001| ***                   | 0.72     | 0.58 to 0.89| .002 | ***                   |          |
| Medicare                  | 0.65             | 0.53 to 0.79   | <.0001| ***                   | 0.87     | 0.70 to 1.08| .219 |                       |          |
| Stage at diagnosis        |                  |                |      |                       |          |          |      |                       |          |
| Localized                 | 1.00             | —              |      | —                     |          | 1.00     | —              |          |                       |          |
| Regional                  | 1.01             | 0.87 to 1.18   | .869 |                       | 0.97     | 0.83 to 1.13| .692 |                       |          |
| Distant                   | 1.09             | 0.94 to 1.27   | .257 |                       | 0.89     | 0.76 to 1.04| .137 |                       |          |
| Survival time             |                  |                |      |                       |          |          |      |                       |          |
| ≤ 12 mo                   | 1.00             | —              |      | —                     |          | 1.00     | —              |          |                       |          |
| > 12 mo                   | 0.71             | 0.63 to 0.80   | <.0001| ***                   | 0.66     | 0.58 to 0.75| <.0001| ***                   |          |

Abbreviations: AOR, adjusted odds ratio; EoL, end of life; OR, odds ratio.
*P < .1, **P < .05, ***P < .01.
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### APPENDIX

**TABLE A1.** Cohort Characteristics

| Characteristic               | Freq. | Percent |
|------------------------------|-------|---------|
| **Sex**                      |       |         |
| Male                         | 2,658 | 57.4    |
| Female                       | 1,971 | 42.6    |
| **Age group at death**       |       |         |
| < 60                         | 1,065 | 23.0    |
| 60-69                        | 1,310 | 28.3    |
| 70-79                        | 1,353 | 29.2    |
| ≥ 80                         | 901   | 19.5    |
| **Year of death**            |       |         |
| 2009-2011                    | 1,078 | 23.3    |
| 2012-2014                    | 1,974 | 42.6    |
| 2015-2017                    | 1,577 | 34.1    |
| **Insurance**                |       |         |
| Private                      | 603   | 13.0    |
| Medicaid                     | 1,515 | 32.7    |
| Medicare/Medicaid            | 1,303 | 28.2    |
| Medicare                     | 1,208 | 26.1    |
| **Stage at diagnosis**       |       |         |
| Localized                    | 1,142 | 24.7    |
| Regional                     | 1,716 | 37.1    |
| Distant                      | 1,771 | 38.3    |
| **Survival time**            |       |         |
| ≤ 12 mo                      | 2,763 | 59.7    |
| > 12 mo                      | 1,866 | 40.3    |