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Predictors of In-Hospital Mortality in Patients With Metastatic Cancer Receiving Specific Critical Care Therapies

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Abstract

Background—In-hospital mortality is high for critically ill patients with metastatic cancer. To help patients, families, and clinicians make an informed decision about invasive medical treatments, we examined predictors of in-hospital mortality among patients with metastatic cancer who received critical care therapies (CCTs).

Patients and Methods—We used the 2010 California Healthcare Cost and Utilization Project: State Inpatient Databases to identify admissions of patients with metastatic cancer (age ≥ 18 years) who received CCTs, including invasive mechanical ventilation (IMV), tracheostomy, percutaneous endoscopic gastrostomy (PEG) tube, acute use of dialysis, and total parenteral nutrition (TPN). We first described the characteristics and outcomes of patients who received any CCTs. We then used multivariable logistic regression models with generalized estimating equations (to account for clustering within hospitals) to identify predictors of in-hospital mortality among patients who received any CCTs.

Results—For 2010, we identified 99,085 admissions among patients with metastatic cancer. Of these, 9,348 (9.4%) received any CCT during hospitalization; 50% received IMV, 15% PEG tube, 8% tracheostomy, 40% TPN, and 8% acute dialysis. Inpatient mortality was 30%. Of patients who

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received any CCT and survived to discharge, 27% were discharged to a skilled nursing facility. Compared with patients who died, costs of care were \$3,019 higher for admissions in which patients survived the hospitalization. Predictors of in-hospital mortality included non-white race (vs whites), lack of insurance (vs Medicare), unscheduled admissions, principal diagnosis of infections (vs cancer-related), greater burden of comorbidities, end-stage renal disease, liver disease and lung cancer (vs other cancers).

Conclusions—Although more studies are needed to better understand risks and benefits of specific treatments in the setting of specific cancer types, these data will help to inform decision-making for patients with metastatic cancer who become critically ill.

Major advances in the detection and treatment of cancer have occurred in the past decades. These advances, along with progress in the supportive management of patients with cancer undergoing treatment, have led to a significant increase in survival rates.¹ As a consequence of this improved survival, the number of patients with advanced cancer who need and receive aggressive care (eg, intensive care therapies for cancer-related complications) has been steadily rising.^{2–4}

The prognosis for patients with cancer requiring intensive care unit (ICU) level of care has been poor, but more recent data suggest that outcomes have improved due to advances in cancer treatment, development of strategies to delay the use of chemotherapy in patients with chronic malignancies, improved ICU management, changes in ICU admission policies, and early detection of the causes leading to ICU admission.⁵ Therefore, studies suggest that these patients may derive benefit from intensive care support.^{2,5–8} Despite that, mortality rates were reported in the range of 55% to 83% for cohorts of patients with mixed hematologic malignancies and solid tumors requiring critical care therapies (CCTs).^{8,9} Therefore, we now face the challenge of determining how to best assist patients, families, and caregivers in making decisions about invasive medical interventions. Patients and families would benefit from seeing outcomes in a contemporary cohort of patients with cancer. Moreover, patients and families need more information about the predictors of improved survival among patients with metastatic cancer who require CCTs.

Prior studies that aimed to predict mortality in critically ill patients with cancer have been limited by small sample size, single-center design, or a single CCT (eg, mechanical ventilation). In addition, most of these studies have examined single cancer subtype or did not exclude only patients with metastatic cancer. Therefore, we aimed to analyze the outcomes of patients with metastatic cancer who received various CCTs (eg, mechanical ventilation, tracheostomy, percutaneous endoscopic gastrostomy [PEG] tube, total parenteral nutrition [TPN], acute use of dialysis), and to describe the predictors of in-hospital mortality among hospitalized patients with metastatic cancer who required CCTs.

Patients and Methods

Data Source

We used data from the Agency for Healthcare Research and Quality (AHRQ), the 2010 California Health Care Cost and Utilization Project: State Inpatient Database (SID), and the American Hospital Association (AHA) Annual Survey Database. The California SID

includes 100% of state's inpatient discharge records from the hospitals. Demographic characteristics, payer information, principal diagnoses, cost, discharge disposition, and death during hospitalization are recorded. We selected California for this analysis because it is one of the largest SIDs and it includes information on do-not-resuscitate (DNR) status. Methodology of data collection has been previously published.¹⁰ The AHA Annual Survey Database compiles responses from 6,300 hospitals nationwide and includes up to 1,000 fields of information categorizing an institution's organizational structure, facility, and service lines; inpatient and outpatient utilization; expenses; and staffing.¹¹

Population

We included all admissions from January 1 to December 30, 2010, and of patients aged 18 years and older with a diagnosis of metastatic cancer. We identified metastatic cancer using ICD-9-CM diagnostic codes (196.0–199.1, 789.51, 209.70–209.75, 209.79) (see supplemental eTable 1, available with this article at JNCCN.org).^{12–15} We excluded patients with hematologic malignancies because staging is complex and outcomes are different compared with metastatic solid tumors (eg, even stage IV cancers are sometimes treated with a goal of cure). We limited the sample to admissions where patients received any of the following CCTs: invasive mechanical ventilation (IMV; 96.70–96.72), prolonged mechanical ventilation (96.72), PEG (43.11), acute kidney injury (AKI) requiring dialysis (requiring both 584.5–585.9 and 39.95), TPN (99.15), and tracheostomy (31.1, 31.21, 31.29).

Covariates

We categorized age into quartiles (<55, 55–64, 65–74, and >75 years, and assessed comorbidities using an adaptation of a combined comorbidity score derived from the Elixhauser comorbidity index.¹⁶ However, to avoid recalculation, we excluded from this score conditions related to our diagnoses of interest, including metastatic solid tumors, weight loss, solid tumor without metastases, and HIV/AIDS. We included end-stage renal disease (ESRD) on dialysis as an additional comorbidity, and classified it based on ICD-9-CM codes (549.8 and 399.5), excluding AKI (584.5–585.9). We used DNR as a predictor, using a variable for DNR status contained in the California SID. DNR status is determined based on whether the order was written at the time of or within the first 24 hours of the patient's admission to the hospital.¹⁷ To better understand how cancer subtype affects mortality, we included primary cancer type as a variable, defined using ICD-9-CM codes (140–209, excluding 196.0–199.1 and 200–208) (see supplemental eTable 2).¹²

We also classified the principal diagnosis using the Clinical Classification Software (CCS) codes. The CCS is a classification tool developed by AHRQ that collapses more than 14,000 ICD-9-CM diagnosis codes and 3,900 ICD-9-CM procedure codes into a smaller set of clinically meaningful categories.¹⁸

To obtain hospital characteristics, we linked the SID database to the AHA Annual Survey. We determined hospital teaching status by using variables indicating whether the hospital was a member of the Council of Teaching Hospitals and Health Systems (COTH), had an approved residency training program according to the Accreditation Council for Graduate Medical Education, or had an internship or residency approved or accredited by American

Osteopathic Association or medical school affiliation reported to the American Medical Association. We assessed whether hospitals were rural or urban using the 2013 Rural-Urban Continuum Codes determined by the United States Department of Agriculture Economic Research Service. Hospital bed size was classified according to the number of beds as small (<200), medium (200–399), and large (≥ 400).

Outcomes

The primary outcome was in-hospital mortality. Secondary outcomes included hospital length of stay (LOS), cost of care, and discharge disposition for patients who survived the hospitalization.

The California SID contains hospital charges calculated by hospital accounting systems. We converted charges to costs using the Health Care Cost and Utilization Project hospital-specific cost-to-charge ratios based on hospital accounting reports from the Centers for Medicare & Medicaid Services (CMS).¹⁹

Analyses

We used descriptive statistics to compare the characteristics and outcomes of patients who died versus those who survived the hospitalization to better understand which group of patients was most likely to benefit from CCTs. We also evaluated the same characteristics and outcomes in the subset of admissions in which patients received IMV (with or without other CCTs).

We used counts and percentages, means and standard deviations, and percentile distributions to describe patient characteristics. We assessed differences between patients who survived to discharge and those who died using chi-square tests for categorical variables and Wilcoxon rank sum tests for continuous variables.

We examined predictors of in-hospital mortality using multivariable logistic regression with generalized estimating equations accounting for hospital clustering effect. We created separate mortality models for any CCTs (including IMV) and for IMV (with or without other CCTs), because we believed that predictors might be different. All patient characteristics were included in the mortality models. Effect modification of cancer subtype and DNR status was evaluated via interaction terms. All analyses were performed using SAS statistical software (Version 9.3, Cary, NC). The Baystate Medical Center Institutional Review Board determined that the project did not constitute human subjects research.

Results

For the year 2010, we identified 99,085 admissions among patients with metastatic cancer and 9,348 (9.4%) included administration of one or more CCTs: IMV in 50%, PEG tube in 15%, tracheostomy in 8%, TPN in 40%, and AKI requiring dialysis in 8%. The overall inpatient mortality rate for patients with metastatic cancer was 10%.

Demographics and Clinical and Hospital Characteristics Among Patients Who Received CCTs

The mean age among patients was 65 years (SD, 13.8), 50% were male, 59% were white, and 52% had Medicare insurance. DNR was documented in 14% of the admissions. Most principal diagnoses were cancer-related (45%) followed by infections diagnoses (20%). The average comorbidity score was 2 (SD, 1.9). For primary cancer subtype, 14% were lung, 13% were colorectal, 8% were genitourinary, and 5% were breast malignancy. A quarter (24%) of admissions involved patients with unidentified cancer subtype. Included patients during those admissions were treated at 318 hospitals; 47% were seen at teaching hospitals, and 30% were seen at hospitals that had 400 or more beds. Other characteristics are shown in Table 1. Characteristics of patients who received IMV are presented in supplemental eTable 3.

Comparison of Characteristics in Patients Who Died Versus Survived to Discharge: CCTs and IMV Group

Among all patients who received CCTs (9,348), 67% (6,286) survived the hospitalization. Among patients who received IMV, 46% (2,136) survived the hospitalization. Comparing nonsurvivors and survivors who received CCTs, 21% and 10% of the patients had metastatic lung cancer, respectively; for IMV, 23% and 17% of the patients had metastatic lung cancer respectively. DNR order was documented during admissions in 23% of nonsurvivors and 10% of survivors who received any CCTs, similar in those who receive IMV. Of the patients who received CCTs and survived, 32% were discharged to short-term hospitals or post-acute facilities. For patients who received IMV and survived, 47% were discharged to short-term hospitals or post-acute facilities. Other characteristics are shown in Tables 2 and 3.

Cost and Hospital LOS

Patients who received CCTs and survived the hospitalization had longer hospital LOS than those who died (12 days [SD, 14.8] vs 8 days [SD, 17.0]; $P<.001$). Costs for admissions where patients survived to discharge were higher (median, \$36,425; interquartile range [IQR], \$15,874–\$64,377) compared with patients who died (median, \$33,406; IQR, \$20,509–\$62,970; $P<.0001$). Among admissions in which patients received IMV and survived the hospitalization, LOS was longer for survivors (13 days [SD, 18.6]) than for patients who died (7 days [SD 16.2]; $P<.001$). Costs were higher for admissions in which patients survived to discharge (median, \$52,156 [IQR, \$31,290–\$87,799] vs \$33,195 [IQR, \$15,070–\$65,086]; $P<.0001$). In-hospital mortality rates were 33% for patients who received any CCTs and 54% for those who received IMV.

Multivariate Analyses

Statistically significant predictors of death for patients who received any CCTs or IMV included race, comorbidities, cancer subtype, principal diagnosis, DNR status, and an unscheduled admission (Table 4). Age and gender were not associated with in-hospital mortality. We did not find evidence of a significant interaction between cancer subtype and DNR status.

In a multivariable model for mortality among patients who received any CCTs, the following factors were associated with mortality: nonwhite race (black vs white: odds ratio [OR], 1.44; 95% CI, 1.2–1.68; and Hispanic vs white: OR, 1.2; 95% CI, 1.04–1.37) and uninsured status (vs Medicare; OR, 2.00; 95% CI, 1.18–2.83). Presence of ESRD (OR, 2.03; 95% CI, 1.12–2.94) or liver disease (OR, 1.94; 95% CI, 1.55–2.33) was also significantly associated with in-hospital mortality. Compared with patients with lung cancer, those with colorectal (OR, 0.32; 95% CI, 0.26–0.38) and genitourinary (OR, 0.58; 95% CI, 0.46–0.70) cancers were less likely to die in the hospital. Admissions with a DNR status were strongly associated with in-hospital mortality (OR, 2.32; 95% CI, 2.01–2.63). Patients admitted to the hospital with a principal diagnosis related to infectious, cardiovascular/circulatory, or pulmonary disorders compared with cancer-related causes had higher odds of dying in the hospital.

In a separate model to identify predictors of in-hospital mortality restricted to admissions in which patients received IMV, our findings were very similar (Table 4). Patients with private insurance who received IMV were more likely to die in the hospital compared with patients who had Medicare (OR, 1.26; 95% CI, 1.01–1.51). ESRD was not associated with in-hospital mortality in patients who received IMV. For admissions with DNR status documented, patients who received IMV were 3 times as likely to die in the hospital compared with admissions with no DNR order on admission (OR, 3.11; 95% CI, 2.50–3.72).

Discussion

Using a large population-based cohort of patients with metastatic solid tumors who received CCTs, we found that, overall, outcomes for patients with metastatic cancer who required CCTs in the hospital remained poor. One-third of admissions that included patients with metastatic cancer who received any CCTs died in the hospital, as did half of included patients who received IMV. Of the patients who survived the hospitalization, almost one-third of the patients were discharged to a skilled nursing facility. For patients receiving IMV, this number increased to 50%. Patients who survived had increased hospital LOS and higher costs of care compared with those who died.

Our findings must be placed in the context of prior work. First, mortality rates among patients with cancer who received IMV have been reported to range from 55% to 83%.⁹ However, these studies included a mix of hematologic malignancies and solid tumors, were not limited to metastatic cancer, and did not include all CCTs. Second, lung cancer subtype was an important predictor of mortality. Prior studies have been conducted that were specific to cancer subtypes. Mortality rates in patients with lung cancer requiring ICU care were reported to be 24% to 54%, and were not limited to those who required IMV.^{20–22} Other studies have also examined how cancer subtypes compare with each other. Azouley et al⁶ reported that 30-day mortality rates were comparable across cancer subtypes in patients receiving both invasive and noninvasive mechanical ventilation for leukemia/lymphoma (70.5%), multiple myeloma (72%), and solid tumors (76.4%). Here, we only report the inpatient mortality for patients with metastatic solid tumors who received any CCTs; it is likely that the 30-day mortality is higher.

These results have important implications for practicing clinicians. Patients who require any CCT (or in particular IMV) and have other associated higher-risk factors (eg, a DNR order, lung cancer, ESRD or liver disease, or noncancer admitting diagnosis) should be counseled about their poorer prognosis. For example, the average mortality risk for a patient with metastatic cancer who requires IMV is 50%, but this is likely to be greater than if that patient also has ESRD. In contrast, patients with genitourinary or colorectal cancer who were not DNR at admission and do not have a diagnosis of ESRD or liver disease may have better odds of survival. Although not limited to patients who received IMV, a retrospective study identified the use of IMV and severity of organ failure as predictors of poor outcome in the ICU for a group of patients with lung cancer.²³ Therefore, identifying higher- and lower-risk populations can provide an opportunity for patients, caregivers, and family to commence and/or consolidate discussions about goals of care. Future research should consider the development of a clinical prediction score that can be used to assist clinicians as they describe the risks and benefits of CCTs to patients, families, and caregivers.

We found higher mortality rates among nonwhite patients with cancer requiring CCTs. Numerous studies have shown similar findings in patients with cancer. Many reasons have been postulated, including the underlying, more aggressive, cancer biology, higher incidence of cancer, later stage of cancer at diagnosis, difference in receipt of cancer therapy, and lower thresholds for use of CCTs and IMV at hospitals with a larger population of white patients.^{24–28} Nonwhite patients have also been shown to use more CCTs and less end-of-life care.^{29,30} The higher mortality rate in this group is therefore likely multifactorial, but may also indicate disparities in access to care or early diagnosis for nonwhite patients. Interventions at the population and health care system level to promote uptake in screening in minority patients decreases in the interval between diagnosis and treatment, and increased attention paid to the cultural difference in end-of life care are needed.

There are important limitations of our study. We used ICD-9 codes to define metastatic cancer and the various cancer subtypes. These codes have unfortunately not been validated. However, this allowed us to understand differences in outcomes by cancer subtype. We only included patients with metastatic cancer who received specific CCTs (IMV, tracheostomy, PEG tube, acute use of dialysis, and TPN). Therefore, our findings cannot be generalized to all patients needing ICU care. We lacked information on cancer severity and treatments, and did not know whether patients were enrolled in a palliative care program or hospice at time of admission. Additionally, we do not have information on ICU admission and treatment limitation policies, as studies have suggested outcomes may improve with broader ICU admission policies.^{5,8,31,32} However, we did not use ICU admission as an inclusion criterion, so this may mean that this limitation is less important. We also reported inpatient mortality only, and we may have underestimated the mortality rate as some patients may have died soon after discharge. It was surprising that 16% of patients who received IMV actually had a DNR order. It is possible that the DNR status was changed after care escalation.

Conclusions

Our study showed that in a cohort of patients with metastatic cancer who received CCTs, the mortality rate is high. It is especially high for those with metastatic lung cancer who

received CCTs. Demographic factors (race, insurance status) and clinical factors (unscheduled admission, principal diagnosis, comorbidities, and DNR status) were predictors for in-hospital mortality. These risk factors should be considered when helping patients with metastatic cancer determine their goals of care. Future work should focus on predictors among individual cancer subtypes and modifiable risk factors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Demographic, Hospital, and Clinical Characteristics in Patients With Metastatic Cancer Who Received CCTs

Characteristics	Received CCTs (n=9,348)	Died (n=3,060)	Alive (n=6,286)	P Value
Age, mean (SD), y	65.1 (13.8)	67 (13.6)	66 (13.8)	.0181
Age, y (%)				.0612
<55	1,979 (21.2)	612 (20.0)	1,367 (21.8)	
55–64	2,319 (24.8)	739 (24.2)	1,580 (25.1)	
65–74	2,539 (27.2)	874 (28.6)	1,665 (26.5)	
>75	2,511 (26.9)	835 (27.3)	1,674 (26.6)	
Sex (%)				.0872
Male	4,594 (49.2)	1,453 (50.5)	3,050 (48.6)	
Race ^a (%)				<.0001
White	5,272 (58.9)	1,560 (53.9)	3,712 (61.3)	
Black	905 (10.1)	369 (12.8)	536 (8.9)	
Hispanic	1,588 (17.7)	537 (18.6)	1,049 (17.3)	
Other	1,189 (13.3)	428 (14.8)	761 (12.6)	
Payer (%)				.0021
Medicare	4,901 (52.4)	1,630 (53.3)	3,270 (52.0)	
Medicaid	1,407 (15.1)	488 (16.0)	918 (14.6)	
Private insurance	2,732 (29.2)	824 (27.0)	1,908 (30.4)	
No charge/other	135 (1.4)	56 (1.8)	79 (1.3)	
Self-pay	173 (1.9)	62 (2.0)	111 (1.8)	
DNR ^b (%)				<.0001
No	8,000 (85.6)	2,361 (77.2)	5,637 (89.7)	
Yes	1,346 (14.4)	698 (22.8)	648 (10.3)	
Cancer subtype (%)				<.0001
Lung	1,301 (13.9)	653 (21.3)	648 (10.3)	
Breast	451 (4.8)	206 (6.7)	245 (3.9)	
Colorectal	1,223 (13.1)	245 (8.0)	977 (15.5)	
Genitourinary	738 (7.9)	83 (9.0)	464 (7.4)	
Other cancer or >1 cancer subtype	3,412 (36.5)	884 (29.2)	2,517 (40.4)	
No identified subtype	2,223 (23.8)	788 (25.8)	1,435 (22.8)	
Scheduled admission ^c (%)				<.0001
No	7,622 (81.5)	2,741 (89.6)	4,879 (77.6)	
Yes	1,725 (18.5)	319 (10.4)	1,406 (22.4)	
Comorbidity score, ^d mean (SD)	2 (1.9)	2 (1.9)	1 (1.9)	<.0001
Principal diagnosis (%)				<.0001
Cancer-related	4,185 (44.8)	1,015 (33.2)	3,169 (50.4)	

Characteristics	Received CCTs (n=9,348)	Died (n=3,060)	Alive (n=6,286)	P Value
Infections	1,831 (19.6)	1,067 (34.9)	764 (12.2)	
Other pulmonary disorders	876 (9.4)	417 (13.6)	459 (7.3)	
Other cardiovascular and circulation disorders	340 (3.6)	152 (5.0)	188 (3.0)	
Other neurologic disorders	137 (1.5)	42 (1.4)	95 (1.5)	
Other gastrointestinal disorders	922 (9.9)	156 (5.1)	765 (12.2)	
Fluid and electrolyte/renal disorders	366 (3.9)	65 (2.1)	301 (4.8)	
Other	691 (7.4)	146 (4.8)	545 (8.7)	
Teaching hospital (%)	4,344 (47.0)	1,289 (43.0)	3,055 (49.0)	<.0001
Urban ^e (%)	9,155 (99.0)	3,001 (99.3)	6,152 (98.9)	.0814
Bed size ^e (%)				.0306
Small	2,463 (26.6)	852 (28.2)	1,610 (25.9)	<.0001
Medium	3,975 (43.0)	1,295 (42.9)	2,679 (43.1)	
Large	2,808 (30.4)	876 (29.0)	1,932 (31.1)	
Types of CCTs (%)				
Invasive mechanical ventilation	4,622 (49.5)	2,486 (81.2)	2,136 (34.0)	
PEG tube	1,346 (14.4)	173 (5.7)	1,173 (18.7)	
Tracheostomy	725 (7.8)	167 (5.5)	558 (8.9)	
Total parenteral nutrition	3,670 (39.3)	580 (19.0)	3,090 (40.2)	
AKI requiring dialysis	730 (7.8)	316 (10.3)	414 (6.6)	

Abbreviations: AKI, acute kidney injury; CCTs, critical care therapies; DNR, do not resuscitate; PEG, percutaneous endoscopic gastrostomy.

^a394 missing.

^b2 missing.

^c1 missing.

^d9 missing.

^e102 missing

Table 2

Discharge Disposition, Costs, and Length of Stay for Patients With Metastatic Cancer Who Received CCTs

Characteristics	Received CCTs (n=9,348)	Died (n=3,060)	Alive (n=6,286)	P Value
Discharge disposition ^a				
Home	1,990 (21.3)		1,990 (31.7)	NA
Short-term hospital	383 (4.1)		383 (6.1)	
SNF, ICF, facility	1,627 (17.4)		1,627 (25.9)	
Home health care	2,110 (22.6)		2,110 (33.6)	
AMA	27 (0.3)		27 (0.4)	
Discharge alive, unknown	149 (1.6)		149 (2.4)	
Total charge/patient (USD \$100,000) ^b				
Median (SD)	152,246 (206,100)	146,485 (221,258)	154,584 (198,095)	.0056
Cost/charge ratio ^c				
Median (SD)	35,422 (47.8)	33,406 (50,469)	36,425 (45,306)	<.0001
Length of stay (d) ^d				
Mean (SD)	11 (15.6)	8 (17.0)	12 (14.8)	<.0001

Abbreviations: AMA, against medical advice; CCTs, critical care therapies; ICF, intermediate care facility; NA, not applicable; SNF, skilled nursing facility.

^a2 missing.

^b1,273 missing.

^c1,286 missing.

^d3 missing.

Table 3

Discharge Disposition, Costs, and Length of Stay for Patients With Metastatic Cancer Who Received IMV

Characteristics	Received IMV (n=4,623)	Died (n=2,486)	Alive (n=2,136)	P Value
Discharge disposition ^a				
Home	581 (12.6)		581 (27.2)	NA
Short-term hospital	235 (5.1)		235 (11.0)	
SNF, ICF, facility	774 (16.8)		774 (36.2)	
Home health care	479 (10.4)		479 (22.4)	
AMA	11 (0.2)		11 (0.5)	
Discharge alive, unknown	56 (1.2)		56 (2.6)	
Total charge/patient (USD \$100,000) ^b				
Median (SD)	182,682 (234,991)	146,184 (225,359)	225,121 (239,791)	<.0001
Cost/charge ratio ^c				
Median (SD)	42,766 (53,439)	33,196 (51,090)	52,156 (54,528)	<.0001
Length of stay (d) ^d				
Mean (SD)	10 (17.6)	7 (16.2)	13 (18.6)	<.0001

Abbreviations: AMA, against medical advice; ICF, intermediate care facility; IMV, invasive mechanical ventilation; NA, not applicable; SNF, skilled nursing facility.

^a 1 missing.

^b 3 missing.

^c 561 missing.

^d 569 missing.

Table 4

Predictors of In-Hospital Mortality for Patients With Metastatic Cancer Who Received CCTs and IMV

Variables	In-Hospital Mortality Adjusted Odds Ratios (95% CI)	
	CCTs	IMV
Cancer subtype		
Lung	1 (referent)	1 (referent)
No identified cancer subtype	0.62 (0.53–0.72)	0.70 (0.57–0.84)
Breast	0.82 (0.62–1.02)	0.91 (0.64–1.19)
Colorectal	0.32 (0.26–0.38)	0.48 (0.36–0.60)
Genitourinary	0.58 (0.46–0.7)	0.75 (0.55–0.95)
Other cancer or >1 subtypes	0.50 (0.42–0.57)	0.71 (0.58–0.84)
Sex		
Male	1 (referent)	1 (referent)
Female	0.97 (0.87–1.07)	0.97 (0.84–1.10)
DNR		
No	1 (referent)	1 (referent)
Yes	2.33 (2.03–2.64)	3.11 (2.50–3.72)
Age, y		
<55	1 (referent)	1 (referent)
55–64	0.96 (0.82–1.10)	0.96 (0.77–1.15)
65–74	1.12 (0.92–1.31)	1.06 (0.82–1.30)
>75	1.03 (0.85–1.22)	1.04 (0.80–1.29)
Race		
White	1 (referent)	1 (referent)
Hispanic	1.20 (1.04–1.37)	1.26 (1.03–1.48)
Black	1.44 (1.20–1.68)	1.36 (1.08–1.65)
Other	1.23 (1.04–1.41)	1.23 (0.99–1.48)
Payer		
Medicare	1 (referent)	1 (referent)
Medicaid	1.10 (0.90–1.29)	1.02 (0.79–1.25)
Private insurance	1.17 (1.00–1.35)	1.26 (1.01–1.51)
No charge/other	2.00 (1.18–2.83)	1.51 (0.70–2.32)
Self-pay	1.30 (0.81–1.8)	1.04 (0.54–1.54)

Variables	<u>In-Hospital Mortality Adjusted Odds Ratios (95% CI)</u>	
	CCTs	IMV
Comorbid score		
2	1 (referent)	1 (referent)
0	0.53 (0.46–0.60)	0.77 (0.63–0.91)
1	0.76 (0.67–0.85)	0.90 (0.76–1.04)
Comorbidities		
Weight loss	0.72 (0.65–0.80)	0.93 (0.80–1.07)
ESRD	2.02 (1.11–2.93)	1.72 (0.80–2.64)
Liver problem	1.93 (1.54–2.32)	1.58 (1.15–2.00)
Principal diagnosis		
Cancer-related	1 (referent)	1 (referent)
Infections	2.83 (2.46–3.20)	2.04 (1.70–2.39)
Other pulmonary disorders	1.73 (1.44–2.02)	0.95 (0.77–1.14)

Abbreviations: CCTs, critical care therapies; DNR, do not resuscitate; ESRD, end-stage renal disease; IMV, invasive mechanical ventilation.