Association between the Availability of Hospital-based Palliative Care and Treatment Intensity for Critically Ill Patients

May Hua¹, Xiaoyue Ma^{1,2}, R. Sean Morrison³, Guohua Li^{1,2,4}, and Hannah Wunsch^{1,5,6,7}

¹Department of Anesthesiology and ²Center for Health Policy and Outcomes in Anesthesia and Critical Care, Columbia University College of Physicians and Surgeons, New York, New York; ³Icahn School of Medicine at Mount Sinai, New York, New York; ⁴Department of Epidemiology, Columbia University Mailman School of Public Health, New York, New York; ⁵Department of Critical Care Medicine, Sunnybrook Health Sciences Center, Toronto, Ontario, Canada; and ⁶Department of Anesthesia and ⁷Interdisciplinary Department of Critical Care Medicine, University of Toronto, Toronto, Ontario, Canada

Abstract

Rationale: In the intensive care unit (ICU), studies involving specialized palliative care services have shown decreases in the use of nonbeneficial life-sustaining therapies and ICU length of stay for patients. However, whether widespread availability of hospital-based palliative care is associated with less frequent use of high intensity care is unknown.

Objectives: To determine whether availability of hospital-based palliative care is associated with decreased markers of treatment intensity for ICU patients.

Methods: Retrospective cohort study of adult ICU patients in New York State hospitals, 2008–2014. Multilevel regression was used to assess the relationship between availability of hospital-based palliative care during the year of admission and hospital length of stay, use of mechanical ventilation, dialysis and artificial nutrition, placement of a tracheostomy or gastrostomy tube, days in ICU and discharge to hospice.

Results: Of 1,025,503 ICU patients in 151 hospitals, 814,794 (79.5%) received care in a hospital with a palliative care program. Hospital length of stay was similar for patients in hospitals with and without palliative care programs (6 d [interquartile range, 3–12] vs. 6 d [interquartile range, 3–11]; adjusted rate ratio, 1.04 [95% confidence interval 1.03–1.05]; $P < 0.001$), as were other healthcare use outcomes. However, patients in hospitals with palliative care programs were 46% more likely to be discharged to hospice than those in hospitals without palliative care programs (1.7% vs. 1.4%; adjusted odds ratio, 1.46 [95% confidence interval 1.30–1.64]; $P < 0.001$).

Conclusions: The availability of hospital-based palliative care was not associated with differences in in-hospital treatment intensity, but it was associated with significantly increased hospice use for ICU patients. Currently, the measurable benefit of palliative care programs for critically ill patients may be the increased use of hospice facilities, as opposed to decreased healthcare use during an ICU-associated hospitalization.

Keywords: palliative care; critical illness; hospices; retrospective studies; intensive care units

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Correspondence and requests for reprints should be addressed to May Hua, M.D., M.Sc., Department of Anesthesiology, Columbia University College of Physicians and Surgeons, 622 West 168th Street PH5, Room 527-D, New York, NY 10032. E-mail: mh2633@cumc.columbia.edu.

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Critically ill patients often undergo high-intensity care, which is characterized by the use of invasive procedures and life-sustaining therapies. This care may not be in line with patients' preferences (1, 2) and may cause significant distress (3–5). With increases in use of intensive care at the end of life (6), a reexamination of the value of high-intensity care is now part of the national healthcare agenda because the downsides may outweigh the benefits. Several organizations, including the Institute of Medicine and the Choosing Wisely campaign, have advocated increasing the use of palliative care to mitigate high treatment intensity and as a way to better align the care provided with the care that patients prefer (7–10). Moreover, the burden of palliative care needs in the intensive care unit (ICU) is substantial, with approximately 14% of all ICU patients meeting one or more criteria for palliative care consultation (11).

Several studies have demonstrated that use of palliative care consultation, or specialized palliative care, is associated with decreases in use of nonbeneficial life-sustaining therapies and ICU length of stay (12–14). These data have helped drive a national expansion of palliative care services. Yet, it is unclear if “real-world” palliative care programs, outside these original studies, provide the same benefits. Thus, the goal of this study was to determine the overall effectiveness of specialized palliative care for critically ill patients by examining the relationship between the availability of hospital-based palliative care services and markers of treatment intensity (as measured by resource use during a hospitalization requiring ICU care) on a population level. The abstract of this article was previously presented at the 2017 Beeson Annual Meeting and the 2018 ATS International Conference (15).

Methods

Patients and Data Collection

The study protocol was reviewed and approved by the institutional review board of Columbia University Medical Center, New York, New York (IRB-AAAJ2158). The need for written informed consent was waived. Data for this study came from a novel database combining patient-level data from the New York Statewide Planning and Research Cooperative System (SPARCS),

hospital-level characteristics from the American Hospital Association (AHA) Annual Survey, and information about palliative care programs from the National Palliative Care Registry (NPCR) for the years 2008–2014. SPARCS is a comprehensive data-reporting system of patient-level data, including patient characteristics, diagnoses and treatments, services, and charges for every hospital discharge in New York State; these data have been used extensively, both on their own and as part of the Nationwide Inpatient Sample, for research purposes (16–18). The NPCR is a database maintained by the Center to Advance Palliative Care, which collects detailed data on operational characteristics of palliative care programs. Participation is voluntary and at no cost to eligible programs; to be eligible, programs must be licensed by their state and must have been providing services for at least 1 month and in one or more healthcare settings. Data are collected via an online annual questionnaire that is completed by participating programs. These data are aggregated anonymously for annual reports, fed back to participants for quality improvement, and have been used previously for research purposes (19).

The cohort consisted of all patients aged 18 years and older who had an index acute care hospitalization with admission to an ICU (defined by ICU bed use billing codes). Patients with intermediate or psychiatric ICU charges were not designated as ICU patients. We excluded repeat admissions for patients (retaining the first admission only), and to decrease heterogeneity of hospital characteristics, we also excluded small hospitals (<100 beds) and those in rural areas, which resulted in exclusion of approximately 24% of hospitals per year and 7.4% of patients.

Patient-level covariates that were available within SPARCS included age, sex, race, insurance type, urban residence, patient type (nonsurgical, surgical), number of Elixhauser comorbidities (20), diagnosis of sepsis (21), use of a billing code for having an “encounter for palliative care,” risk of mortality, and year of admission. Hospital-level variables derived from the AHA Annual Survey included whether hospitals were in an urban location, teaching status of the hospital, hospital bed size and the total number of admissions, surgical procedures, and physician and nurse full-time

equivalents, adjusted for hospital bed size; variables were matched using AHA data corresponding to the patient's year of admission. (For further details on covariates, *see* the online supplement.)

The primary exposure for this study was the availability of a palliative care program at the hospital during the year of admission. This was determined using a stepwise process, combining data from the AHA and NPCR databases, with the use of web searching and direct contact to fill in any missing data (*see* online supplement). The validity of the AHA data in determining the availability of a palliative care program has previously been established (22). For hospitals that developed a palliative care program during the study period, the exposure was assigned on the basis of whether the hospital had a program during the year of a patient's admission. To reduce misclassification, if hospitals developed a palliative care program during the study period, we excluded data from that hospital for the year during which the program was established as well as the for subsequent year, both to allow for penetration of the program within the hospital and because we did not have information about when in the year the program was initiated. We did not use a patient-level exposure for receipt of specialized palliative care, because this cannot be reliably determined in population-level data (23).

Outcomes

We operationalized treatment intensity using measures of resource use during a hospitalization requiring ICU care, and we examined several outcomes, including length of stay, use of procedures, and discharge destination. The primary outcome for this study was hospital length of stay. This was chosen as the primary outcome because prior studies have demonstrated that use of specialized palliative care is associated with a decrease in length of stay (13, 24, 25). Secondary outcomes included days in ICU (based on the number of charges for ICU bed use) for all ICU patients (including survivors), the use of procedures including mechanical ventilation, dialysis, placement of a tracheostomy or gastrostomy tube, enteral or parenteral nutrition, and cardiopulmonary resuscitation (based on International Classification of Diseases, Ninth Revision, codes; for details, *see* the

online supplement) (26), as well as discharge to hospice and in-hospital mortality.

Statistical Analysis

We summarized demographic and clinical characteristics, and we calculated standardized differences for patients who received care in hospitals with and without palliative care programs. We assessed the association between availability of hospital-based palliative care during the year of admission and outcomes using multilevel regression, adjusting for hospital as a random effect. Negative binomial regression was used for ordinal outcomes, and logistic regression was used for binary outcomes. Because the primary exposure of interest was a hospital-level variable, we performed grand mean centering for patient-level covariates (27). In regression models, we included age, sex, race, and risk of mortality during hospitalization *a priori* as confounders, as well as year of admission and any additional variables that had a standardized difference greater than 0.1 (28).

Sensitivity Analyses

To confirm the robustness of our primary analysis, we performed a number of sensitivity analyses. First, to address large differences in hospital characteristics, we repeated the primary analysis, stratifying on teaching status and hospital bed size. Second, we conducted a “dose–response” analysis based on the maturity of the program, using a three-level categorical exposure. We compared outcomes in hospitals that always had a palliative care program (“mature” hospitals) and hospitals that developed a palliative care program during the study period (“nascent” hospitals) with hospitals that never had a palliative care program (“never” hospitals). For patients who received care in “nascent” hospitals that developed a program during the study period, patients cared for in years before the introduction of a palliative care program were assigned “never” status, whereas those cared for in years after the introduction of a palliative care program were assigned “nascent” status. Third, we conducted a difference-in-differences analysis to estimate the effect of implementing a palliative care program on outcomes. For this analysis, we included only “never” hospitals and “nascent” hospitals, comparing the change in outcomes in hospitals that developed a

palliative care program with the change in outcomes occurring over time in hospitals that never had a palliative care program. In addition, for “nascent” hospitals, we excluded hospitals that developed programs in the first year of the study period (2008) or the last two years (2013 and 2014), because these hospitals would have either not enough baseline or follow-up data. Fourth, because we used a hospital-level exposure to approximate patient-level receipt of specialized palliative care, we conducted a subgroup analysis in patients with a primary admission diagnosis of metastatic cancer (identified using the coding algorithm from the Elixhauser comorbidity index) (20); this represents a patient population that is potentially more likely to have received a palliative care consultation during the hospital stay. (For further details, *see* the online supplement.) Last, we performed a quantitative bias analysis to address the possibility of residual confounding (29); this analysis quantifies the frequency and magnitude of a hypothetical unmeasured confounder that would abrogate the association between an exposure and an outcome. Database management and statistical analysis were performed using

SAS 9.4 software (SAS Institute) and Stata 13.1 software (StataCorp LP).

Results

Characteristics of Critically Ill Patients Cared for in Hospitals with and without Palliative Care Programs

Within New York State from 2008 to 2014, there were 151 hospitals, of which 86 consistently had a palliative care program for all years (“mature”), 28 never had a program (“never”), and 37 developed a program during the study period (“nascent”). There were large differences in hospital characteristics: Hospitals with palliative care programs were more likely to be hospitals with teaching status (76.7% for mature vs. 54.0% for nascent vs. 39.3% for never); bed size greater than or equal to 400 (62.8% for mature vs. 21.6% for nascent vs. 7.1% for never); and higher numbers of yearly admissions, surgical operations, and fully employed physicians and nurses (Table 1). Within these hospitals, 1,025,503 patients had a first hospitalization in which they were admitted to an ICU (*see* Figure E1 in the online supplement). Of these patients, 814,794 (79.5%) received care in a hospital

Table 1. Characteristics of hospitals in New York State, stratified by availability of a palliative care program

	Never (<i>n</i> = 28)	Nascent (<i>n</i> = 37)	Mature (<i>n</i> = 86)
Teaching hospital, <i>n</i> (%) [*]	11 (39.3)	20 (54.0)	66 (76.7)
Bed size, <i>n</i> (%) [*]			
100–399	26 (92.3)	29 (78.4)	32 (37.2)
≥400	2 (7.1)	8 (21.6)	54 (62.8)
Total admissions, median (IQR) [†]	7,406 (4,869–10,234)	12,033 (7,547–18,307)	20,237 (14,605–37,123)
Total surgical operations, median (IQR) [†]	6,824 (4,316–8,436)	8,229 (6,029–11,684)	15,307 (9,288–25,520)
Full-time equivalent physicians and dentists, median (IQR) [†]	22 (7–47)	24 (11–44)	70 (30–170)
Full-time equivalent registered nurses, median (IQR) [†]	229 (161–410)	364 (243–547)	715 (428–1,329)

Definition of abbreviation: IQR = interquartile range.

^{*}Because data were matched by hospital year, several hospitals had characteristics change during the study period. For the purposes of the table, each hospital was assigned on the basis of the category to which they belonged for the majority of years of the study period.

[†]Because data were matched by hospital year, hospitals had varying values by year. For the purposes of the table, values were averaged over the study period and assigned to each hospital before calculating summary statistics.

during a year in which a palliative care program was available. Overall, there were few differences in patient characteristics. Patients cared for in hospitals with a palliative care program versus no palliative care program were more likely to be of nonwhite race (black, 17.5% vs. 13.6%; other, 19.0% vs. 16.9%) and to have private insurance (39.5% vs. 32.5%), and they were less likely to live in a rural location (3.5% vs. 7.0%) and pay for care out of pocket (3.9% vs. 10.1%). Gross measures of severity of illness did not differ. Use of the billing code V66.7 (“encounter for palliative care”) was more common in patients cared for in hospitals with a palliative care program (3.4% vs. 1.9%) (Table 2).

Association between Availability of Hospital-based Palliative Care and Treatment-Intensity Outcomes

There was a statistically significant but not clinically meaningful increase in hospital length of stay between patients who received care in hospitals with and without palliative care programs for the overall population (6 d [interquartile range {IQR}, 3–12] vs. 6 d [IQR, 3–11]; adjusted rate ratio, 1.04 [95% confidence interval (CI), 1.03–1.05]; $P < 0.001$) or for decedents (8 d [IQR, 3–17] vs. 8 d [IQR, 3–16]; adjusted rate ratio, 0.97 [95% CI 0.95–0.99]; $P = 0.001$). Other markers of high resource use (ICU days, use of mechanical ventilation and dialysis, placement of a tracheostomy or gastrostomy tube, and use of cardiopulmonary resuscitation) were not substantially different, with the exception of enteral/parenteral nutrition (9.6% vs. 10.6%; adjusted odds ratio [aOR], 0.92 [95% CI, 0.88–0.96]; $P < 0.001$). However, patients in hospitals with a palliative care program were more likely to be discharged to hospice (1.7% vs. 1.4%; aOR, 1.46 [95% CI, 1.30–1.64]; $P < 0.001$). Mortality during hospitalization did not differ (10.1% vs. 10.9% for hospitals without a palliative care program; aOR, 1.03 [95% CI, 0.98–1.07]; $P = 0.34$) (Table 3).

Sensitivity Analyses

Because there were large differences in hospital-level characteristics between patients cared for in hospitals with and without palliative care programs, we conducted an analysis, stratifying on teaching status and hospital bed size (grouped as 100–399 or ≥ 400 beds). Results for length of stay were similar to the primary analysis; other markers of resources use

Table 2. Baseline characteristics of patients cared for in hospitals with and without palliative care programs

	Palliative Care Program*		Standardized Difference
	No (n = 210,709)	Yes† (n = 814,794)	
Age, yr, mean (SD)	64.3 (18.1)	63.3 (18.2)	0.07
Age range, yr, n (%)			
18–64	94,780 (46.4)	399,440 (49.0)	
65–74	41,131 (19.5)	161,848 (19.9)	
75–84	44,277 (21.0)	158,875 (19.5)	
≥ 85	27,461 (13.0)	94,631 (11.6)	–0.01
Sex, n (%)			
Female	100,243 (47.6)	383,435 (47.1)	
Male	110,462 (52.4)	431,349 (52.9)	0.14
Race, n (%)			
White	148,348 (69.5)	514,901 (63.2)	
Black	28,674 (13.6)	142,178 (17.5)	
Other	33,792 (16.9)	154,142 (19.0)	0.33
Rural residence, n (%)			
Rural	14,740 (7.0)	28,233 (3.5)	
Mixed	97,653 (46.3)	279,269 (34.3)	0.26
Urban	97,088 (46.1)	502,584 (61.7)	
Insurance, n (%)			
Medicare	98,626 (46.8)	375,542 (46.1)	0.19
Medicaid	18,991 (9.0)	71,400 (8.8)	
Private	68,486 (32.5)	322,117 (39.5)	
Self-pay	21,187 (10.1)	31,706 (3.9)	
Other	3,419 (1.6)	14,029 (1.7)	
Surgical, n (%)	80,715 (38.9)	388,648 (47.7)	0.06
Number of Elixhauser comorbidities, n (%)			
0	17,650 (8.4)	81,597 (10.0)	
1–3	120,822 (57.3)	457,763 (56.2)	
≥ 4	72,237 (34.3)	275,434 (33.8)	0.01
Risk of mortality on hospitalization, n (%)‡			
Minor	60,246 (28.6)	233,987 (28.7)	
Moderate	50,265 (23.9)	194,347 (23.9)	
Major	49,614 (23.6)	189,152 (23.2)	
Extreme	50,583 (24.0)	197,308 (24.2)	–0.03
Sepsis, n (%)§	52,054 (24.7)	192,509 (23.6)	
Use of “encounter for palliative care” billing code	3,956 (1.9)	27,718 (3.4)	0.1

*The availability of a palliative care program was determined according to whether the hospital had a program during the year of admission.

†The following numbers of patients were missing data for the listed covariates: sex ($n = 14$), race ($n = 5,468$), rural residence ($n = 5,936$), risk of mortality on hospitalization ($n = 1$).

‡The risk of mortality indicator is calculated using a proprietary grouping software developed by 3M Health Information Systems and is based on age, comorbidities, procedures, and principal diagnosis for the hospitalization.

§The presence of sepsis was determined using the Angus definition, an algorithm based on the International Classification of Diseases, Ninth Revision.

||The International Classification of Diseases, Ninth Revision, contains a diagnosis code V66.7 for “encounter for palliative care,” which may be used when documentation supports delivery of “palliative care,” “end-of-life care,” “hospice care,” or “terminal care.” This code is not specific to the delivery of specialized palliative care by consultants.

were largely nonsignificant, with the exception of tracheostomy and gastrostomy tube placement, which were more likely to occur in nonteaching and medium-sized hospitals with a palliative care program but less likely in large hospitals with a palliative care program. Use of enteral/parenteral nutrition was also

less likely in nonteaching and medium-sized hospitals with palliative care programs. The effect of palliative care programs on increasing discharge to hospice was limited to teaching hospitals (aOR, 1.87 [95% CI, 1.60–2.18]; $P < 0.001$) and large hospitals (aOR, 2.81 [95% CI, 2.26–3.49]; $P < 0.001$) (Table E1).

Table 3. Outcomes for patients cared for in hospitals with and without palliative care programs

	Unadjusted Outcomes Palliative Care Program		Adjusted Effect for Patients Receiving Care at a Hospital with a Palliative Care Program* (95% CI)	P Value
	No (n = 210,709)	Yes (n = 814,794)		
Primary outcome				
Length of stay, d, median (IQR) [†]				
All	6 (3–11)	6 (3–12)	1.04 (1.03–1.05)	<0.001
Died during hospitalization	8 (3–16)	8 (3–17)	0.97 (0.95–0.99)	0.001
Survived to hospital discharge	6 (3–11)	6 (3–11)	1.05 (1.04–1.05)	<0.001
Secondary outcomes				
ICU bed use, d, median (IQR) [†]				
All	2 (1–5)	2 (1–5)	0.97 (0.97–0.98)	<0.001
Died during hospitalization	4 (1–9)	4 (2–9)	0.96 (0.94–0.98)	<0.001
Survived to hospital discharge	2 (1–4)	2 (1–4)	0.97 (0.96–0.98)	<0.001
Mechanical ventilation, % [‡]	21.2	20.0	1.04 (1.00–1.08)	0.05
Dialysis, % [‡]	4.3	4.3	1.01 (0.95–1.07)	0.82
Tracheostomy, % [‡]	3.0	3.0	0.97 (0.90–1.04)	0.35
Gastrostomy tube placement, % [‡]	3.1	2.9	0.99 (0.92–1.07)	0.88
Enteral or parenteral nutrition, % [‡]	10.6	9.6	0.92 (0.88–0.96)	<0.001
Cardiopulmonary resuscitation, % [‡]	1.9	1.7	1.09 (0.99–1.21)	0.09
Discharge to hospice, % [§]	1.4	1.7	1.46 (1.30–1.64)	<0.001
In-hospital mortality, % [‡]	10.9	10.1	1.03 (0.98–1.07)	0.34

Definition of abbreviations: CI = confidence interval; ICU = intensive care unit; IQR = interquartile range.

*This column reports the incidence rate ratio for length of stay and ICU bed use days as well as the odds ratio for all other secondary outcomes. All models are adjusted for age; sex; race; type of patient (surgical; nonsurgical); type of insurance; urban residence; risk of mortality during hospitalization; year of admission; and hospital characteristics, including teaching hospital, hospital bed size, total admissions per year/total number of beds, full-time equivalent physicians/total number of beds, and full-time equivalent nurses/total number of beds.

[†]Results of multilevel negative binomial regression, with hospital as a random effect.

[‡]Results of multilevel logistic regression, with hospital as a random effect.

[§]Excludes patients who died during their hospitalization.

For the “dose–response” analysis, there were 210,709 patients who received care in “never” hospitals that did not have a palliative care program, 54,434 patients who received care in a “nascent” hospital subsequent to the development of a program, and 760,360 patients who received care in a “mature” hospital that consistently had a palliative care program throughout the entire study period. Results were similar to the primary analysis, with no meaningful or consistent differences in length of stay or ICU resource use, but a significant increase

in discharge to hospice was observed when comparing “mature” hospitals with “never” hospitals (aOR, 1.48 [95% CI, 1.14–1.92]; $P = 0.004$) and “nascent” hospitals with “never” hospitals (aOR, 1.45 [95% CI, 1.28–1.64]; $P < 0.001$). Of patients in “nascent” and “never” hospitals, 239,159 were included in the difference-in-differences analysis. For the difference-in-differences model, patients who received care in a hospital that developed a palliative care program again had a significantly increased likelihood being discharged to hospice

(aOR, 1.48 [95% CI, 1.25–1.76]; $P < 0.001$). Last, for the subgroup of critically ill patients with metastatic cancer ($n = 42,572$), the likelihood of being discharged to hospice was also higher for patients cared for in a hospitals with a palliative care program (aOR, 1.35 [95% CI, 1.10–1.66]; $P = 0.005$) (Figure 1 and Table E2).

The quantitative bias analysis was conducted to determine the strength and the frequency of a single unmeasured binary confounder that would be necessary to remove the association between the availability of hospital-based palliative care and the likelihood of discharge to hospice. Using the lower bound of the 95% CI from the primary analysis (1.31), and assuming a baseline prevalence of the hypothetical confounder of 10% for patients cared for in hospitals without a palliative care program and 20% for patients cared for in hospitals with a palliative care program, an unmeasured confounder would have to have an odds ratio of 6.38 to nullify the association between the availability of hospital-based palliative care and discharge to hospice. To parallel some of the larger observed differences in hospital characteristics, if the baseline prevalence of a confounder were 40% for patients cared for in hospitals without a program and 80% for patients cared for in hospitals with a program, an unmeasured confounder would have to have an odds ratio of 2.35 to nullify the association (Figure 2 and Table E3). These odds ratios for hypothetical confounders exceeded those of most measured confounders in the primary multilevel regression analysis (Table E4), indicating that unmeasured confounders would have to be much more strongly associated with discharge to hospice than known confounders to abrogate the observed association.

Discussion

In a population-level cohort of critically ill patients, we found that the availability of hospital-based palliative care was not associated with substantial decreases in treatment intensity. We did not observe decreases in hospital length of stay or other measures of ICU resource use, mirroring results of other studies examining the association between specialized palliative care and treatment intensity (30, 31). However, there was a significant association

Figure 1. Results of sensitivity analyses examining the association between availability of hospital-based palliative care and hospital discharge to hospice in critically ill patients. The primary analysis and several sensitivity analyses for the outcome of discharge to hospice are presented. The center marker denotes the point estimate of the adjusted effect of receiving care in a hospital with a palliative care program in a given year, with the end markers denoting the upper and lower bounds of the 95% confidence interval.

between the availability of hospital-based palliative care and discharge to hospice observed in large teaching hospitals, and this finding was robust to multiple sensitivity analyses. Because discharge to hospice is an infrequent outcome, we observed a moderate relative increase in the likelihood of discharge to hospice (odds ratio, 1.46) that corresponded to only a small absolute increase (0.3%). Although we did observe other associations between the availability of a palliative care program and either increases or decreases in resource use, these associations were not consistently observed across analyses (e.g., gastrostomy tube placement) or were not clinically meaningful (e.g., hospital length of stay). These data suggest that availability of specialized palliative care for critically ill patients may facilitate use of hospice facilities as opposed to decreasing resource use during the acute care episode. This finding is in line with other studies demonstrating that use of specialized palliative care can decrease downstream healthcare use, particularly within the last year of life (32, 33).

Contrary to prior studies (13, 24, 25), we did not observe a meaningful decrease in ICU days or hospital length of stay for patients who died in a hospital with a palliative care program. However, these studies often demonstrated differences in resource use in the setting of a specific intervention to increase use of specialized palliative care. It also may be that changes in clinical practice have occurred since, leading to decreases in length of stay overall. Also, as

awareness of the importance of palliative care has grown, it may be that palliative care is increasingly provided by generalists at hospitals without a palliative care program, leading to a lack of observed effect. In addition, our study may differ because we were studying the availability of hospital-based palliative care services (an ecological approach) rather than a patient-level

exposure of receipt of specialized palliative care. Another possible explanation is that the ability of specialized palliative care to decrease nonbeneficial resource use is largely dependent on the timing of its initiation (34–37), and specialized palliative care is often initiated late in the course of illness (13, 38, 39). Because early specialized palliative care is not part of routine care for critically ill patients, this may have limited our ability to detect any differences; interestingly, the one outcome for which we did observe a consistent effect (discharge to hospice) is less dependent on early initiation.

Increasing discharge to hospice is generally viewed as a desirable outcome. Less medicalized death has been associated with higher ratings of quality of life, quality of death, and quality of end-of-life care (40–42), as well as less psychological symptomatology in bereaved caregivers (43, 44). Moreover, because hospice is believed to be underused (6), increased discharge to hospice may be a reasonable quality indicator to measure the efficacy of a palliative care program. The lack of valid outcomes to assess the effectiveness of specialized palliative care in the ICU has been cited as a significant knowledge gap

Figure 2. Quantitative bias analysis examining unmeasured confounding. This sensitivity analysis illustrates the conditions necessary for a single binary unmeasured confounder to nullify the observed association between availability of hospital-based palliative care and discharge to hospice. Each colored line corresponds to a different prevalence of the confounder in controls (hospitals without a palliative care program). For example, if a confounder was present in 20% of patients cared for in hospitals without a palliative care program (red line) and in 40% of patients cared for in hospitals with a palliative care program, the confounder would have to increase the odds of discharge to hospice by almost fourfold (odds ratio, 3.69) to account for the observed difference in outcome.

and research priority (45, 46). Measuring healthcare use outcomes for this purpose may be problematic; affecting use is necessarily dependent on timing of initiation, which is hampered by the difficulty of clearly identifying suitable populations for specialized palliative care. Other patient-centered outcome metrics such as quality of life or goal-concordant care are difficult to measure, particularly in population-level data. Thus, discharge to hospice may represent an outcome metric that is favorable, clear, reliable, and relatively easy to measure.

Our study has several strengths. We performed multiple sensitivity analyses to demonstrate the reproducibility of our results. Furthermore, given the limitations of our exposure, these analyses aim to strengthen the causal link between our exposure and outcome by including a “dose–response” analysis to address the issue of a “biological gradient” and a difference-in-differences analysis to address temporality (47). Because our study was limited by the data available, we also performed a quantitative bias analysis to address the possibility of residual confounding, demonstrating that a hypothetical unmeasured confounder would have to be more strongly associated with the outcome than most of the measured confounders included in our analysis.

The main limitation of our analysis is the use of a hospital-level exposure for specialized palliative care. Unfortunately, it is not currently possible to accurately identify which patients actually received specialized palliative care in population-level data (23). This may have impacted our ability to detect an association between

specialized palliative care and a change in outcomes, resulting in a type II error. However, indication bias would be an important drawback of using a patient-level exposure, and use of a hospital-level exposure is less susceptible to this type of confounding. Furthermore, there is variability among palliative care programs, and we were unable to account for factors (such as the size and staffing of the program as well as the penetration of the program within the ICU) that may influence the ability of the program to affect outcomes. Particularly as the growth of palliative care programs in hospitals increases (22), the inclusion of such variables may allow for a more nuanced understanding of the effectiveness of specialized palliative care. Another limitation is that hospitals that have palliative care programs may be fundamentally different from those that do not have palliative care programs. To decrease the heterogeneity of hospital characteristics, we excluded small and rural hospitals, which may limit the generalizability of our results. We were also unable to account for differences in use of specialized palliative care in hospitals or differences in ICU care. Although we adjusted for multiple hospital characteristics that are likely to be associated with a hospital’s “norm” of treatment intensity and performed stratified and quantitative bias analyses that support the robustness of our findings, it is possible that other differences in the care provided between hospitals with and without palliative care programs could account for our observed findings. Last, all outcomes in this study were related to healthcare use because they are readily captured in administrative data. However,

these outcomes do not capture many of the benefits of specialized palliative care, including improvements in quality of life, communication, symptom control, and patient/family satisfaction.

These data indicate that for critically ill patients, the availability of specialized palliative care may potentially decrease nonbeneficial resource use through increasing use of hospice. Currently, measuring effectiveness of specialized palliative care for critically ill patients on a population level may be limited by the choice of outcome or to datasets in which receipt of palliative care consultation may be accurately determined on a patient level. Future work should focus on developing methods to identify individual receipt of specialized palliative care on a population level, identifying characteristics associated with effective palliative care programs, improving ways to assess the effectiveness of programs, and determining which critically ill patients may benefit most from use of specialized palliative care. Without such additional work to assess and improve its implementation, the potential benefits of specialized palliative care in critically ill patients may not be fully realized. ■

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