Regional Variation in the Association Between Advance Directives and End-of-Life Medicare Expenditures

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Context It is unclear if advance directives (living wills) are associated with end-of-life expenditures and treatments.

Objective To examine regional variation in the associations between treatment-limiting advance directive use, end-of-life Medicare expenditures, and use of palliative and intensive treatments.

Design, Setting, and Patients Prospectively collected survey data from the Health and Retirement Study for 3302 Medicare beneficiaries who died between 1998 and 2007 linked to Medicare claims and the National Death Index. Multivariable regression models examined associations between advance directives, end-of-life Medicare expenditures, and treatments by level of Medicare spending in the decedent's hospital referral region.

Main Outcome Measures Medicare expenditures, life-sustaining treatments, hospice care, and in-hospital death over the last 6 months of life.

Results Advance directives specifying limits in care were associated with lower spending in hospital referral regions with high average levels of end-of-life expenditures (–$5585 per decedent; 95% CI, –$10 903 to –$267), but there was no difference in spending in hospital referral regions with low or medium levels of end-of-life expenditures. Directives were associated with lower adjusted probabilities of in-hospital death in high- and medium-spending regions (–9.8%; 95% CI, –16% to –3% in high-spending regions; –5.3%; 95% CI, –10% to –0.4% in medium-spending regions). Advance directives were associated with higher adjusted probabilities of hospice use in high- and medium-spending regions (17%; 95% CI, 11% to 23% in high-spending regions, 11%; 95% CI, 6% to 16% in medium-spending regions), but not in low-spending regions.

Conclusion Advance directives specifying limitations in end-of-life care were associated with significantly lower levels of Medicare spending, lower likelihood of in-hospital death, and higher use of hospice care in regions characterized by higher levels of end-of-life spending.

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END-OF-LIFE HEALTH CARE IS A frequent target for efforts to control Medicare spending. In 2006, treatment for patients in their last year of life accounted for more than one-quarter of Medicare spending.[1] Marked geographic variation in Medicare end-of-life spending is well documented,[2] and this variation is believed to be driven by physician practice style rather than by differences in patients' preferences for aggressiveness of treatment at the end of life.[3] There is concern that this expensive care may have limited clinical effectiveness and may be contrary to what patients want. Surveys report that many patients do not wish to receive aggressive treatment at the end of their lives; however, these preferences are often undocumented.[4,5] A national study by Barnato and colleagues[6] found that 42% of white Medicare beneficiaries worried about receiving too much care at the end-of-life, whereas an equal proportion worried about receiving too little.

Patients can use advance directives to document their preferences for the use or avoidance of life-sustaining treatments (living wills) or to appoint a surrogate to make treatment decisions should they become no longer competent to make those decisions (durable power of attorney for health care). Although advance directives have become more common in the past few decades, evidence is mixed on whether they change the course of treatment provided near the end-of-life.[7-10]

It is sometimes overlooked that an advance directive can only influence treatment when the patient's wishes are inconsistent with what would be provided absent an advance directive. The wide variation in end-of-life Medicare expenditures across geographic regions suggests that default treatment levels also vary regionally. Advance directives specifying limits at

See also pp 1483 and 1485.

Author Video Interview available at www.jama.com.

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the end-of-life may have their greatest impact in regions where the norms are to provide very high-intensity end-of-life treatment. Given that there exist regions with consistently high levels of spending at the end of life that may be of limited benefit and contrary to patient preferences, we used nationally representative survey data from the Health and Retirement Study (HRS) linked to respondents' Medicare claims to examine the relationship of advance directives with the cost and aggressiveness of end-of-life treatment in geographic regions across the United States characterized by high, medium, and low average end-of-life expenditures.

METHODS

Study Population

We analyzed survey and Medicare claims data for HRS respondents who died between 1998 and 2007 at age 65 years or older or after qualifying for Medicare through disability or end-stage renal disease. The HRS is a large, nationally representative panel survey that conducts biennial interviews of older US residents.[11] The HRS also conducts an interview with a proxy informant, typically next-of-kin, after the respondent's death. During the postmortem interview, informants are asked about the decedent's experience at the end of life, including the nature and type of their advance directives. Oral informed consent was obtained from participants and proxies in the original study. The institutional review board of the University of Michigan approved the study protocol.

Because our primary interest was in end-of-life Medicare spending and use, we limited our analytic sample to patients continuously enrolled in fee-for-service Medicare during the last 6 months of life. We used data on deaths through 2007, which were the most recently available data linked to Medicare claims.

Advance Directives

We measured the presence and type of advance directive from interviews with respondents' next-of-kin conducted after death. For living wills, informants were asked: "Did [first name] provide written instructions about the treatment or care [she/he] wanted to receive during the final days of [her/his] life?" If respondents had a written advance directive in place, additional questions were asked about the type of written instructions. Our analysis included those who indicated living wills limiting the type of care provided and those requesting all care. These informant reports have been used to document advance directive status previously.[4] For durable power of attorney, informants were asked: "Did [first name] make any legal arrangements for a specific person or persons to make decisions about [his/her] care or medical treatment if [he/she] could not make those decisions [himself/herself]?"

Medicare Claims

During biennial interviews, HRS respondents were asked to provide their Medicare number and consent to the release of their claims for research purposes. For each decedent, we calculated Medicare spending in the last 6 months of life across all care settings (inpatient, outpatient, carrier, durable medical, hospice, home health, and skilled nursing). All spending measures were adjusted to 2007 US dollars using the medical consumer price index.

End-of-life hospital treatment is a major driver of end-of-life expense, and a setting in which many aggressive procedures to sustain life are performed. We used MedPAR and hospice files to identify all hospitalizations and hospice use in the last 6 months of life. We used *International Classification of Diseases, Ninth Revision, Clinical Modification* procedure codes to identify a set of life-sustaining interventions that have been previously used as measures of end-of-life treatment intensity (intubation and mechanical ventilation, tracheostomy, gastrostomy tube placement, hemodialysis, enteral and parenteral nutrition, and cardiopulmonary resuscitation).[12] We examined any hospice use at the end-of-life as a measure of palliative care. We assessed comorbidities in the year preceding the last 6 months of life using the Elixhauser method for inpatient data.[13]

Regional Intensity of End-of-Life Care

We used hospital referral region measures of average Medicare spending per decedent in the last 6 months of life reported by the Dartmouth Atlas of Health Care averaged across the years 1999 through 2005.[14] We characterized regions by quartiles of end-of-life spending averaged across the 7-year period. Decedent's region intensity was determined by zip code of residence.

Statistical Analysis

We used generalized linear models with a log link function and gamma distribution to fit skewed Medicare end-of-life expenditure data.[15] Multivariable regression models assessed the relationships between hospital referral region end-of-life treatment intensity, advance directives specifying limits in treatment, and Medicare expenditures in the last 6 months of life. We first estimated the regressions typically reported in the literature, which assume a constant relationship between advance directives and individual end-of-life resource use. We next allowed the relationship between treatment-limiting advance directives and spending to vary for patients in high-, medium-, and low-spending regions by including interactions between treatment-limiting advance directives and region spending type. Regressions also controlled for sex, self-reported nonwhite race (due to the sample size, we collapsed respondents reporting black and other race relative to the reference group of white decedents), 5-year age categories, whether the respondent was in the highest tertile of household wealth at the last interview, indicators for having less than a high school education

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and a high school degree (relative to at least some college), being widowed or single or separated or divorced (vs married), self-reported chronic conditions in the interview prior to the last 6 months of life, Elixhauser comorbidities calculated from hospitalizations in the 12-month period before the last 6 months of life, and a linear time trend.

We tested for differential effects of treatment-limiting advance directives across regions by calculating average marginal effects of advance directives in low-, medium-, and high-spending regions and by conducting nonlinear Wald tests[16] of the equality of spending on decedents at the end of life with and without treatment-limiting advance directives within and across levels of region spending. Two-sided significance testing was used throughout, and a *P* value of .05 was considered statistically significant.

We estimated logistic regressions of life-sustaining treatments, in-hospital death, and hospice use among decedents hospitalized during the last 6 months of life controlling for patient characteristics described above to test their relationship between treatment-limiting advance directives and regional spending.

Our sensitivity analyses included examining components of Medicare spending, estimating models for decedents with and without at least 1 end-of-life hospitalization separately, and analyses stratifying by cause of death using 15-cause recodes from the National Death Index. We used SAS version 9.2 (SAS Institute Inc, Cary, North Carolina) for data manipulation and Stata 11 MP (StataCorp, College Station, Texas) for analyses.

RESULTS

A total of 4761 HRS participants who died between 1998 and 2007 (82% of 5810 decedents with postmortem interviews) also had linked Medicare data. To accurately account for end-of-life health care use, we excluded 1445 decedents with any managed care enrollment during the last 6 months of life and excluded 14 decedents who reported military coverage who might have received care through Veterans Affairs facilities.

Our cohort included 3302 decedents. Their mean age at death was 82.8 years. Fifty-six percent were women; 70% were hospitalized at least once in the last 6 months of life; 41% died in a hospital; 61% had either a living will or written durable power of attorney; and 39% completed a written, treatment-limiting advance directive. TABLE 1 presents the characteristics of individuals with and without a treatment-limiting advance directive. Median Medicare spending in the last 6 months of life did not vary by treatment-limiting advance directive status. In unadjusted comparisons, those with treatment-limiting advance directives had lower rates of life-sustaining treatment (34% vs 39%, $P=.002$), lower rates of in-hospital death (37% vs 43%, $P<.001$), and higher rates of hospice use (40% vs 26%, $P<.001$). Those with advance directives were more likely to be white, affluent, and highly educated.

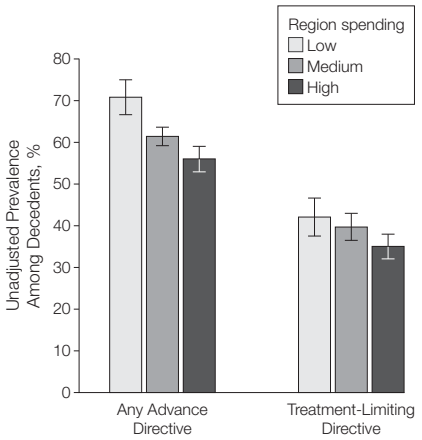
We compared end-of-life care of decedents living in hospital referral regions in the lowest quartile of Medicare spending (median unadjusted spending, $8787; range, $7252 to

Table 1. Characteristics of Decedents by Treatment-Limiting Advance Directive Status[a]

	No. (%) of Patients		
	Treatment-Limiting Advance Directive (n = 1275)	No Limiting Directive (n = 2027)	*P* Value for Difference
End-of-life use			
Medicare spending, median (range), $	21 008 (0-380 200)	21 614 (0-522 754)	.53
Any hospitalization	906 (71)	1449 (73)	.25
Hospitalizations, median (range)	1 (0-9)	1 (0-10)	.18
Any life-sustaining treatments	434 (34)	791 (39)	.002
In-hospital death	468 (37)	881 (43)	<.001
Hospice stay	510 (40)	527 (26)	<.001
Decedent characteristics			
Women	715 (56)	1075 (53)	.07
Nonwhite	64 (5)	446 (22)	<.001
Age, mean (SD), y	84.0 (8.0)	82.0 (9.1)	<.001
Lived in low-spending region	204 (16)	243 (12)	.004
Lived in high-spending region	351 (28)	650 (32)	.006
Durable power of attorney only		584 (29)	
Wealth >$100 000	638 (50)	649 (32)	<.001
<High school education	396 (31)	1055 (52)	<.001
High school graduate	447 (35)	548 (27)	<.001

[a] Hospital referral regions were classified using Dartmouth Atlas of Healthcare national Medicare end-of-life spending data, 1999-2005, not Health and Retirement Study data. Low-spending hospital referral regions had a median of $8787 (range, $7252-$9707); medium-spending regions, $10 848 (range, $10 242-$12 404); and high-spending regions, $15 744 (range, $12 446-$29 797). These averages were not adjusted for inflation.

Figure. Geographic Variation in Advance Directives



The unadjusted proportion of decedents with advance directives across hospital referral regions in the United States. Of the 3302 Health and Retirement Study participants who died between 1998 and 2007, 454 lived in low-spending regions (median, $8787; range, $7252-$9707), 1847 in medium-spending regions (median, $10 848; range $10 242-$12 404), 1001 in high-spending regions (median, $15 744; range, $12 446-$29 797). Error bars indicate 95% CIs. Any advance directive includes decedents with a written advance directive or durable power of attorney. Treatment-limiting advance directives are written documents specifying limitations in the types of treatment provided.

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$9707), middle half (median, $10 848; range, $10 242 to $12 404), and highest quartile (median, $15 744; range, $12 446 to $29 797; see FIGURE). There was substantial geographic diversity in the rates of advance directives among regions. Decedents residing in low-spending regions were more likely to have a treatment-limiting advance directive than decedents in high-spending regions (42% vs 36%; $P < .001$; Figure). After adjusting for demographic and socioeconomic characteristics, decedents in high-spending regions continued to face lower odds of having a treatment-limiting advance directive (odds ratio [OR], 0.69; 95% CI, 0.54 to 0.88). Although there was considerable variation in advance directive use (Figure) and median end-of-life spending (TABLE 2) across regions, relatively little difference existed in cause of death or comorbidity prior to the end of life (Table 2). Regression-adjusted end-of-life spending was significantly lower for decedents in low-spending regions (predicted spending, $21 741 [95% CI, $19 668 to $23 816]; difference, $4400 [95% CI, $2083 to $6717]) and higher for those in high-spending regions (predicted spending, $37 841 [95% CI, $34 855 to $40 107]; difference, $11 340 [95% CI, $8479 to $14 200]) relative to those in medium-spending regions. Spending was considerably higher for nonwhite decedents (difference, $6561; 95% CI, $3293 to $9829) and lower for decedents aged 90 years or older than younger decedents (difference, –$7871; 95% CI, –$11 212 to –$4,530). After adjusting for patient characteristics and hospital referral region-spending intensity, there was no difference in Medicare spending in the last 6 months of life for those with ($28 348; 95% CI, $26 698 to $29 999) and without advance directives ($29 352 [95% CI, $27 885 to $30 819]; difference, –$1004 [95% CI, –$3366 to $1359]) when using regressions that forced the association with advance directives to be the same for all regions.

Table 2. Decedent Characteristics by Level of Regional End-of-Life Spending[a]

	Spending Region, No. (%)		
	Low (n = 454)	Medium (n = 1847)	High (n = 1001)
Medicare spending, median (range)[b]			
Decedents with a treatment-limiting advance directive	14 153 (48.4-263 398)	20 509 (0-166 349)	25 290 (0-380 200)
Decedents with no treatment-limiting advance directive	15 880 (0-128 920)	20 628 (0-243 901)	26 616 (0-522 754)
Cause of death			
Cancer	93 (21)	399 (22)	185 (18)
Cardiovascular disease	178 (40)	763 (41)	458 (46)
Comorbidities prior to end-of-life			
Congestive heart failure	47 (11)	187 (10)	135 (13)
Valvular disease	16 (3.5)	72 (3.9)	46 (4.6)
Peripheral vascular disorders	18 (3.9)	87 (4.7)	49 (4.9)
Hypertension, uncomplicated	78 (17)	388 (21)	222 (22)
Hypertension, complicated	19 (4.1)	95 (5.1)	63 (6.3)
Chronic pulmonary disease	49 (11)	232 (13)	122 (12)
Diabetes, uncomplicated	31 (7)	193 (10)	129 (13)
Diabetes, complicated	8 (1.7)	53 (2.8)	29 (2.9)
Hypothyroidism	20 (4.4)	82 (4.4)	65 (6.5)
Renal failure	13 (2.8)	88 (4.8)	41 (4.1)
Metastatic cancer	9 (1.9)	34 (1.8)	20 (2)
Solid tumor	15 (3.3)	40 (2.1)	28 (2.8)
Fluid and electrolyte disorders	44 (9.9)	155 (8.4)	91 (9)
Deficiency anemia	32 (7.2)	162 (8.7)	117 (12)
Depression	19 (4.2)	75 (4)	26 (2.6)

[a] Hospital referral regions were classified using Dartmouth Atlas of Healthcare national Medicare end-of-life spending data, 1999-2005, not Health and Retirement Study data. Low-spending hospital referral regions had a median of $8787 (range, $7252-$9707); medium-spending regions, $10 848 (range, $10 242-$12 404); and high-spending regions, $15 744 (range, $12 446-$29 797). These represent nominal dollars.
[b] Spending for study participants is reported in 2007 US dollars.

Table 3. Regression-Adjusted Total Medicare Spending in Last 6 Months of Life: Adjusted Association With Regional Spending Levels and Advance Directive Use[a]

	Predicted Spending (95% CI), $			
Spending Regions[b]	Treatment-Limiting Advance Directive	No Limiting Directive	Difference (95% CI), $	*P* Value
Low	21 966 (19 228 to 24 703) (n = 203)	21 407 (18 380 to 24 434) (n = 251)	559 (–3547 to 4665)	.79
Medium	26 272 (24 465 to 28 078) (n = 721)	26 002 (24 489 to 27 514) (n = 1126)	270 (–2235 to 2776)	.83
High	33 933 (30 233 to 37 681) (n = 351)	39 518 (35 871 to 43 167) (n = 650)	–5585 (–10 903 to –267)	.04

[a] Health and Retirement Study linked to Medicare claims, 1998-2007. The Table reports average predicted spending based on average marginal effects from a general linear model of Medicare spending on the interaction between regional spending level and decedent advance directive status, sociodemographic characteristics, and comorbidities.
[b] Hospital referral regions were classified using Dartmouth Atlas of Healthcare national Medicare end-of-life spending data, 1999-2005, not Health and Retirement Study data. Low-spending hospital referral regions had a median of $8787 (range, $7252-$9707); medium-spending regions, $10 848 (range, $10 242-$12 404); and high-spending regions, $15 744 (range, $12 446-$29 797). These were not adjusted for inflation.

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However, there was important geographic heterogeneity in the relationship between advance directives and end-of-life spending (TABLE 3). In high-spending regions, adjusted spending on patients with a treatment-limiting advance directive was $33 933 (95% CI, $30 233 to $37 681), whereas adjusted spending for patients without an advance directive was $39 518 (95% CI, $35 871 to $43 167; difference, –$5585; 95% CI, –$10 903 to –$267). Having a treatment-limiting advance directive was not associated with differences in aggregate end-of-life spending for decedents in low- and medium-spending regions.

Treatment-limiting advance directives were associated with site of death and palliative care for decedents in medium- and high-spending regions (TABLE 4). Directives were associated with lower probabilities of in-hospital death in high- and medium-spending regions but not in low-spending regions. Thus, in high-spending regions, patients without an advance directive had a 47% adjusted probability of in-hospital death (95% CI, 44% to 51%), whereas those with an advance directive had a 38% probability of in-hospital death (95% CI, 32% to 43%; difference, –9.8%; 95% CI, –16% to –3%). The equivalent results for in-hospital death for those in medium-spending regions were 42% without an advance directive (95% CI, 39% to 45%) and 37% with an advance directive (95% CI, 33% to 41%; difference, –5.3%; 95% CI, –10% to –0.4%). In high-spending regions, patients without a limiting advance directive had a 24% adjusted probability of hospice use (95% CI, 21% to 28%), whereas those with a directive had an adjusted probability of hospice use of 41% (95% CI, 36% to 46%; difference 17%, 95% CI; 11% to 23%). Similar differences in hospice use occurred in medium-spending regions. There was no statistically significant relationship between treatment-limiting advance directive use and receipt of life-sustaining treatments during hospitalizations in the last 6 months of life, although the point estimates were in the same direction as for total end-of-life expenditures in high-spending regions, ie, lower likelihood of use of life-sustaining treatments among those with treatment-limiting advance directives (P=.11).

Table 4. Predicted Probability of Treatments in the Last 6 Months of Life: Adjusted Association With Regional Spending Levels and Advance Directive Use[a]

Spending Regions[b]	Advance Directive Probability, % (95% CI): Treatment-Limiting Advance Directive	Advance Directive Probability, % (95% CI): No Limiting Directive	Percentage-Point Difference (95% CI)	P Value
Any hospice (n = 3302)				
Low	37 (31 to 44) (n = 203)	35 (30 to 41) (n = 251)	1.6 (–7 to 10)	.72
Medium	38 (34 to 42) (n = 721)	27 (24 to 30) (n = 1126)	11 (6 to 16)	<.001
High	41 (36 to 46) (n = 351)	24 (21 to 28) (n = 650)	17 (11 to 23)	<.001
In-hospital death (n = 3302)				
Low	35 (29 to 41) (n = 203)	39 (32 to 46) (n = 251)	3.8 (–5.3 to 13)	.41
Medium	37 (33 to 41) (n = 721)	42 (39 to 45) (n = 1126)	–5.3 (–10 to –0.4)	.04
High	38 (32 to 43) (n = 351)	47 (44 to 51) (n = 650)	–9.8 (–16 to –3)	.003
Life-sustaining treatments (n = 3302)				
Low	29 (23 to 36) (n = 203)	28 (23 to 33) (n = 251)	1.4 (–7 to 10)	.74
Medium	36 (33 to 40) (n = 721)	37 (34 to 40) (n = 1126)	–0.9 (–6 to 4)	.72
High	39 (34 to 44) (n = 351)	44 (40 to 48) (n = 650)	–5.2 (–12 to 1)	.11

[a] Health and Retirement Study linked to Medicare claims, 1998-2007. The Table reports predicted probabilities using marginal effects from logit models predicting treatment status as a function of the interaction between regional spending level and decedent advance directive status, sociodemographic characteristics, and comorbidities.

[b] Hospital referral regions were classified using Dartmouth Atlas of Healthcare national Medicare end-of-life spending data, 1999-2005, not Health and Retirement Study data. Low-spending hospital referral regions had a median of $8787 (range, $7252-$9707); medium-spending regions, $10 848 (range, $10 242-$12 404); and high-spending regions, $15 744 (range, $12 446-$29 797). These were not adjusted for inflation.

The differences in Medicare spending observed among those with advance directives in high-spending regions appear to be driven mainly by lower inpatient spending ($7509, 95% CI, $3404-$11 614) slightly offset by higher hospice spending ($976; 95% CI, $294-$1658; eTable 1 available at http://www.jama.com). The differences in end-of-life spending across regions and advance directive status are concentrated among the 2384 decedents (72%) experiencing at least 1 hospitalization in the last 6 months of life (eTable 2). There was no evidence of heterogeneity of the advance directive effect in high-spending region by cause of death (P=.44 for joint test of significance; eFigure).

Nearly 4% of those with advance directives (1.5% of decedents overall) requested all care possible in their advance directive. There were too few such decedents in our study to reliably estimate the effects of such advance directives; these decedents are included in the no-limiting directive group. On average, these decedents used $8060 more care at the end-of-life (P=.02) than decedents with treatment-limiting directives.

Our results were consistent across numerous alternative specifications including an ordinary least squares regression, excluding all veterans because Veterans Affairs care is unobserved in the Medicare claims, excluding disabled decedents who are younger than 65 years but observed in the Medicare claims, excluding decedents with cancer as the cause of death, and excluding those who wrote advance directives in the last 6 months of life (eTable 3-6; eFigure).

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COMMENT

Using linked personal interviews and Medicare claims for decedents in a large, nationally representative study, we found that advance directives specifying limits in treatment were more common in areas with lower levels of end-of-life spending. When patients in high-spending areas had advance directives limiting treatments, they averaged significantly lower end-of-life Medicare spending, were less likely to have an in-hospital death, and had significantly greater odds of hospice use than decedents without advance directives in these regions.

Our findings may reconcile prior, seemingly conflicting evidence that advance directives both reduce[17,18] and do not affect[10,19] end-of-life health care expenditures and use of life-sustaining treatments. We replicate the absence of a global relationship between advance directives and resource use but extend the analysis to show that treatment-limiting advance directives are associated with lower Medicare expenditures for beneficiaries living in geographic regions characterized by aggressive end-of-life care. Most studies—including the 1980s landmark Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatment (SUPPORT)[7]—relied on samples from a small number of hospitals, precluding such geographic comparisons.[17]

These results suggest both the power and limitations of advance directives. One interpretation of these data is that advance directives are most effective when one prefers treatment that is different from the local norms. Thus, in high-intensity regions, more limited treatment requires an explicit statement. Treatment-limiting advance directives were associated with increased likelihood of palliative hospice care and lower rates of in-hospital deaths in high- and medium-spending regions, where patients were most likely to receive aggressive end-of-life treatment. This has important implications for patient quality of death and well-being of family and friends. Previous research has found that next-of-kin report that the quality of death is higher for decedents who die at home[20] or in hospice care[21] relative to hospital and nursing home settings, that caregivers report worse overall physical and mental health following deaths characterized by use of aggressive end-of-life treatment,[18] and surviving spouses of hospice decedents are less likely to die within 18 months of widowhood relative to those whose spouses did not use hospice.[22]

Interestingly, we found that while treatment-limiting advance directives were associated with significantly lower total end-of-life Medicare expenditures in high-spending hospital referral regions, the relationship between treatment-limiting advance directives and the receipt of aggressive life-sustaining treatments (eg, intubation and mechanical ventilation, hemodialysis, and enteral and parenteral nutrition) was less strong. This may suggest that treatment-limiting advance directives are associated with a quicker withdrawal of these aggressive and expensive interventions, even if the likelihood of initiating these treatments is less strongly affected. Given the significant consequences of these treatments for both patient and family well-being and health care costs, future research should be aimed at better understanding how advance directives, durable power of attorney provisions, and newer initiatives to improve in-the-moment end-of-life decision making[23] affect the initiation and withdrawal of life-sustaining treatments.

Our results indicate a statistically and economically significant relationship between advance directives and regional practice patterns. The regional variations literature has asserted that significant savings to the Medicare population could be achieved if high-spending regions practiced more like low-spending regions.[24,25] However, we note that patient preferences may also contribute to observed differences, possibly in a mutually reinforcing pattern. If an additional 6% of decedents in high-intensity regions had had treatment-limiting advance directives in place (matching preferences in low-spending regions), our estimates suggest that Medicare spending on the 790 061 beneficiaries dying in high-spending hospital referral regions in 2006 would have been $265 million lower. We urgently need studies to examine the extent to which greater advance directive use in high-intensity regions would result in treatment that is more concordant with patient preferences and to understand the patient, physician, and health system characteristics that lead to higher rates of use in low-spending regions.

Our findings should be interpreted in light of several limitations. Because we used Medicare claims data to measure use, we were unable to include decedents not in fee-for-service Medicare. The associations and impact of advance directives may be different in other populations. However, Medicare-eligible adults account for more than 70% of deaths in the United States.[26] We also lacked information about decedents who had not consented to the HRS-Medicare data linkage, even though demographics of decedents in the linkage were similar to the full sample (eTable 8 available at http://www.jama.com).

Because our study was observational, we were unable to assess causal effects of advance directive use. We focused on the last 6 months of life so were unable to address the question of how advance directives alter spending patterns over an individual's life course nor to address the extent to which they influence the length of life. Although limitations of the look-back approach to studying end-of-life intensity are well-known, this approach addresses the policy-relevant question of health care use just before death.[27] Our sensitivity analyses suggest that our results are not driven by heterogeneous patient characteristics. Furthermore, we did not have patients' own reports of preferences or copies of their advance directives. However, the postmortem interviews are conducted with proxy informants, often widows or adult children, who are likely to know of ad-

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vance directives if they were used; 78% were involved in decedents' end-of-life decisions. Recent studies of older adults and their surrogate decision makers support the reliability of this approach.[28,29]

Advance directives are associated with important differences in treatment during the last 6 months of life for patients who live in areas of high medical expenditures but not in other regions. This suggests that the clinical effect of advance directives is critically dependent on the context in which a patient receives care. Advance directives may be especially important for ensuring treatment consistent with patients' preferences for those who prefer less aggressive treatment at the end of life but are patients in systems characterized by high intensity of treatment.

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Study concept and design: Nicholas, Langa, Iwashyna, and Weir.
Acquisition of data: Nicholas, Langa, and Iwashyna.
Analysis and interpretation of data: Nicholas, Langa, Iwashyna, and Weir.
Drafting of the manuscript: Nicholas, Langa, Iwashyna, and Weir.
Critical revision of the manuscript for important intellectual content: Nicholas, Langa, Iwashyna, and Weir.
Statistical analysis: Nicholas.
Administrative, technical, or material support: Nicholas, Langa, Iwashyna, and Weir.
Study supervision: Nicholas.
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