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Regional Variations in Health Care Intensity and Physician Perceptions of Quality of Care

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Background: Research has documented dramatic differences in health care utilization and spending across U.S. regions with similar levels of patient illness. Although patient outcomes and quality of care have been found to be no better in regions of high health care intensity, it is unknown whether physicians in these regions feel more capable of providing good patient care than those in low-intensity regions.

Objective: To determine whether physicians in high-intensity regions feel better able to care for patients than physicians in low-intensity regions.

Design: Physician telephone survey.

Setting: 51 metropolitan and 9 nonmetropolitan areas of the United States and a supplemental national sample.

Participants: 10 577 physicians who provided care to adults in 1998 or 1999 were surveyed for the Community Tracking Study (response rate, 61%).

Measurements: The End-of-Life Expenditure Index, a measure of spending that reflects differences in the overall quantity of medical services provided rather than differences in illness or price, was used to determine health care intensity in the physicians' community. Outcomes included physicians' perceived availability of clinical services, ability to provide high-quality care to patients, and career satisfaction.

Results: Although the highest-intensity regions have substantially more hospital beds and specialists per capita, physicians in these regions reported more difficulty obtaining needed services for their patients. The proportion of physicians who felt able to obtain elective hospital admissions ranged from 50% in high-intensity regions to 64% in the lowest-intensity region ($P < 0.001$ for the relationship between intensity and perceived ability to obtain hospital admissions); the proportion of physicians who felt able to obtain high-quality specialist referrals ranged from 64% in high-intensity regions to 79% in low-intensity regions ($P < 0.001$). Compared with low-intensity regions, fewer physicians in high-intensity regions felt able to maintain good ongoing patient relationships (range, 62% to 70%; $P < 0.001$) or able to provide high-quality care (range, 72% to 77%; $P = 0.009$). In most cases, differences persisted but were attenuated in magnitude after adjustment for physician attributes, practice characteristics, and local market factors (for example, managed care penetration); the difference in perceived ability to provide high-quality care was no longer statistically significant ($P = 0.099$).

Limitations: The cross-sectional design prevented demonstration of a causal relationship between intensity and physician perceptions of quality.

Conclusion: Despite more resources, physicians in regions of high health care intensity did not report greater ease in obtaining needed services or greater ability to provide high-quality care.

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Spending on medical care varies widely across the United States. In regions such as Albany, New York, and Minneapolis, Minnesota, Medicare spending averages approximately $5000 per enrollee, while spending is twice as high in other areas, such as Los Angeles, California, and Miami, Florida (1). To a small extent, this variation reflects differences in illness (residents of Miami are slightly sicker than residents of Minnesota) and prices (Medicare pays more for the same service in Los Angeles than in Albany) (2). Most of the variation, however, reflects geographic differences in the intensity of practice—that is, differences in the quantity of health care services provided per capita (2, 3).

Whether more care means better care (and therefore warrants the higher expenditure) has been the subject of intense interest. Investigators seeking to answer this question have examined several patient outcomes, most of which seem to be no better in areas of higher health care intensity (4–7). The largest study to date evaluated the quality and outcomes of care for almost 1 million Medicare enrollees and found that patients in the highest-intensity regions spent more time in the hospital and had more frequent physician visits, specialist consultations, tests, and minor procedures, but their long-term mortality rates (after adjustment for baseline health status) were 2% to 5% higher than those in the lowest-intensity regions (8). Other patient-level outcomes also did not favor high-intensity regions: quality of care, as judged by clinical performance measures; access to care; and patient-reported satisfaction with care were no better (and were sometimes worse) than in the lowest-intensity regions (8, 9).

Little is known, however, about whether high-intensity regions might provide a better environment for practicing physicians. One might expect that physicians in low-

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Context

Regional differences in expenditures for medical care in the United States have not been associated with better patient outcomes; their effects on physician satisfaction are unknown.

Contribution

These investigators examined this issue using a survey of a nationally representative sample of physicians. Physicians in high-intensity (high-expenditure) regions perceived lower availability of services and more difficulty providing high-quality care than those in low-intensity regions.

Cautions

Assessment of regional intensity was based on Medicare utilization and might not reflect intensity in younger age groups.

Implications

Higher levels of health care spending do not necessarily improve physician satisfaction.

—The Editors

intensity regions, where beds and physicians are relatively scarce, would be more likely to perceive resource constraints and barriers to providing high-quality care. Given a smaller local supply of physicians, they might have to work harder than those in high-intensity regions and feel less satisfied with their relationships with other physicians and patients, and with the quality of care they are able to provide. These qualities of the practice environment strongly influence physician satisfaction (10, 11), which might also be expected to suffer in an environment with limited resources. Such findings would call into question the use of low-intensity regions as a reasonable benchmark for U.S. practice (12, 13). To explore these questions, we analyzed the data from a national survey of physicians.

METHODS

Overview

We used Medicare data to categorize U.S. hospital referral regions by the intensity of health care utilization within the region. We then used data from a national physician survey to examine whether physicians' perceptions varied according to the intensity of the regions in which they practiced. We also used regression analyses to determine whether associations between physician perceptions and health care intensity could be explained by regional differences in other factors that may influence physicians' perceptions. Such factors include patient characteristics (for example, age), physician attributes (for example, sex or specialty), practice characteristics (for example, size or revenue sources), and other market-level factors (such as managed care penetration) (14). We also explored whether observed differences in physician perceptions of practice were better explained by local supply of health care resources than by local health care intensity.

Study Population

We analyzed data from the second round of the physician survey component of the Community Tracking Study (CTS), which was conducted by the Center for Studying Health System Change from 1998 to 1999 (15). This telephone survey used a complex design that included physicians from 60 community sites (51 metropolitan and 9 nonmetropolitan areas) and a small, independently drawn national sample (16). Using the Masterfiles of the American Medical Association and the American Osteopathic Association, the CTS sampled active nonfederal physicians who spent at least 20 hours per week in direct patient care. Residents, fellows, and physicians in specialties, such as radiology, pathology, and anesthesiology, were excluded; primary care physicians were oversampled. Physicians (n = 12 280) were surveyed by telephone between August 1998 and November 1999 in interviews that averaged 21 minutes. Participants received $25 after completing the survey. On the basis of the estimated number of eligible participants, the response rate was 61%. Additional information on the survey can be found elsewhere (17, 18). Because our study focused on associations between physician perceptions and local differences in health care intensity for Medicare enrollees, we excluded physicians who reported that they did not care for adult patients. Our resulting sample comprised 10 577 respondents.

Measures

Local Health Care Intensity

We used a previously derived Medicare spending measure, the End-of-Life Expenditure Index, as our measure of local intensity. This index is calculated as average spending (as determined by standardized national prices) on hospital and physician services provided to Medicare enrollees age 65 and older during their last 6 months of life, adjusted for age, sex, and race. This measure reflects the component of local Medicare spending that is attributable to the overall quantity of medical services provided, not to local differences in illness or price (8, 9). In previous work, we have shown that the greater than 50% differences that exist across U.S. regions in health care spending at the end of life are unrelated to differences in case mix or patient preferences (19). We have also demonstrated that the baseline health status of Medicare enrollees is relatively similar across different levels of health care intensity (8). We calculated the End-of-Life Expenditure Index for each of the 306 U.S. hospital referral regions from 1994 to 1997 (the years immediately preceding the survey) and used the results to classify regions into quintiles of intensity. Physicians were assigned to the hospital referral region that included the county of their primary practice location, and in turn to a local intensity level and a quintile of intensity.

We report characteristics of different quintiles of intensity—including average overall per capita Medicare

spending, average burden of patient illness, and per capita supplies of physicians and hospital beds—derived from our previous work (9). Data regarding overall Medicare spending and average per capita supply of medical resources were obtained from the Dartmouth Atlas for Health Care. Average burden of illness was calculated by using logistic regression to estimate the effect of baseline characteristics on 1-year risk for death for all individuals in each of 3 disease-specific cohorts (hip fracture, colorectal cancer, and acute myocardial infarction) (9).

Physician Perceptions of Practice

Our analyses were based on responses to 12 questions from the CTS physician survey. Of the 12 questions, 6 that focused on the availability of specific clinical services (for example, "How often are you able to obtain high-quality diagnostic imaging services when you think it is necessary?") elicited responses along a 6-point Likert scale ("always," "almost always," "frequently," "sometimes," "rarely," and "never"). The remaining 6 questions asked physicians to gauge their level of agreement with various statements regarding health care quality and career satisfaction (for example, "I have adequate time to spend with my patients during their office visits") along a 5-point Likert scale (response choices ranged from "agree strongly" to "disagree strongly"). We dichotomized responses to yield the outcome measures for all analyses in the present study (for example, "always" or "almost always" vs. all other responses; "agree strongly" or "agree somewhat" vs. all other responses). We also repeated the analysis with alternate cut-points; these analyses confirmed that the findings were not sensitive to our choice of cut-points, which were identical to those used in previous work (20). Certain questions were asked only of primary care physicians (family or general practitioners, geriatric or adolescent medicine practitioners, general internists, general pediatricians, or subspecialists who spend most of their time in 1 of these areas of primary care practice) or only of specialists; other questions were inapplicable to some physicians. The proportion of physicians who were ineligible to respond ranged from 0% for 5 of the 6 questions about perceived health care quality to 44% for the question regarding perceived availability of inpatient mental health services. Item nonresponse was less than 1% among eligible respondents for each outcome measure.

Covariates

In addition to questioning physicians about various aspects of their practice experience, the CTS physician survey collected extensive information about physician attributes and practice characteristics. Covariates in our analyses included the physician's sex, number of years in practice, specialty (family or general practice, internal medicine, medical subspecialties, and surgical specialties), board certification status, and income relative to the median income in the county; whether the physician was a U.S. medical school graduate; and practice setting (1- or 2-physician practice, single-specialty group practice of 3 physicians or more, multispecialty practice, group or staff health maintenance organization, medical school–based practice, hospital-based practice, or other). We also examined the role of managed care within the practice as measured by the percentage of practice revenue paid on a capitated basis, the number of managed care contracts (fewer than 10 vs. 10 or more), and the percentage of patients for whom the physician served as a gatekeeper. Less than 1% of respondents had any missing covariates (item nonresponse $<1\%$ for 2 covariates and otherwise nil). Survey data also allowed us to construct proxy patient-level demographic variables (that is, percentage of revenue from Medicare as a proxy for patient age and percentage of revenue from Medicaid as a proxy for patient socioeconomic status). For the subset of physicians in hospital referral regions that contained at least 3 physicians (10 487 out of 10 577 respondents), we were able to construct regional measures of managed care penetration; as was done in earlier work that used these data (14), we calculated the weighted average of the individual reports of the percentage of practice revenue from managed care by survey respondents in the hospital referral region.

Statistical Analysis

Results are displayed according to quintile of intensity. All reported tests for trend, however, are based on logistic regression in which the independent variable is intensity in the physician's region (expressed as a continuous variable) and the dependent variable is the individual physician's (dichotomized) response. All analyses use the appropriate weights and clustering information provided by the CTS to account for sampling probability and nonresponse; consequently, the results presented here are representative of the population of nonfederal physicians who provide direct patient care to adults in the continental United States. Using the log likelihood test to evaluate whether a nonlinear description of intensity would provide a better fit to the data, we found that a model incorporating a quadratic term was superior to the linear model for only 1 of the 12 outcome variables. In addition, we completed a graphical evaluation of residuals, which showed no obvious undue influence of extreme values in the models. All analyses were performed by using SUDAAN, version 9.0.1 (Research Triangle Institute, Research Triangle Park, North Carolina) to account for the complex sample design (21).

To see whether our findings might reflect differences in physicians and their practices across regions that differed in local health care intensity (rather than reflecting a direct relationship between intensity and physician perceptions), we repeated all analyses using multiple regression models with intensity at the level of hospital referral region as the exposure (expressed as a continuous variable), adjusting sequentially for patient characteristics, physician attributes, practice characteristics, and market-level factors (as previ-

Table 1. **Characteristics of Areas with Varying Levels of Local Health Care Intensity**

Characteristic	Quintile of Intensity					Ratio of Highest to Lowest Intensity
	1 (Lowest) (n = 2326)	2 (n = 2421)	3 (n = 1223)	4 (n = 2315)	5 (Highest) (n = 2292)	
End-of-Life Expenditure Index, $*	9074	10 616	11 559	12 598	14 644	1.61
Medicare per capita spending, $†	5229	5692	6069	6614	8283	1.58
Burden of illness (predicted 1-year mortality rate), %‡	24.85	24.63	24.87	24.78	24.80	1.00
Hospital beds per 1000 persons, n§	2.4	2.6	2.9	2.9	3.2	1.32
Physicians per 100 000 persons, n§						
Total	184.8	189.4	184.4	204.6	242.4	1.31
Family practitioners and general practitioners	35.9	31.3	29.6	25.9	26.5	0.74
General internists	21.3	23.4	22.6	28.5	37.3	1.75
Medical subspecialists	26.9	28.8	28.6	34.8	44.4	1.65
Surgeons	43.8	45.6	46.0	50.3	56.4	1.29
All other specialties	56.8	60.3	57.5	65.1	77.7	1.37

* The End-of-Life Expenditure Index is derived from the average age-, sex-, and race-adjusted per capita fee-for-service spending on hospital and physician services in the hospital referral region within each quintile for Medicare enrollees who were in their last 6 months of life. For details, see the Methods section (9).
† Average age-, sex-, and race-adjusted per capita fee-for-service spending in the hospital referral regions within each quintile for all Medicare services (excluding enrollees in health maintenance organizations) in 2000 (1).
‡ The illness index was measured as the average predicted risk for death (by using logistic regression) within 1 year of an index hospitalization for acute myocardial infarction, hip fracture, and colorectal cancer from 1994 to 1995 (7).
§ Average age- and sex-adjusted supply (1996) of the specified medical resource in the hospital referral regions within that intensity level.

ously described). We also included in the model such local supply-level variables as age- and sex-adjusted bed supply and total physician population in each hospital referral region. Analyses were repeated after we stratified the data by physician specialty.

Role of the Funding Sources

The funding sources had no role in the design, conduct, or reporting of the study or in the decision to submit the manuscript for publication.

RESULTS

Medicare spending averaged 58% higher in the highest-intensity quintile than in the lowest-intensity quintile ($8283 per capita vs. $5229 in 2000) despite illness levels that were nearly identical (**Table 1**). High-intensity regions also had more hospital beds (ranging from 3.2 per 1000 persons in the highest-intensity quintile to 2.4 per 1000 persons in the lowest-intensity quintile), more physicians overall (ranging from 242 to 185 per 100 000 persons), and more medical subspecialists (ranging from 44 to 27 per 100 000) per capita than low-intensity regions.

Despite the additional resources, physicians practicing in high-intensity regions were much less likely than those in low-intensity regions (range, 64% to 50%) to report being able to obtain elective hospital admissions (**Figure 1**, *left*). Similarly, they were less likely to report being able to obtain adequate inpatient lengths of stay, high-quality specialist referrals, and high-quality diagnostic imaging services. Physicians in high-intensity regions were, however, more likely to report being able to obtain high-quality outpatient mental health services than those in low-intensity regions. The poor availability for mental health services across all regions is also clear in **Figure 1**.

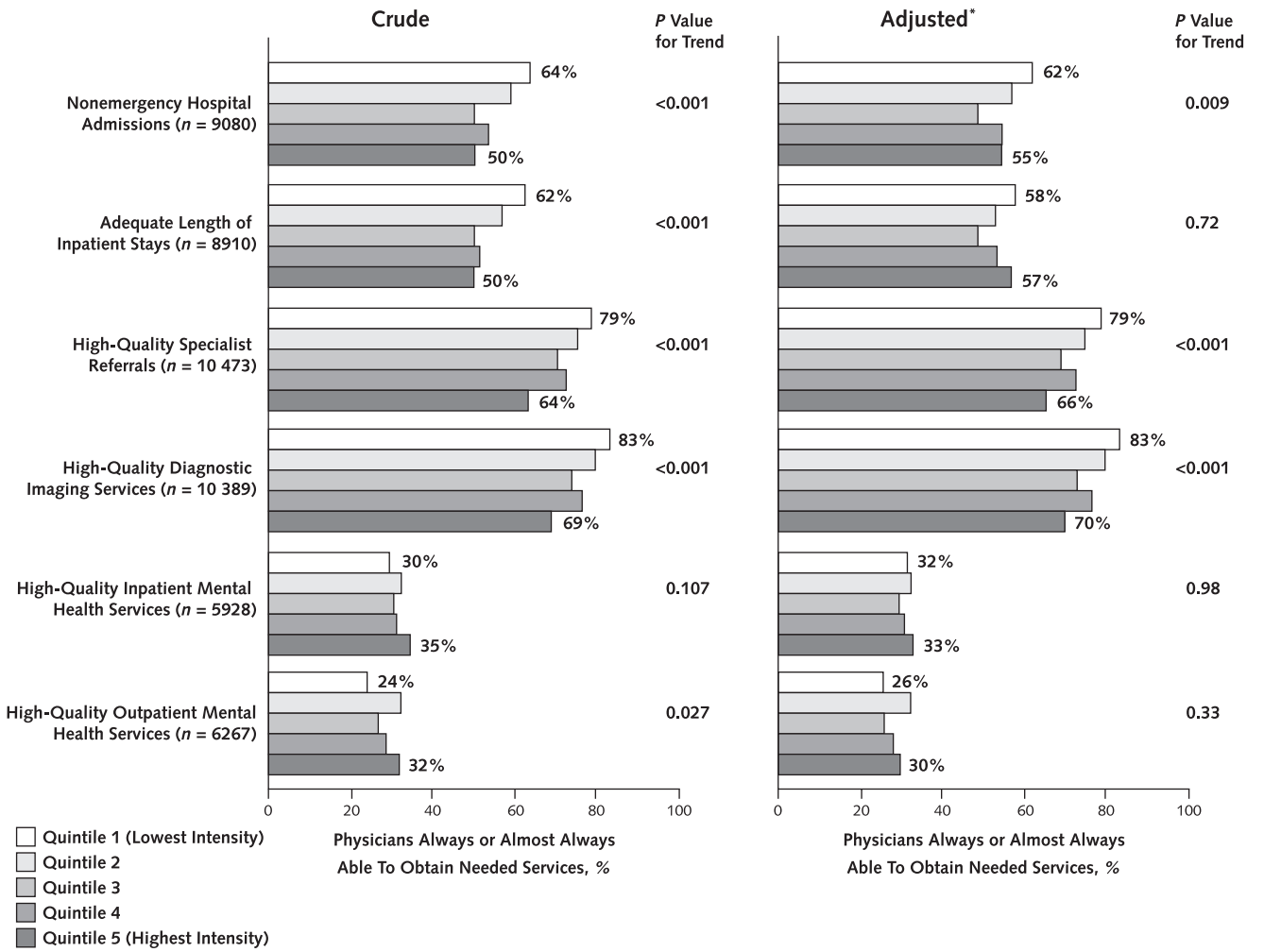
Local health care intensity was also associated with physicians' perceptions of their practice experience. The left panel of **Figure 2** shows that physicians in high-intensity regions were less likely to report having the freedom to make clinical decisions that met their patients' needs (range, 83% to 74%). Although physicians in low-intensity and high-intensity regions were equally likely to feel that they had adequate time with their patients, physicians in high-intensity regions were less likely to feel they could maintain the kind of relationships with their patients that promote high-quality care. Both specialists and primary care physicians in high-intensity regions were less likely than those in low-intensity regions to report adequate communication with their counterparts. Finally, physicians in high-intensity regions were less likely to feel capable of providing high-quality care to all of their patients and were less satisfied with their careers overall. Analyses that stratified data by physician specialty similarly failed to show a positive correlation between local intensity and physician perceptions of availability and quality of care.

We investigated whether our findings might reflect differences in the composition of the physician population (for example, physician attributes and practice characteristics) across regions rather than differences in local health care intensity. **Table 2** shows that there are important differences in the characteristics of physicians and their practices across regions. As expected, the proportion of physicians who provide primary care (particularly family practitioners) is lowest in high-intensity regions. In addition, physicians in high-intensity regions were much more likely to be international medical graduates, to practice in 1- or 2-physician practices, and to have 10 or more managed care contracts than those in low-intensity regions.

Adjustment for all physician and practice characteris-

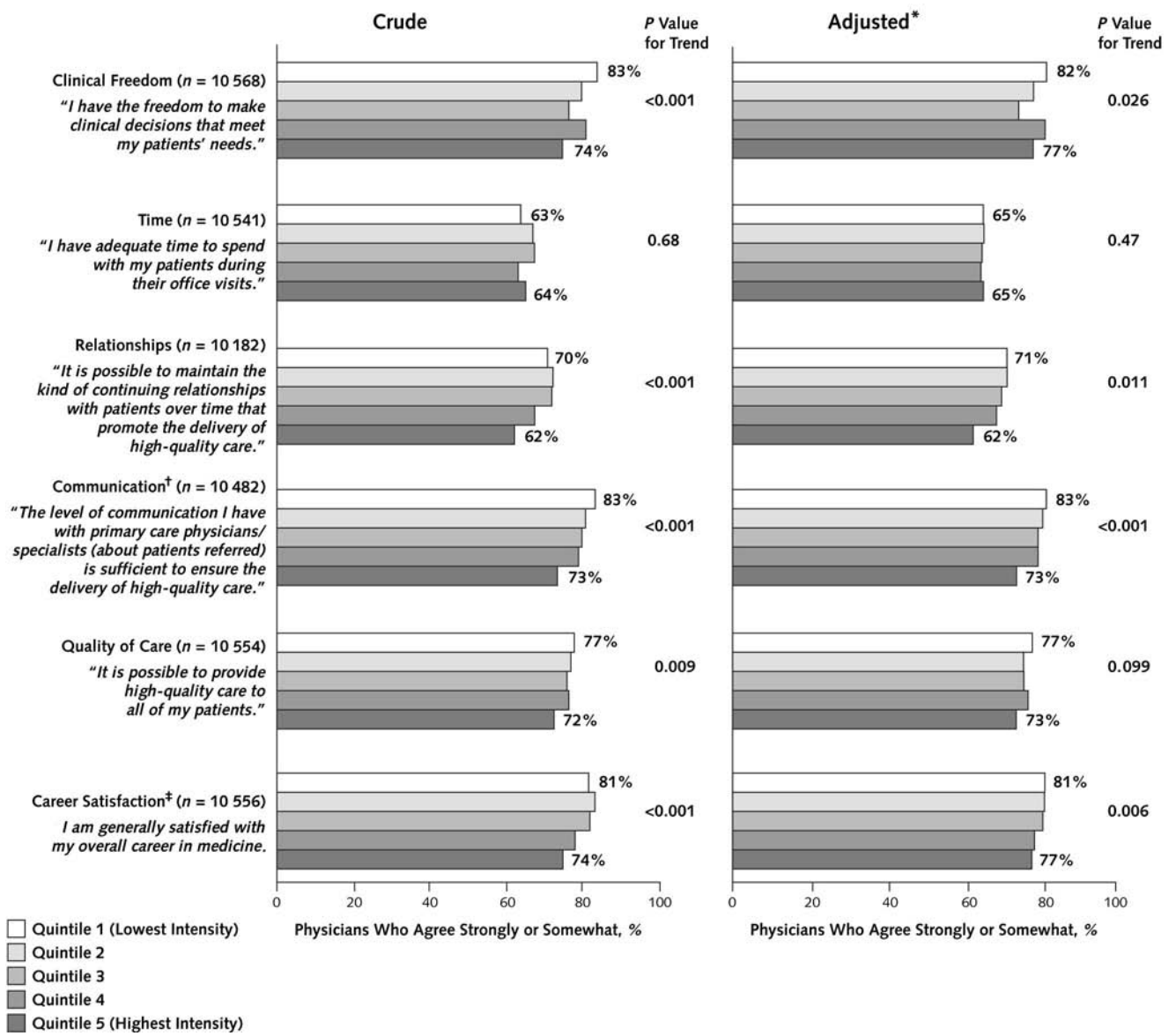
tics, market-level factors, and local health care supply (as previously described) affected most of our findings only modestly (**Figures 1** and **2**, *right*). Differences between high- and low-intensity quintiles became somewhat attenuated. After adjustment, the proportion of physicians who felt able to obtain elective hospital admissions ranged from 55% in the highest-intensity quintile to 49% in the middle quintile and to 62% in the lowest-intensity quintile. The adjusted proportion of physicians who felt they had the freedom to make clinical decisions ranged from 77% in the highest-intensity quintile to 82% in the lowest-intensity quintile. However, all trends that favored low-intensity areas for perceived availability of services and quality of care were preserved with 2 exceptions: The trends favoring low-intensity regions became nonsignificant for overall perceived quality of care provided (P for trend = 0.099) and disappeared for perceived ability to obtain adequate length of inpatient stays (P for trend = 0.72). In no instances were high-intensity regions favored in multivariate models. In the crude model, perceived availability of outpatient mental health was greater in high-intensity regions; however, this trend disappeared in the adjusted model (P for trend = 0.33). Further details of these models for 4 representative outcome variables are provided in **Appendix Tables 1** through 4 (available at www.annals.org). Although we had been concerned that local health care intensity could be serving as a proxy for local physician and bed supply, we found no statistically significant relationship between these supply variables and physician perceptions. Furthermore, inclusion of these variables in the model did not affect the strength or direction of the relationship between intensity and physician perceptions.

Figure 1. **Proportion of physicians practicing in regions with differing levels of local health care intensity who report being able to obtain the following services when medically necessary.**



Crude and adjusted results are presented. The number of respondents, shown in parentheses, differs for each question because some questions did not apply to some specialties and because of some item nonresponse (<1% for each question). *Adjusted for all variables included in the final model (patient, physician, and practice characteristics; market-level managed care; local hospital bed and physician supply).

Figure 2. **Proportion of physicians practicing in regions with differing levels of local health care intensity who agree with the following statements about their practice experience.**



Crude and adjusted results are presented. The number of respondents, shown in parentheses, differs for each question because some questions did not apply to some specialties and because of some item nonresponse (<1% for each question). *Adjusted for all variables included in the final model (patient, physician, and practice characteristics; market-level managed care; local hospital bed and physician supply). †Primary care physicians were asked about their communication with specialists and vice versa. ‡Response categories differed from those for the other 5 questions. These results reflect physicians who responded that they were "somewhat satisfied" or "very satisfied" with their overall career.

DISCUSSION

We found that U.S. physicians in areas of high health care intensity feel no better able to provide quality care than those in low-intensity areas. Despite having access to one-third more beds per capita, these physicians reported greater difficulty hospitalizing their patients than those in low-intensity regions. Although high-intensity regions had over 60% more medical subspecialists, physicians in these areas were the least satisfied with the accessibility and quality of specialty referrals. Furthermore, high-intensity regions had the highest physician-to-patient ratios but physicians in these regions felt the least able to maintain high-quality relationships with patients. Finally, physicians in high-intensity regions felt the least able to provide high-quality care and were the least satisfied with their careers.

Several limitations of the current study must be acknowledged. First, our measure of exposure, local health care intensity, was based on utilization of Medicare services; therefore, this measure might not accurately reflect health care intensity for the remainder of the population of

persons younger than 65 years of age. Several previous studies, however, have shown strong correlations at the regional level between practice patterns for populations younger and older than 65 years of age (22, 23) and at the state level between Medicare spending and total per capita health care spending (24).

Second, some readers may be concerned about the subjective nature of our outcome measures, which represent physicians' reported experience of medical practice, and about our decision to dichotomize the measured outcomes by using our choice of cut-points. Our specific purpose, however, was to study physicians' subjective experience—that is, to assess whether higher levels of health care intensity afford physicians advantages that have not been considered in previous studies that examined the effects of spending on the quality of medical care. We chose to dichotomize the outcome measures to render the comparisons more clinically interpretable. Replicating our analyses by using different cut-points or the original Likert scales as outcome measures did not affect the direction of the associations that we found or their statistical significance.

Third, as is the case with all survey-based research, the generalizability of our findings to the entire physician population may be limited by nonresponse. The response rate of 61%, however, compares favorably with rates from other national telephone surveys of physicians, which generally range from 48% to 65% (25–30). Furthermore, for survey nonresponse to reverse the generally negative associations that we found between intensity and physician-reported perceptions of accessibility and quality, the perceptions of the nonresponders would have to vary systematically with local intensity, and in the opposite direction from those of their responding colleagues in the same regions. This scenario seems unlikely.

Fourth, we must consider the possibility of unmeasured confounding. Our study, as well as the work of others (14, 31, 32), has pointed to several factors that are important predictors of physician perceptions and could confound the relationship between local health care intensity and physician perceptions of care. These factors include physician income, specialty, practice setting, and the extent of managed care involvement in the practice. The strength of the observed negative associations between intensity and physician perceptions, however, was only modestly affected by adjustment for all of these factors. Even the inclusion of variables that reflected local supply of health care resources (hospital beds and physicians), which are closely correlated with local intensity and might medi-

Table 2. **Characteristics of Physicians in the Sample**

Characteristic	Quintile of Intensity					Test for Trend*
	1 (Lowest) (n = 2326)	2 (n = 2421)	3 (n = 1223)	4 (n = 2315)	5 (Highest) (n = 2292)	
Demographic characteristic						
Mean age, *y*	47.0	46.7	47.4	47.7	48.2	↑
Mean years in practice	15.6	15.4	16.1	16.0	16.2	↑
Women, %	22	17	17	22	20	–
Training, %						
Internal medicine	19	19	21	27	27	↑
Medical subspecialties	27	28	31	29	30	↑
Family practice or general practice	35	33	29	24	23	↓
Surgical specialties	19	19	18	20	19	–
Board-certified or board-eligible	89	87	85	84	81	↓
International medical school graduate	11	14	20	22	36	↑
Practice setting, %						
1- or 2-physician practice	31	32	37	37	47	↑
Group practice of 3 physicians or more	28	30	28	23	20	↓
Group or staff health maintenance organization	8	4	4	5	6	–
Medical school	7	8	8	9	8	–
Hospital-based practice	14	16	11	15	11	–
Other	12	11	10	11	8	↓
Revenue sources and compensation						
Mean percentage of revenue from Medicare	30	33	35	33	34	↑
Mean percentage of revenue from Medicaid	14	14	15	14	13	–
Mean percentage of revenue from managed care	44	38	38	42	44	–
Managed care role in practice						
Mean percentage of revenue paid on a capitated basis	21	13	14	16	21	–
Mean percentage of patients for whom physician is gatekeeper	40	35	37	41	45	↑
10 or more managed care contracts, %	41	47	45	55	55	↑
Provides primary care, %	39	33	34	30	29	↓

* Test for trend by using linear regression or logistic regression with the characteristic as the dependent variable and health care intensity (measured as End-of-Life Expenditure Index) in the physician's hospital referral region as the exposure. Arrows show the direction of any statistically significant association ($P < 0.05$) between regional differences in health care intensity and physician characteristics. An arrow pointing upward indicates that as health care intensity increases across regions, the percentage of physicians with a given characteristic increases.

ate the association between intensity and physician perceptions, affected the relationship negligibly. We cannot rule out the possibility of an unmeasured confounder; however, it would take a strong confounder to reverse the direction of the observed associations.

Given our unexpected finding that physicians in "richer" areas perceive themselves to have a poorer ability to provide health care, perhaps most important is the need for a reasonable causal theory. In other words, why might *more* be associated with the perception of *less*? What attributes of practice in high-intensity regions could lead physicians to report more obstacles to providing high-quality care and to perceive more resource constraints when more resources are available?

The perception of a shortage of hospital services could be due to higher demand by individual physicians in high-intensity regions. These physicians may believe more strongly that the hospital is a better or more efficient place to provide care than the outpatient setting because it enables them to arrange more easily for tests and consultations. Patients might also have these beliefs and pressure physicians for hospital admission. Even if there were no differences in physician or patient beliefs, however, the perception of a shortage could be attributable to more physicians competing for beds. Specifically, internists and medical subspecialists have relatively fewer beds available *per physician* in high-intensity regions, even though the supply of available beds *per patient* is much greater.

The perceived difficulty in obtaining high-quality specialty referrals and diagnostic services might reflect higher demand by individual physicians (or by patients) for these services in high-intensity regions. Another possibility is that this perception may reflect actual differences in the quality of the services available to survey respondents in areas of low and high intensity. Perceived availability may also reflect a *relative* shortage of these services in high-intensity regions (similar to the explanation proposed for a perceived shortage of hospital beds). Rates of specialty referral in these regions are more than double those in low-intensity regions, and rates of imaging services are more than 60% higher (9). The availability of services *per patient referred* may therefore be lower in high-intensity regions. This paradoxical relationship between actual resource levels and perceived resource availability demonstrates the problem with formulating policy decisions about "shortages" on the basis of local perceptions.

We must also try to explain why a higher-intensity practice environment might be associated with less satisfactory communication between physicians and relationships with patients, and with lower perceived quality of care. Poorer communication may be related to the fact that patients in high-intensity regions generally have many more physicians involved in their care (9, 33). The more physicians who need to communicate about a given patient, the poorer that communication is likely to be. Similarly, quality of care may be compromised. The greater the number of physicians involved in a patient's care, the less responsibility each physician feels toward the patient. This condition is not only likely to reduce the quality of the relationship between physician and patient, but it is also likely to increase care fragmentation (34, 35). Such fragmentation may contribute to the deficiencies in the quality and outcomes of care that were reported in higher-intensity regions in earlier studies (8, 9, 36). Furthermore, physicians in high-intensity regions may also feel less able to provide high-quality care because of the greater complexity of managing the average patient, who has been subjected to more tests, more referrals, and more hospitalizations (37). For each patient, there is more to keep track of, more to do during each visit, and a lower likelihood that any physician feels able to do it all adequately.

Local practice patterns (and therefore health care intensity and spending) result from the interaction of multiple factors: population characteristics, including patient expectations; physician behavior; and structural attributes of the local care system, such as resource levels and managed care penetration. Our study does not provide direct evidence of the relative contribution of each of these factors to the practice patterns that were observed across regions. The findings, however, raise questions about the inpatient-based and specialist-oriented practice patterns that characterize high-intensity regions. Previous studies demonstrated that higher-intensity practice patterns are not associated with higher quality as defined by clinical performance measures (such as β-blocker use after myocardial infarction) (9, 38, 39), enhanced patient satisfaction (8), or lower mortality rates (4–8). Our findings provide further insight: Physicians in these regions do not feel more satisfied with their careers, nor do they feel better able to take care of their patients. This observation holds true even after accounting for the varied backgrounds, practices, and managed care influences of physicians in different regions.

Our findings are relevant to current policy debates. Even the possibility that higher health care intensity, itself closely related to greater physician supply, could lead to lower quality of care underscores the importance of proceeding carefully with decisions about further expansion of the physician workforce (40, 41). Our findings also indicate that concerns that physicians in lower-intensity regions have inadequate local resources and are more dissatisfied with their careers are misplaced. Further research to learn from the practice patterns in lower-intensity regions (12) may offer important insights into efforts to improve the quality of health care and to control the growth of health care spending.

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Appendix Table 1. **Factors Associated with Physicians' Perceived Ability To Obtain Hospital Admissions***

Characteristic	Odds Ratio†						
	A	B	C	D	E	F	G
Intensity at level of hospital referral region (End-of-Life Expenditure Index) (95% CI)‡	0.91 (0.89–0.94)§	0.91 (0.88–0.94)§	0.92 (0.89–0.95)§	0.93 (0.90–0.97)§	0.94 (0.90–0.97)§	0.95 (0.91–0.99)§	–
Patient characteristics (practice-specific)‖							
Age	–	1.05§	1.06§	1.06§	1.05§	1.05§	1.05§
Socioeconomic status	–	0.92§	0.94§	0.94§	0.94§	0.94§	0.94§
Physician characteristics							
Years in practice							
<10 years	–	–	1.13	1.09	1.09	1.08	1.08
10 to 25 years	–	–	0.95	0.94	0.94	0.94	0.94
>25 years (referent)	–	–	1.0	1.0	1.0	1.0	1.0
Women	–	–	0.81§	0.80§	0.80§	0.80§	0.81§
Board-certified/board-eligible	–	–	1.24§	1.18	1.18	1.18	1.20
U.S. medical school graduate	–	–	1.26§	1.22§	1.21§	1.21§	1.25§
Specialty							
Family practice/general practice (referent)	–	–	1.0	1.0	1.0	1.0	1.0
Internal medicine	–	–	1.08	1.05	1.06	1.06	1.06
Medical subspecialties	–	–	0.58§	0.57§	0.57§	0.58§	0.57§
Surgical specialties	–	–	0.94	0.94	0.95	0.95	0.94
Income (relative to median county income)¶	–	–	1.03§	1.03§	1.03§	1.03§	1.03§
Practice characteristics and role of managed care							
Practice setting							
1- or 2-physician practice (referent)	–	–	–	1.0	1.0	1.0	1.0
Group practice of 3 physicians or more	–	–	–	1.35§	1.35§	1.35§	1.38§
Multispecialty group practice	–	–	–	0.68§	0.68§	0.69§	0.69§
Group or staff health maintenance organization	–	–	–	2.22§	2.23§	2.22§	2.26§
Medical school	–	–	–	1.27§	1.27§	1.29§	1.31§
Hospital-based practice	–	–	–	1.40§	1.39§	1.41§	1.45§
Other	–	–	–	1.19	1.19	1.19	1.22
10 or more managed care contracts**	–	–	–	0.86§	0.87§	0.87§	0.86§
Gatekeeper for at least 50% of patients	–	–	–	0.87	0.88	0.88	0.87
Revenue from capitated contracts††	–	–	–	1.01	1.01	1.01	1.01
Market characteristics							
Managed care penetration at level of hospital referral region‡‡	–	–	–	–	0.97	0.96	0.96
Local health care supply							
Number of physicians per 100 000 persons§§	–	–	–	–	–	0.99	0.98§
Number of hospital beds per 1000 persons‖‖	–	–	–	–	–	0.93	0.86§

* The logistic regression model sequentially adds: (A) intensity at the level of hospital referral region, (B) patient characteristics, (C) physician characteristics, (D) practice characteristics, (E) area-level managed care penetration, and (F) local health care supply to predict a physician's perceived ability (always or almost always) to obtain nonemergency hospital admissions. In model G, practice intensity is removed from the full model.
† Odds ratios are provided to show how parameter estimates were affected by the incorporation of additional model terms; they should not be interpreted as relative risks because the outcome exhibited is common.
‡ Odds ratio is for a $1000 increment in End-of-Life Expenditure Index.
§ Differs significantly from 1 ($P < 0.05$).
‖ Odds ratio is for a 10–percentage point increment in revenue from Medicare (or Medicaid).
¶ Odds ratio is for a 1-unit increment in the ratio of physician income to median county income.
** Odds ratio is for a 10–percentage point increment in revenue from managed care contracts.
†† Odds ratio is for a 10–percentage point increment in the percentage of revenue paid on a capitated basis.
‡‡ Odds ratio is for a 10–percentage point increment in managed care penetration.
§§ Odds ratio is for an increment of 10 physicians per 100 000 persons.
‖‖ Odds ratio is for an increment of 10 acute care hospital beds per 1000 persons.

Appendix Table 2. **Factors Associated with Physicians' Perceived Ability To Obtain Referrals to High-Quality Specialists***

Characteristic	Odds Ratio†						
	A	B	C	D	E	F	G
Intensity at level of hospital referral region (End-of-Life Expenditure Index) (95% CI)‡	0.89 (0.86–0.91)§	0.88 (0.86–0.91)§	0.91 (0.88–0.93)§	0.92 (0.89–0.94)§	0.92 (0.89–0.95)§	0.89 (0.86–0.92)§	–
Patient characteristics (practice-specific)‖							
Age	–	1.06§	1.05§	1.05§	1.04§	1.04§	1.04§
Socioeconomic status	–	0.94§	0.95§	0.94§	0.93§	0.93§	0.93§
Physician characteristics							
Years in practice							
<10 years	–	–	0.91	0.87	0.86	0.87	0.87
10 to 25 years	–	–	0.94	0.92	0.93	0.93	0.93
>25 years (referent)	–	–	1.0	1.0	1.0	1.0	1.0
Women	–	–	0.83§	0.81§	0.81§	0.80§	0.81§
Board-certified/board-eligible	–	–	1.07	1.04	1.05	1.05	1.08
U.S. medical school graduate	–	–	1.57§	1.54§	1.54§	1.54§	1.66§
Specialty							
Family practice/general practice (referent)	–	–	1.0	1.0	1.0	1.0	1.0
Internal medicine	–	–	1.00	0.96	0.99	0.97	0.96
Medical subspecialties	–	–	0.61§	0.56§	0.58§	0.58§	0.56§
Surgical specialties	–	–	0.48§	0.46§	0.48§	0.47§	0.46§
Income (relative to median county income)¶	–	–	1.05§	1.05§	1.04§	1.04§	1.04§
Practice characteristics and role of managed care							
Practice setting							
1- or 2-physician practice (referent)	–	–	–	1.0	1.0	1.0	1.0
Group practice of 3 physicians or more	–	–	–	1.30§	1.29§	1.28§	1.34§
Multispecialty group practice	–	–	–	0.83§	0.84	0.83§	0.84§
Group or staff health maintenance organization	–	–	–	2.96§	3.04§	3.06§	3.17§
Medical school	–	–	–	1.47§	1.47§	1.43§	1.49§
Hospital-based practice	–	–	–	1.43§	1.41§	1.35§	1.45§
Other	–	–	–	1.16	1.15	1.13	1.19
10 or more managed care contracts**	–	–	–	0.84§	0.86§	0.86§	0.84§
Gatekeeper for at least 50% of patients	–	–	–	0.71§	0.73§	0.73§	0.72§
Revenue from capitated contracts††	–	–	–	1.03§	1.04§	1.04§	1.04§
Market characteristics							
Managed care penetration at level of hospital referral region‡‡	–	–	–	–	0.88§	0.90§	0.89§
Local health care supply							
Number of physicians per 100 000 persons§§	–	–	–	–	–	1.02	0.99
Number of hospital beds per 1000 persons‖‖	–	–	–	–	–	1.18§	0.97

* The logistic regression model sequentially adds: (A) intensity at the level of hospital referral region, (B) patient characteristics, (C) physician characteristics, (D) practice characteristics, (E) area-level managed care penetration, and (F) local health care supply to predict a physician's perceived ability (always or almost always) to obtain referrals to high-quality specialists. In model G, practice intensity is removed from the full model.
† Odds ratios are provided to show how parameter estimates were affected by the incorporation of additional model terms; they should not be interpreted as relative risks because the outcome exhibited is common.
‡ Odds ratio is for a $1000 increment in End-of-Life Expenditure Index.
§ Differs significantly from 1 ($P < 0.05$).
‖ Odds ratio is for a 10–percentage point increment in revenue from Medicare (or Medicaid).
¶ Odds ratio is for a 1-unit increment in the ratio of physician income to median county income.
** Odds ratio is for a 10–percentage point increment in revenue from managed care contracts.
†† Odds ratio is for a 10–percentage point increment in the percentage of revenue paid on a capitated basis.
‡‡ Odds ratio is for a 10–percentage point increment in managed care penetration.
§§ Odds ratio is for an increment of 10 physicians per 100 000 persons.
‖‖ Odds ratio is for an increment of 10 acute care hospital beds per 1000 persons.

Appendix Table 3. **Factors Associated with Physicians' Perceptions of Their Ability To Provide High-Quality Care***

Characteristic	Odds Ratio†						
	A	B	C	D	E	F	G
Intensity at level of hospital referral region (End-of-Life Expenditure Index) (95% CI)‡	0.96 (0.93–0.99)§	0.96 (0.93–0.99)§	0.96 (0.93–0.99)§	0.97 (0.94–1.00)	0.97 (0.94–1.00)	0.96 (0.94–1.00)	
Patient characteristics (practice-specific)‖							
Age	–	1.02	1.01	1.01	1.01	1.01	1.01
Socioeconomic status	–	0.99	0.99	0.98	0.98	0.98	0.98
Physician characteristics							
Years in practice							
<10 years	–	–	1.32§	1.34§	1.33§	1.33§	1.33§
10 to 25 years	–	–	0.95	0.95	0.95	0.95	0.96
>25 years (referent)	–	–	1.0	1.0	1.0	1.0	1.0
Women	–	–	0.82§	0.82§	0.82§	0.82§	0.82§
Board-certified/board-eligible	–	–	1.00	1.02	1.02	1.02	1.03
U.S. medical school graduate	–	–	0.97	0.95	0.95	0.95	0.97
Specialty							
Family practice/general practice (referent)	–	–	1.0	1.0	1.0	1.0	1.0
Internal medicine	–	–	1.06	1.06	1.07	1.07	1.07
Medical subspecialties	–	–	0.88	0.78§	0.79§	0.79§	0.78§
Surgical specialties	–	–	0.87	0.80§	0.82§	0.82§	0.81§
Income (relative to median county income)¶	–	–	1.01	1.01	1.00	1.00	1.00
Practice characteristics and role of managed care							
Practice setting							
1- or 2-physician practice (referent)	–	–	–	1.0	1.0	1.0	1.0
Group practice of 3 physicians or more	–	–	–	1.18§	1.18§	1.18§	1.19§
Multispecialty group practice	–	–	–	0.75§	0.75§	0.75§	0.75§
Group or staff health maintenance organization	–	–	–	1.66§	1.68§	1.68§	1.70§
Medical school	–	–	–	1.01	1.01	1.00	1.01
Hospital-based practice	–	–	–	1.46§	1.45§	1.44§	1.47§
Other	–	–	–	1.17	1.17	1.17	1.18
10 or more managed care contracts**	–	–	–	0.80§	0.81§	0.81§	0.80§
Gatekeeper for at least 50% of patients	–	–	–	0.64§	0.65§	0.65§	0.65§
Revenue from capitated contracts††	–	–	–	0.99	1.00	1.00	1.00
Market characteristics							
Managed care penetration at level of hospital referral region‡‡	–	–	–	–	0.96	0.96	0.96
Local health care supply							
Number of physicians per 100 000 persons§§	–	–	–	–	–	1.00	0.99
Number of hospital beds per 1000 persons‖‖	–	–	–	–	–	1.03	0.97

* The logistic regression model sequentially adds: (A) intensity at the level of hospital referral region, (B) patient characteristics, (C) physician characteristics, (D) practice characteristics, (E) area-level managed care penetration, and (F) local health care supply to predict a physician's perceived ability (always or almost always) to obtain referrals to high-quality specialists. In model G, practice intensity is removed from the full model.
† Odds ratios are provided to show how parameter estimates were affected by the incorporation of additional model terms; they should not be interpreted as relative risks because the outcome exhibited is common.
‡ Odds ratio is for a $1000 increment in End-of-Life Expenditure Index.
§ Differs significantly from 1 ($P < 0.05$).
‖ Odds ratio is for a 10–percentage point increment in revenue from Medicare (or Medicaid).
¶ Odds ratio is for a 1-unit increment in the ratio of physician income to median county income.
** Odds ratio is for a 10–percentage point increment in revenue from managed care contracts.
†† Odds ratio is for a 10–percentage point increment in the percentage of revenue paid on a capitated basis.
‡‡ Odds ratio is for a 10–percentage point increment in managed care penetration.
§§ Odds ratio is for an increment of 10 physicians per 100 000 persons.
‖‖ Odds ratio is for an increment of 10 acute care hospital beds per 1000 persons.

Appendix Table 4. Factors Associated with Physicians' Career Satisfaction*

Characteristic	Odds Ratio†						
	A	B	C	D	E	F	G
Intensity at level of hospital referral region (End-of-Life Expenditure Index) (95% CI)‡	0.92 (0.88–0.95)§	0.92 (0.88–0.95)§	0.93 (0.89–0.97)§	0.94 (0.90–0.98)§	0.94 (0.90–0.98)§	0.93 (0.89–0.98)§	–
Patient characteristics (practice-specific)‖							
Age	–	0.96§	0.95§	0.95§	0.94§	0.94§	0.94§
Socioeconomic status	–	1.00	1.00	0.98	0.98	0.98	0.98
Physician characteristics							
Years in practice							
<10 years	–	–	1.97§	1.93§	1.93§	1.92§	1.92§
10 to 25 years	–	–	0.94	0.93	0.93	0.93	0.93
>25 years (referent)	–	–	1.0	1.0	1.0	1.0	1.0
Women	–	–	0.92	0.92	0.92	0.92	0.93
Board-certified/board-eligible	–	–	1.57§	1.53§	1.53§	1.54§	1.56§
U.S. medical school graduate	–	–	1.20§	1.12	1.12	1.12	1.17§
Specialty							
Family practice/general practice (referent)	–	–	1.0	1.0	1.0	1.0	1.0
Internal medicine	–	–	0.82§	0.81§	0.82§	0.82§	0.82§
Medical subspecialties	–	–	0.94	0.82§	0.84	0.85	0.83
Surgical specialties	–	–	0.70§	0.64§	0.65§	0.66§	0.65§
Income (relative to median county income)¶	–	–	1.07§	1.07§	1.06§	1.06§	1.06§
Practice characteristics and role of managed care							
Practice setting							
1- or 2-physician practice (referent)	–	–	–	1.0	1.0	1.0	1.0
Group practice of 3 physicians or more	–	–	–	1.35§	1.35§	1.34§	1.38§
Multispecialty group practice	–	–	–	0.77§	0.77§	0.77§	0.77§
Group or staff health maintenance organization	–	–	–	1.40§	1.41§	1.41§	1.45§
Medical school	–	–	–	1.86§	1.83§	1.81§	1.85§
Hospital-based practice	–	–	–	1.54§	1.53§	1.51§	1.57§
Other	–	–	–	1.20	1.19	1.18	1.21
10 or more managed care contracts**	–	–	–	0.85§	0.86§	0.86§	0.84§
Gatekeeper for at least 50% of patients	–	–	–	0.80§	0.82	0.81	0.80§
Revenue from capitated contracts††	–	–	–	0.96§	0.96§	0.96§	0.96§
Market characteristics							
Managed care penetration at level of hospital referral region‡‡	–	–	–	–	0.94	0.97	0.96
Local health care supply							
Number of physicians per 100 000 persons§§	–	–	–	–	–	1.00	0.98
Number of hospital beds per 1000 persons‖‖	–	–	–	–	–	1.09	0.98

* The logistic regression model sequentially adds: (A) intensity at the level of hospital referral region, (B) patient characteristics, (C) physician characteristics, (D) practice characteristics, (E) area-level managed care penetration, and (F) local health care supply to predict a physician's perceived ability (always or almost always) to obtain referrals to high-quality specialists. In model G, practice intensity is removed from the full model.
† Odds ratios are provided to show how parameter estimates were affected by the incorporation of additional model terms; they should not be interpreted as relative risks because the outcome exhibited is common.
‡ Odds ratio is for a $1000 increment in End-of-Life Expenditure Index.
§ Differs significantly from 1 ($P < 0.05$).
‖ Odds ratio is for a 10–percentage point increment in revenue from Medicare (or Medicaid).
¶ Odds ratio is for a 1-unit increment in the ratio of physician income to median county income.
** Odds ratio is for a 10–percentage point increment in revenue from managed care contracts.
†† Odds ratio is for a 10–percentage point increment in the percentage of revenue paid on a capitated basis.
‡‡ Odds ratio is for a 10–percentage point increment in managed care penetration.
§§ Odds ratio is for an increment of 10 physicians per 100 000 persons.
‖‖ Odds ratio is for an increment of 10 acute care hospital beds per 1000 persons.