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RESEARCH ARTICLE

Medical Group Characteristics and the Cost and Quality of Care for Medicare Beneficiaries

Lawrence P. Casalino, Patricia Ramsay, Laurence C. Baker, Michael F. Pesko, and Stephen M. Shortell

Objective. To estimate the relationship between outcomes of care and medical practices' structure and use of organized care improvement processes.

Data Sources/Study Setting. We linked Medicare claims data to our national survey of physician practices (2012–2013). Fifty percent response rate; 1,040 responding practices; 31,888 physicians; 868,213 attributed Medicare beneficiaries.

Study Design. Cross-sectional observational analysis of the relationship between practice characteristics and total spending, readmissions, and ambulatory care–sensitive admissions (ACSAs), for all beneficiaries and five categories of beneficiary defined by predicted need for care.

Principal Findings. Practices with 100+ physicians and 50–99 physicians had, respectively, annual spending per high-need beneficiary that was $1,870 (12.5 percent) and $1,824 higher than practices with 1–2 physicians, and readmission rates 1.64 and 1.71 higher. ACSA rates did not vary significantly by practice size. Outcomes did not vary significantly by ownership or by practices' use of organized processes to improve care.

Conclusions. Large practices had higher spending and readmission rates than the smallest practices, especially for high-need beneficiaries. There were no significant performance differences between physician-owned and hospital-owned practices. Policy makers should consider the effects of specific policies on provider organization, pending further research to learn which types of practice provide better care.

Key Words. Medical groups, hospital employment of physicians

The organization of medical practice in the United States is changing rapidly. Physicians are selling their practices to hospitals (O'Malley, Bond, and Berenson 2011; Burns, Goldsmith, and Sen 2013). Independent practices are merging to become larger (Muhlestein and Smith 2016). The number of federally qualified community health centers (FQHCs) is growing (Mukamel et al.

2016). These trends are long-standing, but they appear to have been accelerated by policies such as accountable care organization (ACO) programs, Meaningful Use, and higher payments for outpatient visits provided in hospital-based sites of care ("facility fees"). MACRA (the Medicare Access and CHIP Reauthorization Act of 2015), which aims to move the United States more rapidly toward value-based payment, may further accelerate these trends (Casalino 2017; Gaynor, Mostashari, and Ginsburg 2017; Schneider and Hall 2017). Yet little is known about the impact of the size and ownership of physician practices on the quality and cost of health care (Casalino 2006; Goldsmith et al. 2015).

The processes that practices use to improve care are also changing. Practices are increasingly using quality improvement (QI) processes, health information technology (HIT), and systematic care management processes (CMPs) to improve the care they provide. There is mixed evidence on the impact of these processes; much of this evidence comes from studies of practices that have volunteered to participate (so may differ from practices that do not volunteer) and/or are located in limited geographic areas (Friedberg et al. 2015; Lammers, McLaughlin, and Barna 2016; Sinaiko et al. 2017; Unruh et al. 2017).

No study to date has combined data on both practices' structural characteristics and the processes practices use to improve care for a large national sample of physician practices of all sizes and linked these to patient outcomes. We linked data from a large, unique data source—the third National Study of Physician Organizations (NSPO3)—to Medicare claims data. We measured the performance of practices for Medicare beneficiaries overall and for five categories of beneficiaries defined by predicted spending on their care, with a particular focus on high-need beneficiaries.

Although the empirical data to date are limited and mixed, conceptually one might hypothesize that larger practices (Crosson 2005) and

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hospital-owned practices have more resources, are therefore able to use more processes to improve care, and therefore should have better outcomes, particularly for high-need patients, who might benefit most from high-quality care (Blumenthal et al. 2016; Cross et al. 2017; Long et al. 2017).

METHODS

Medical Practice Population

NSPO3 provides a rich source of information on the characteristics of a large sample of practices of all sizes in the United States (Wiley et al. 2015). We created a random sample of practices using the IMS Healthcare Organizational Services database, excluding Veterans Administration and academic medical center practices. The sample was national, but the 17 areas participating in the Robert Wood Johnson Aligning Forces for Quality program were oversampled. Practices were eligible if at least 40 percent of their physicians (for practices with fewer than 20 physicians) or at least 30 percent (for practices with 20 or more physicians) were in one or more of the following specialties: general internal medicine, family medicine, general practice, cardiology, endocrinology, and pulmonology. These specialties were chosen because they are particularly likely to provide ongoing care for patients with chronic illnesses.

Survey Methods

We conducted a 40-minute telephone survey between January 2012 and November 2013 with the lead physician or administrator of each practice that agreed to participate. The survey instrument (Appendix SA2) was based on prior NSPO surveys; it focused on practices' use of QI, CMP, and HIT processes. One thousand three hundred and ninety-eight practices responded, yielding an adjusted response rate of 50.0 percent according to the American Association for Public Opinion Research's method RR3 (American Association for Public Opinion Research 2011). We restricted our analyses to the 1,040 practices that included at least 15 percent primary care physicians. There were 31,888 physicians in these practices.

Beneficiary Population

Using 2012 Medicare claims, we attributed 868,213 beneficiaries to the 1,040 practices. We attributed beneficiaries to the practice for which the sum of

allowed charges for primary care services for the beneficiary was greater than the sum of allowed charges for services received by all other practices combined (Appendix SA3). Beneficiaries were eligible if they were at least 65 years old as of January 1, 2011, were not in the end-stage renal disease program, and were alive and enrolled in Medicare Parts A and B throughout 2011 and 2012.

Study Variables

Medicare Spending. Using the 2012 Master Beneficiary Summary Cost and Use file, we measured total spending per beneficiary, defined as the allowed amounts paid for services by Medicare, co-insurers, and the beneficiary. We also measured spending in four subcategories: hospital services, physician services, post-acute care, and other services. We winsorized spending on outliers in each subcategory by reducing individual beneficiary spending above the 99th percentile to the amount spent at the 99th percentile for each subcategory; we summed these amounts to measure total spending. We standardized spending to adjust for geographic differences in Medicare payments at the county level by multiplying spending in each category by the ratio of Medicare county-level total standardized spending to total actual spending in that county in 2012 (Centers for Medicare and Medicaid Services 2016b).

Quality/Utilization Measures. We measured the number of 30-day hospital readmissions for each beneficiary, using the hospital-wide (all-condition) 30-day risk-standardized readmission measure, which excludes planned readmissions (Centers for Medicare and Medicaid Services 2016a). The readmission rate depends in part on processes used by the hospital during the patient's index admission. However, we include readmissions as a measure of practice performance because physician practices have a role in preventing readmissions (e.g., through the timeliness and quality of care provided after discharge) and because practices often choose the hospital to which patients are admitted.

We measured the number of ambulatory care–sensitive admissions (ACSAs) for each beneficiary, identifying ACSAs using the ICD-9 diagnosis codes in the 2016 version of the AHRQ Prevention Quality Indicators (Agency for Healthcare Quality and Research 2016). ACSAs are admissions for conditions such as congestive heart failure, chronic obstructive pulmonary disease, and short-term complications of diabetes for which good outpatient care may reduce the rate of admissions.

High-Need Beneficiaries. Using 2011 Medicare claims and the method developed by Jha et al., we placed each beneficiary into one of five categories of need, ranging from those predicted to have the highest (beneficiaries with two or more frailties) to the lowest (beneficiaries with no chronic conditions) total spending on care in 2012 (Table 1; Joynt et al. 2016). High-need beneficiaries account for a disproportionate share of spending and might particularly benefit from receiving care from high-quality medical practices (Blumenthal et al. 2016).

Medical Group Characteristics. Using data from the NSPO3 survey, we categorized practices as physician-owned, hospital-owned, or community health center. We used six categories of practice size (Table 2) and included each practice's percentage of primary care physicians as a continuous variable. In an additional set of multivariable analyses, we used size/ownership categories —for example, "1–2 physicians, physician-owned," rather than including size and ownership as separate variables (Tables S8–S10).

Health Information Technology, Care Management Processes, and Quality Improvement Activities. Using data from the NSPO3 survey, we gave each group a score on a 14-item HIT index that covered various uses of an EHR, such as clinical decision support, collection of quality data, and electronic connectivity with patients. We measured CMPs by a 20-item index which included items relevant to nurse care management, reminders and education for patients, provision of quality data to physicians, and use of a registry to identify patients with chronic illnesses. We measured QI processes based on whether the practice used one or more of five specific QI processes. The elements of these three indices are shown in Table S1.

Covariates. In all multivariate analyses—for beneficiaries as a whole and within each need category—we risk-adjusted using data from the Medicare Master Beneficiary Summary File, including beneficiaries' age, sex, racial/ethnic group, whether the beneficiary was "dual-eligible" (covered by both Medicare and Medicaid), whether disability was the original reason for Medicare eligibility, and each beneficiary's number of major chronic conditions and number of minor chronic conditions. Based on NSPO3 data, we included dummy variables for whether a practice was involved in pay-for-performance programs with payers and for whether payers publicly reported data on the practice's performance; we included

Table 1: Beneficiary Characteristics

			Fewer Than Two Frailty Indicators			
	All	*Two or More Frailty Indicators*	*Three or More Major Chronic Conditions*	*One or Two Major Chronic Conditions*	*No Major Chronic Conditions; At Least One Minor Chronic Condition*	*No Major or Minor Chronic Conditions*
Beneficiaries, no. (%)	868,213 (100.0)	60,556 (7.0)	91,584 (10.5)	351,154 (40.4)	332,591 (38.3)	32,328 (3.7)
Age, mean (SD)*	76.2 (7.5)	81.3 (8.0)	78.8 (7.6)	76.3 (7.3)	74.8 (6.8)	73.2 (6.8)
Female, no. (%)*,†	519,043 (59.8)	42,452 (70.1)	49,437 (54.0)	204,288 (58.2)	206,051 (62.0)	16,815 (52.0)
Dual-eligible, no. (%)*,†	92,536 (10.7)	11,631 (19.2)	14,910 (16.3)	38,427 (10.9)	24,836 (7.5)	2,732 (8.5)
Disabled as original reason for entitlement, no. (%)*,†	58,617 (6.8)	6,120 (10.1)	11,229 (12.3)	25,988 (7.4)	13,718 (4.1)	1,562 (4.8)
ACSAs/hundred beneficiaries (SD)*,†	3.9 (24.0)	11.7 (42.5)	12.0 (43.5)	3.3 (21.1)	1.0 (11.2)	1.9 (15.2)
Readmissions/hundred beneficiaries, mean (SD)*,†	1.8 (17.8)	5.9 (33.7)	5.2 (30.8)	1.5 (15.3)	0.6 (9.4)	0.8 (10.8)
Total spending per beneficiary in 2012, mean (SD)*,†,‡,§	6,571 (11,473)	14,907 (17,957)	12,073 (15,463)	6,362 (10,605)	4,012 (7,967)	3,962 (9,421)
Hospital spending (inpatient plus outpatient), mean (SD)*,†,§,¶	3,240 (7,373)	6,611 (10,316)	6,336 (10,224)	3,182 (7,109)	1,936 (5,475)	2,207 (6,333)

continued

Table 1. *Continued*

			Fewer Than Two Frailty Indicators			
	All	*Two or More Frailty Indicators*	*Three or More Major Chronic Conditions*	*One or Two Major Chronic Conditions*	*No Major Chronic Conditions; At Least One Minor Chronic Condition*	*No Major or Minor Chronic Conditions*
Physician services spending, mean (SD)*,†,§,¶	1,066 (1,380)	1,780 (1860)	1,764 (1,793)	1,103 (1,339)	758 (1.067)	523 (847)
Post-acute care spending, mean (SD)*,†,§,¶	924 (3,948)	4,411 (8,158)	1,894 (5,485)	700 (3.361)	301 (2,131)	504 (3.027)
All other spending, mean (SD)*,†,§,¶	1,340 (1,724)	2,106 (2,156)	2,080 (2.083)	1,377 (1,705)	1018 (1,445)	729 (1.298)

*Pairwise comparison result was statistically different from zero ($p < .001$) when beneficiaries with two or more frailty indicators category were compared to beneficiaries in each of the three lowest risk categories and when beneficiaries with ≥3 major chronic conditions were compared to beneficiaries in each of the three lowest risk categories.
†Result of test for trend among risk categories was statistically significant from zero ($p < .001$).
‡Total spending calculated as the sum of four spending subcategories (hospital costs, post-acute care costs, physician services costs, and all other costs), each winsorized at the 99th percentile.
§Adjusted for geographic differences at the county level.
¶Winsorized at the 99th percentile.

Table 2: Beneficiary Characteristics by Practice Size and Ownership*

	1–2 Physicians	*3–9 Physicians*	*10–19 Physicians*	*20–49 Physicians*	*50–99 Physicians*	*100+ Physicians*	*MD-Owned*	*Hospital-Owned*	*FQHC/Other CHC*
Practices, no. (%)	446 (42.9)	325 (31.3)	80 (7.7)	67 (6.4)	51 (4.9)	71 (6.8)	701 (67.4)	232 (22.3)	107 (10.3)
Beneficiaries, no. (%)	39,259 (4.5)	75,964 (8.7)	38,273 (4.4)	69,576 (8)	105,812 (12.2)	539,329 (62.1)	389,366 (44.9)	450,174 (51.8)	28,673 (4.3)
Age, mean (SD)	76.5 (2.4)	76 (2.0)‡	75.9 (1.8)	75.7 (1.9)	75.6 (1.6)	76.1 (1.0)	76.3 (2.2)§	76.2 (1.6)**	74.8 (2.3)¶,**
Female, no. (%)†	24,088 (61.4)	46,399 (61.1)	23,759 (62.1)	41,900 (60.2)‡	63,755 (60.3)‡	319,142 (59.2)‡	233,808 (60.1)¶	268,102 (59.6)§	17,133 (59.8)
Dual-eligible. no. (%)†	4,644 (11.8)	6,845 (9.0)‡	5,092 (13.3)‡	8.979 (12.9)‡	10,629 (10.1)‡	56,347 (10.5)‡	44762 (11.5)§	37,007 (8.2)§,**	10,767 (37.6)¶,**
Disabled, no. (%)†	2,984 (7.6)	5,182 (6.8)‡	3,434 (9.0)‡	4,906 (7.1)‡	7,151 (6.8)‡	34,960 (6.5)‡	26,374 (6.8)§,¶	28,621 (6.4)§,**	3,622 (12.6)¶,**
Two or more frailty indicators, no. (%)	2,739 (7)	5,140 (6.8)	2,558 (6.7)	4,426 (6.4)‡	7,111 (6.7)	38,582 (7.2)	27,379 (7.0)§	31,366 (7.0)**	1,811 (6.3)¶,**
Three or more major chronic cond., no. (%)	4,439 (11.3)	7,359 (9.7)‡	4,384 (11.5)	7,031 (10.1)‡	10,935 (10.3)‡	57,436 (10.7)‡	41,254 (10.6)§,¶	47,076 (10.5)§,**	3,254 (11.4)¶,**
One or two major chronic cond., no. (%)	16,226 (41.3)	29,884 (39.3)‡	15,335 (40.1)‡	28,039 (40.3)	43,020 (40.7)	218,650 (40.5)‡	159,058 (40.9)§,¶	180,950 (40.2)§,**	11,146 (38.9)¶,**

continued

Table 2. *Continued*

	1–2 Physicians	*3–9 Physicians*	*10–19 Physicians*	*20–49 Physicians*	*50–99 Physicians*	*100+ Physicians*	*MD-Owned*	*Hospital-Owned*	*FQHC/Other CHC*
No major; at least one minor chronic cond., no. (%)	14,502 (36.9)	30,759 (40.5)‡	14,632 (38.2)‡	27,519 (39.6)‡	40,818 (38.6)‡	204,361 (37.9)‡	147,886 (38.0)§	173,697 (38.6)	11,008 (38.4)**
No major or minor chronic cond., no. (%)	1,353 (3.5)	2,822 (3.7)	1.364 (3.6)	2,561 (3.7)	3,928 (3.7)	20,300 (3.8)‡	13,789 (3.5)§,¶	17,085 (3.8)§,**	1,454 (5.1)¶,**
Practice % revenue from Medicaid, mean (SD)	8.7 (11.7)	11.8 (15.0)‡	19.9 (18.9)‡	18.2 (17.5)‡	15.8 (13.9)‡	9.2 (8.3)	8.1 (11.2)§,¶	11.6 (10.9)§,**	33.4 (18.2)¶,**

*For each row, we used pairwise statistical tests to compare each practice size category to each other and, separately, each ownership category to each other and applied a Bonferroni correction for multiple testing. Here, we present results only from comparisons of each practice size category to 1–2 physicians as well as all ownership categories to each other.
†Result of test for trend among size categories was statistically significant from zero ($p < .05$).
‡Result was statistically different from zero ($p < .05$) when compared to 1- to 2-physician groups.
§Result was statistically different from zero ($p < .05$) when compared to FQHC/Other CHC groups.
¶Result was statistically different from zero ($p < .05$) when compared to hospital-owned groups.
**Result was statistically different from zero ($p < .05$) when compared to physician-owned groups.

the percentage of the practice's revenue from Medicaid as a continuous variable.

Statistical Analyses

We conducted analyses using 2012 Medicare data, after using 2011 data to place beneficiaries into need categories. In unadjusted analyses, we compared beneficiary characteristics as well as outcomes and use of HIT, QI, and CMP processes by practice size and ownership. We also conducted multivariable analyses for each outcome, using the beneficiary as the unit of analysis. We conducted separate analyses for Medicare beneficiaries as a whole and for each of the five need categories. We used negative binomial regression for analyses in which ACSAs or readmissions were the outcome, and linear regression for analyses in which spending was the outcome. We accounted for clustering of beneficiaries within practices using generalized estimating equation procedures.

We conducted two sensitivity analyses: (1) For spending, we conducted a multivariable analysis that included the covariate mean annual spending per beneficiary for the hospital referral region (HRR) in which the beneficiary lived (Table S2a–S2g); and (2) for all outcomes, we conducted a multivariable analysis that included only beneficiary characteristics and practice size, ownership, percent primary care physicians, and percent Medicaid revenue, without the HIT, CMP, and QI indices (Table S3a–S3h). Results of these analyses were consistent with our main analyses.

RESULTS

Beneficiary Characteristics

Of the 868,213 beneficiaries attributed to practices, 7.0 percent had two or more frailty indicators in 2011 and 10.5 percent had three or more major chronic conditions (Table 1). Beneficiaries with ≥2 frailty indicators or ≥3 major chronic conditions were significantly more likely to be dual-eligible or disabled and had significantly higher spending and rates of ACSAs and readmissions. For example, beneficiaries with ≥2 frailty indicators had total spending of $14,907 compared to $6,362 for beneficiaries with one or two major chronic conditions; ACSA rates were 11.7 per hundred beneficiaries per year compared to 3.3; and readmission rates were 5.9 compared to 1.5.

Physician Practice Characteristics and Beneficiary Characteristics

The smaller practices (1–2 and 3–9 physicians) comprised 74.2 percent of all practices, although 62.1 percent of beneficiaries were attributed to 100+ practices (Table 2). Sixty-seven percent of practices were physician-owned, 22.3 percent hospital-owned, and 10.3 percent were community health centers (including 72 federally qualified community health centers and 35 community health centers). Practices with 1–2 physicians cared for significantly higher percentages of dual-eligible and disabled beneficiaries compared to practices with 50–99 and 100+ physicians. Physician-owned practices cared for a higher percentage of dual eligibles (11.5–8.2 percent) than hospital-owned practices; community health centers (CHCs) cared for much higher percentages of dual-eligible (37.6 percent) and disabled beneficiaries.

Physician Practice Characteristics, Processes of Care, and Outcomes

In unadjusted analyses, there was a statistically significant trend toward higher spending as practice size increased, but no significant difference in ACSAs or readmissions (Table 3). Scores on the CMP, QI, and HIT indices increased with practice size, as did participation in pay for performance and public reporting initiatives. Community health centers had higher CMP and QI indices than hospital-owned practices; physician-owned practices had the lowest scores. Community health centers and hospital-owned practices had the highest HIT scores.

Multivariable Analysis of Medical Practice Characteristics, Spending, and Quality

Spending. The largest practice size categories were associated with much higher total Medicare spending, particularly for the highest need beneficiaries (Table 4). For example, compared to practices with 1–2 physicians, mean annual spending across the highest need beneficiaries was $1,870 per beneficiary per year higher for the largest practice category (12.5 percent higher than mean spending for beneficiaries in that category) and $1,824 higher for the next largest. Larger groups had higher spending on physician services and on "other services" across most beneficiary need categories, including the highest need beneficiaries (Table S4a–S4d).

There was no significant difference in total spending between physician-owned and hospital-owned practices across all beneficiaries or for any beneficiary need category (Table 4). Community health centers had $659 lower total

Table 3: Physician Practice Care Improvement Processes and Outcomes by Size and Ownership*

	1–2 Physicians	*3–9 Physicians*	*10–19 Physicians*	*20–49 Physicians*	*50–99 Physicians*	*100+ Physicians*	*MD-Owned*	*Hospital-Owned*	*FQHC/Other CHC*
No. practices (%)	446 (42.9)	325 (31.3)	80 (7.7)	67 (6.4)	51 (4.9)	71 (6.8)	701 (67.4)	232 (22.3)	107 (10.3)
Median size	1	4	12	25	62	225	2	9	12
Percent primary care, mean (SD)†	98.9 (7.4)	92.7 (15.6)‡	67.6 (24.7)‡	78 (21.8)	67.9 (24.4)‡	45.6 (18.8)‡	91.8 (18.6)§,¶	81.6 (25.3)**	78.7 (24.0)**
CMP index, mean (SD)	5 (4.7)	6.3 (5.1)‡	6.9 (5.2)‡	7.1 (5.5)	7.5 (4.5)‡	8.3 (5.5)‡	5.4 (4.8)§,¶	6.8 (5.2)§,**	8.5 (26.2)¶,**
QI index, mean (SD)	0.5 (1)	0.9 (1.2)‡	1.4 (1.4)	1.4 (1.4)‡	2.1 (1.5)‡	2.6 (1.4)‡	0.6 (1.1)§,¶	1.6 (1.5)**	1.9 (1.3)**
HIT index, mean (SD)	7.4 (4.3)	9.6 (3.6)‡	10.2 (3.3)	10.2 (2.8)‡	10.4 (2.7)‡	11.4 (1.8)‡	8.2 (4.2)§,¶	10.7 (2.8)**	9.8 (3.2)**
Any pay for performance, no. (%)†	265 (59.4)	217 (66.8)	48 (60.0)	49 (73.1)	38 (74.5)	64 (90.1)‡	452 (64.5)	159 (68.5)	70 (65.4)
Any public reporting, no. (%)†	233 (52.2)	219 (67.4)‡	56 (70.0)	44 (65.7)	35 (68.6)	54 (76.1)‡	403 (57.5)¶	161 (69.4)**	77 (72.0)
Total costs, mean (SD)†,††	5,500 (3,194)	5,411 (2,794)	5,633 (1,955)	5,606 (1,752)	5,877 (1,964)	6,622 (1,682)‡	5,520 (2,982)	5,750 (2,207)	5,650 (2,570)
ACSAs/ hundred beneficiaries, mean (SD)	3.9 (5.3)	3.6 (3.3)	4.4 (2.8)	3.5 (1.5)	3.4 (1.7)	3.7 (1.2)	3.7 (4.4)	3.9 (3.4)	3.9 (3.3)

continued

Table 3. *Continued*

	1–2 Physicians	*3–9 Physicians*	*10–19 Physicians*	*20–49 Physicians*	*50–99 Physicians*	*100+ Physicians*	*MD-Owned*	*Hospital-Owned*	*FQHC/Other CHC*
Readmissions/ hundred beneficiaries, mean (SD)	1.5 (2.8)	1.4 (2.0)	1.6 (1.4)	1.4 (1.2)	1.5 (0.9)	1.9 (1.0)	1.5 (2.2)	1.7 (2.5)	1.3 (2)

*For each column, we used pairwise statistical tests to compare each practice size category to each other and, separately, each ownership category to each other and applied a Bonferroni correction for multiple testing. Here, we present results only from comparisons of each practice size category to 1–2 physicians as well as all ownership categories to each other.
†Result of test for trend among size categories was statistically significant from zero ($p < .05$).
‡Result was statistically different from zero ($p < .05$) when compared to 1- to 2-physician groups.
§Result was statistically different from zero ($p < .05$) when compared to FQHC/Other CHC groups.
¶Result was statistically different from zero ($p < .05$) when compared to hospital-owned groups.
**Result was statistically different from zero ($p < .05$) when compared to physician-owned groups.
††Total costs calculated as the sum of four cost subcategories (hospital costs, post-acute care costs, physician services costs, and all other costs), each winsorized at the 99th percentile. Adjusted for geographic differences at the county level.

Table 4: Multivariable Analysis of Practice Characteristics and Medicare Spending*,†

			Fewer Than Two Frailty Indicators			
	Total Beneficiary Sample (N = 868,213)	*Two or More Frailty Indicators (N = 60,556)*	*Three or More Major Chronic Conditions (N = 91,584)*	*One or Two Major Chronic Conditions (N = 351,154)*	*No Major Chronic Conditions, At Least One Minor Chronic Condition (N = 332,591)*	*No Major or Minor Chronic Conditions (N = 32,328)*
Estimated regression coefficient (95% confidence interval); *p*-value						
3–9 physicians‡	123 (−197, 442), $p = .45$	848 (−269, 1966), $p = .14$	503 (−299, 1305), $p = .22$	61 (−280, 403), $p = .73$	−194 (−418, 30), $p = .09$	183 (−539, 906), $p = .62$
10–19 physicians‡	92 (−336, 521), $p = .67$	1485 (−50, 3019), $p = .06$	181 (−869, 1231), $p = .74$	119 (−304, 543), $p = .58$	−268 (−560, 25), $p = .07$	19 (−840, 877), $p = .97$
20–49 physicians‡	−55 (−545, 435), $p = .83$	345 (−4147, 1837), $p = .65$	−128 (−1115, 859), $p = .80$	−35 (−547, 477), $p = .89$	−148 (−517, 220), $p = .43$	−615 (−1420, 190), $p = .13$
50–99 physicians‡	441 (−53, 935), $p = .08$	1824 (321, 3326), $p = .02$	1073 (77, 2069), $p = .03$	431 (−94, 956), $p = .11$	−25 (−380, 331), $p = .89$	−8 (−777, 760), $p = .98$
100+ physicians‡	558 (−8, 1125), $p = .05$	1870 (231, 3509), $p = .03$	748 (−280, 1775), $p = .15$	563 (−53, 1179), $p = .07$	170 (−277, 617), $p = .46$	103 (−738, 944), $p = .81$
Physician-owned§	−25 (−434, 384), 0.90	29 (−878, 936), 0.95	−44 (−649, 562), $p = .89$	−24 (−439, 392), $p = .91$	0 (−358, 358), $p = 1.00$	−60 (−540, 420), $p = .81$
FQHC/CHC§	−659 (−1382, 64), $p = .07$	−650 (−2232, 931), $p = .42$	−773 (−2041, 495), $p = .23$	−700 (−1438, 38), $p = .06$	−527 (−1083, 29), $p = .06$	−1086 (−2053, −118), $p = .03$
Practice % primary care physicians	−17 (−25, −8), $p < .001$	−18 (−37, 0), $p = .05$	−23 (−35, −10), $p < .001$	−17 (−26, −8), $p < .001$	−15 (−21, −8), $p < .001$	−17 (−27, −6), $p = .001$
Practice has any pay for performance	−374 (−852, 103), $p = .12$	−1090 (−2303, 123), $p = .08$	−577 (−1325, 171), $p = .13$	−369 (−822, 85), $p = .11$	−236 (−563, 90), $p = .16$	−520 (−1062, 22), $p = .06$

continued

Table 4. *Continued*

			Fewer Than Two Frailty Indicators			
	Total Beneficiary Sample (N = 868,213)	*Two or More Frailty Indicators (N = 60,556)*	*Three or More Major Chronic Conditions (N = 91,584)*	*One or Two Major Chronic Conditions (N = 351,154)*	*No Major Chronic Conditions, At Least One Minor Chronic Condition (N = 332,591)*	*No Major or Minor Chronic Conditions (N = 32,328)*
Practice has any public reporting	−30 (−496, 437), $p = .90$	47 (−1028, 1122), $p = .93$	0 (−734, 734), $p = 1.00$	−57 (−524, 409), $p = .81$	−13 (−366, 340), $p = .94$	−298 (−836, 241), $p = .28$
Practice % revenue from Medicaid	38 (17, 58), $p < .001$	52 (7, 97), $p = .02$	54 (21, 88), $p = .002$	44 (22, 66), $p < .001$	26 (10, 42), $p = .001$	43 (18, 68), $p = .001$
QI index[¶]	104 (−297, 505), $p = .61$	−637 (−1716, 442), $p = .25$	139 (−496, 773), $p = .67$	172 (−261, 605), $p = .44$	202 (−151, 556), $p = .26$	168 (−289, 625), $p = .47$
HIT index[¶]	4 (−391, 400), $p = .98$	−525 (−1401, 350), $p = .24$	51 (−550, 653), $p = .87$	84 (−329, 496), $p = .69$	7 (−333, 348), $p = .97$	−188 (−638, 261), $p = .41$
CMP index[¶]	19 (−416, 453), $p = .93$	713 (−267, 1692), $p = .15$	−143 (−761, 474), $p = .65$	−41 (−503, 422), $p = .86$	−30 (−428, 369), $p = .88$	−90 (−557, 377), $p = .71$

*Each column reports the coefficients from a negative binomial regression performed for a specific stratum of beneficiaries—that is, for all beneficiaries (column 1) and for each of the five categories of beneficiary based on need. Total costs calculated as the sum of four cost subcategories (hospital costs, post-acute care costs, physician services costs, and all other costs), each winsorized at the 99th percentile.

†Adjusted for beneficiary age, sex, race, dual-eligible status, disability as original reason for entitlement, number of major chronic conditions, and number of minor chronic conditions. Coefficients for these variables are shown in Table S6.

‡Reference group is "1–2 physicians."

§Reference group is "hospital-owned."

¶Comparing those scoring in top quartile to all others.

spending ($p = .07$) for all beneficiaries compared to hospital-owned practices. Physician-owned practices had lower total spending on hospital services and higher spending on physician services and other services compared to hospital-owned practices; CHCs had lower spending on physician services. There was no clear pattern of spending differences by practice size/ownership category (Table S8).

Practices with a higher percentage of primary care physicians had lower total spending (e.g., $170 less spending for all beneficiaries for each 10 percent increase in the percentage of primary care physicians). There were no significant differences in total spending or spending in any beneficiary need category based on practice exposure to pay for performance or public reporting, or to increased practice use of QI, CMPs, or HIT.

Readmissions. Practices with one to two physicians had lower readmission rates than practices of other sizes; the differences were statistically significant for the highest need patients (Table 5). For example, the readmission rate for practices with 100+ physicians was 1.64 times that for practices with 1–2 physicians for high-need beneficiaries. The CHC rate of readmissions for all beneficiaries was 0.79 compared to hospital-owned practices ($p = .10$). Practice ownership was not associated with readmissions, and there was no consistent association between the size/ownership variable and readmissions (Table S9). There was no significant relationship between readmissions and public reporting or pay for performance incentives, or use of HIT, care management, or QI processes.

Ambulatory Care–Sensitive Admissions. There were no statistically significant relationships between practice characteristics and ACSAs (Tables S5 and S10).

DISCUSSION

In this very large national survey of physician practices, we found that larger practices had much higher total spending on care, particularly for the highest need beneficiaries. For example, when the highest need beneficiaries were patients of practices with 100+ physicians, total spending was 12.5 percent higher ($1,870 per beneficiary per year higher) than in practices with 1–2 physicians. Total spending was $1,824 per beneficiary per year for the highest need beneficiaries cared for by practices with 50–99 physicians. This higher

Table 5: Multivariable Analysis of Practice Characteristics and 30-Day Unplanned Hospital Readmissions by Beneficiary Risk Category*,†

			Fewer Than Two Frailty Indicators			
	Total Beneficiary Sample (n = 868,213)	*Two or More Frailty Indicators (n = 60,556)*	*Three or More Major Chronic Conditions (n = 91,584)*	*One or Two Major Chronic Conditions (n = 351,154)*	*No Major Chronic Conditions, At Least One Minor Chronic Condition (n = 332,591)*	*No Major or Minor Chronic Conditions (n = 32,328)*
Rate ratio (95% confidence interval), *p*-value						
3–9 physicians‡	1.17 (0.98, 1.39), $p = .08$	1.46 (1.06, 2.00), $p = .02$	1.24 (0.97, 1.59), $p = .09$	1.11 (0.86, 1.42), $p = .43$	0.98 (0.70, 1.37), $p = .90$	1.29 (0.48, 3.50), $p = .61$
10–19 physicians‡	1.33 (1.07, 1.66), $p = .01$	1.93 (1.28, 2.91), $p = .002$	1.27 (0.93, 1.72), $p = .13$	1.38 (1.07, 1.79), $p = .01$	0.86 (0.59, 1.26), $p = .44$	1.84 (0.65, 5.21), $p = .25$
20–49 physicians‡	1.08 (0.88, 1.32), $p = .45$	1.39 (0.96, 2.02), $p = .08$	1.11 (0.85, 1.45), $p = .43$	1.08 (0.83, 1.42), $p = .56$	0.90 (0.62, 1.30), $p = .57$	0.62 (0.21, 1.87), $p = .40$
50–99 physicians‡	1.14 (0.94, 1.39), $p = .18$	1.71 (1.21, 2.40), $p = .002$	1.16 (0.89, 1.50), $p = .27$	1.11 (0.84, 1.46), $p = .46$	0.83 (0.58, 1.17), $p = .28$	0.83 (0.30, 2.33), $p = .73$
100+ physicians‡	1.18 (0.97, 1.44), $p = .10$	1.64 (1.15, 2.35), $p = .01$	1.10 (0.85, 1.42), $p = .46$	1.22 (0.94, 1.59), $p = .13$	0.88 (0.62, 1.25), $p = .49$	0.96 (0.31, 2.92), $p = .94$
Physician-owned§	0.99 (0.88, 1.11), $p = .89$	1.01 (0.88, 1.16), $p = .91$	1.04 (0.90, 1.20), $p = .58$	0.95 (0.84, 1.08), $p = .47$	1.00 (0.84, 1.19), $p = .92$	1.10 (0.74, 1.62), $p = .64$
FQHC/CHC§	0.79 (0.59, 1.05), $p = .10$	0.80 (0.50, 1.26), $p = .33$	0.83 (0.63, 1.11), $p = .21$	0.77 (0.54, 1.10), $p = .15$	0.83 (0.52, 1.31), $p = .42$	0.42 (0.16, 1.11), $p = .08$
Practice % primary care physicians	1.00 (1.00, 1.00), $p = .03$	1.00 (1.00, 1.00), $p = .53$	1.00 (1.00, 1.00), $p = .41$	1.00 (0.99, 1.00), $p = .10$	0.99 (0.99, 1.00), $p < .001$	1.00 (0.99, 1.01), $p = .61$

continued

Table 5. *Continued*

	Total Beneficiary Sample (n = 868,213)	*Two or More Frailty Indicators (n = 60,556)*	*Fewer Than Two Frailty Indicators*			
			Three or More Major Chronic Conditions (n = 91,584)	*One or Two Major Chronic Conditions (n = 351,154)*	*No Major Chronic Conditions, At Least One Minor Chronic Condition (n = 332,591)*	*No Major or Minor Chronic Conditions (n = 32,328)*
Practice has any pay for performance	1.02 (0.89, 1.16), $p = .92$	1.10 (0.91, 1.33), $p = .33$	1.01 (0.87, 1.17), $p = .91$	0.96 (0.84, 1.09), $p = .52$	1.10 (0.90, 1.35), $p = .36$	0.84 (0.48, 1.47), $p = .54$
Practice has any public reporting	1.01 (0.89,1.13), $p = .80$	0.97 (0.82, 1.14), $p = .70$	1.01 (0.92, 1.24), $p = .36$	0.98 (0.86, 1.12), $p = .79$	0.98 (0.81, 1.19), $p = .86$	1.05 (0.68, 1.61), $p = .83$
Practice % revenue from Medicaid	1.01 (1.00, 1.01), $p = .04$	1.01 (1.00, 1.01), $p = .29$	1.00 (0.99, 1.01), $p = .91$	1.01 (1.00, 1.02), $p = .01$	1.01 (1.00, 1.02), $p = .04$	1.01 (0.99, 1.03), $p = .38$
QI index score¶	1.05 (0.94, 1.18), $p = .38$	0.92 (0.78, 1.08), $p = .30$	1.10 (0.98, 1.25), $p = .12$	1.05 (0.92, 1.20), $p = .49$	1.17 (0.97, 1.43), $p = .10$	1.07 (0.71, 1.63), $p = .74$
HIT index score¶	1.00 (0.89, 1.13), $p = .93$	0.98 (0.84, 1.15), $p = .84$	1.01 (0.88, 1.15), $p = .92$	1.00 (0.88, 1.13), $p = .99$	1.05 (0.88, 1.25), $p = .58$	0.93 (0.65, 1.34), $p = .71$
CMP index score¶	1.01 (0.89, 1.15), $p = .90$	1.05 (0.88, 1.26), $p = .58$	0.91 (0.79, 1.06), $p = .23$	1.06 (0.92, 1.23), $p = .44$	0.95 (0.78, 1.14), $p = .57$	1.18 (0.79, 1.78), $p = .42$

*Each column reports the coefficients from a negative binomial regression performed for a specific stratum of beneficiaries—that is, for all beneficiaries (column 1) and for each of the five categories of beneficiary based on need.
†Adjusted for beneficiary age, sex, race, dual-eligible status, disability as original reason for entitlement, number of major chronic conditions, and number of minor chronic conditions. Coefficients for these variables are shown in Table S7.
‡Reference group is "1–2 physicians."
§Reference group is "hospital-owned."
¶Comparing those scoring in top quartile to all others.

spending was not associated with higher quality: Larger practices had higher rates of readmissions and slightly higher, although not statistically significant, rates of ACSAs.

There have been few studies assessing the relationship between practice size and ownership and outcomes. Our finding that larger practices have higher spending without higher quality is consistent with four prior studies (Baker et al. 2014b; Casalino et al. 2014; Kralewski et al. 2015; Cross et al. 2017); of the two studies that differ (Weeks et al. 2010; McWilliams et al. 2013), one focused on large practices thought likely to be high-performing rather than a random sample of large practices (Weeks et al. 2010).

Hospital-owned practices had total spending and quality comparable to physician-owned practices. These results differ from prior studies, which generally find higher total spending and comparable quality in hospital-owned practices (Baker, Bundorf, and Kessler 2014a; Casalino et al. 2014; Neprash et al. 2015; McWilliams et al. 2016; Mafi et al. 2017; Scott et al. 2017). The reasons for this difference are not clear; the other studies relied on measures of hospital ownership that almost certainly failed to identify some physicians working for hospitals, whereas our study used practices' direct report of whether they were employed. CHCs had lower spending and readmission rates than hospital-owned practices, although these did not quite reach statistical significance; the most comparable study carried out to date had a similar finding (Mukamel et al. 2016); other studies have also found favorable performance by CHCs (Gurewich et al. 2011; Goldman et al. 2012).

Our finding of no significant difference in ACSAs by practice size or ownership differs from an earlier study, in which we found that smaller practices and physician-owned practices had lower rates of ACSAs than larger practices and hospital-owned practices (Casalino et al. 2014). We are unable to explain this difference, but note that the earlier study included only practices with 1–19 physicians.

Surprisingly, practices that used more QI, HIT, and CMP processes did not have lower spending or higher quality, even for the highest need beneficiaries, who might benefit most from them. This may be due to differences in practices' implementation of the processes that our measures could not detect, which would bias our results toward the null. There is a trade-off between depth—relatively intensive measurement of these processes in a relatively small sample of (usually volunteer) practices, sometimes as part of a randomized controlled trial (RCT)—and breadth, in which (as in our study) broader measurements are carried out in a larger sample of practices in an attempt to increase generalizability beyond the RCT setting. The literature on these types

of processes—and on medical homes, which use these processes—is mixed, although it is generally believed that they should improve outcomes (Friedberg et al. 2015; Lammers, McLaughlin, and Barna 2016; Sinaiko et al. 2017; Unruh et al. 2017).

This study is unique because it combines multiple qualities: It is very large, included practices that were randomly selected and not volunteers, linked outcomes to practices' characteristics and use of processes to improve care, and measured outcomes for high-need as well as all beneficiaries. The study findings were robust across the sensitivity analyses we conducted. However, limitations should be noted when interpreting the results. First, as an observational, cross-sectional study, our results show associations, not causality. RCTs are better able to demonstrate causality, but are less generalizable, and in any case not feasible as a means of studying the impact of practice size or ownership on outcomes of care, as practices cannot be randomized to size or ownership. Second, findings for other types of practice—for example, single-specialty practices or multispecialty practices that do not include primary care physicians—might be different. Third, our sample of practices, while very large and national in scope, is not a strict national random sample. Fourth, our response rate was 50 percent; a higher rate would be desirable, but survey response rates in general have been declining, with physician surveys often at 50 percent or lower (Cummings, Savitz, and Konrad 2001; Klabunde, Willis, and Casalino 2013). Fifth, our analyses were limited to three outcomes: spending, readmissions, and ACSAs. Sixth, our results are based on 2012 data; it is possible that practices' performance has changed since then.

The main findings of this study, although not conclusive in themselves, are not consistent with the widely held belief that larger organizations provide better care (Tollen 2008). It is possible that this belief is based on the outstanding reputations of organizations such as Kaiser Permanente, Geisinger, and the Mayo Clinic, but that the average large practice performs quite differently. It is possible that beneficiaries of larger practices in our study had higher spending and readmission rates because they are sicker in ways that we could not measure. Larger practices in our study have a higher percentage of specialist physicians; it is possible that specialists attract patients who are complex in ways that we were unable to measure. Although we cannot fully discount this possibility, we note that practices with 1–2 physicians in the study cared for higher percentages of dual-eligible and disabled patients and for comparable percentages of high-need patients and that we used standard risk adjustment as well as analyzing performance by category of patient need. We also controlled for the percentage of primary care physicians in each practice, so our

results compare the performance of practices by size, holding the percentage of primary care physicians (and thus the percentage of specialists) constant. It is also possible that large practices and hospital-owned practices, which are likely to have more financial resources and potential economies of scale than smaller practices and independent practices (Rittenhouse et al. 2011; Wiley et al. 2015), are creating capabilities to improve care that will, eventually, result in better outcomes. We found that larger and hospital-owned practices did use more CMP, QI, and HIT processes.

Alternatively, smaller independent practices may support close relationships of mutual knowledge and trust among physicians, staff, and patients that may be associated with better outcomes (Casalino et al. 2014; Lanham et al. 2016; Stange 2016). If that is true, then it might be useful to try to combine the advantages of small size with a large organization structure that provides both organized processes to improve care (CMPs, QI, HIT) and leaders able to devote substantial time to improving the care the organization provides (Mostashari 2016). This structure might be ownership by a large medical group or hospital, or it might be a facilitating organization that provides these resources to practices that remain independent (Mostashari 2016).

Larger practices and hospital-owned practices can gain an advantage over smaller practices even if their performance is not better, because they can negotiate much higher payment rates from health insurers (Berenson et al. 2012). In addition, hospital-owned practices receive income not available to physician-owned practices from facility fees and the 340B drug purchasing discount program (Conti and Bach 2013; Reschovsky and Rich 2015). Given the rapid movement toward both horizontal and vertical consolidation in U.S. health care, policy makers may want to consider the potential effects of specific policies on consolidation, pending further research to learn which types of practice provide better care (Cutler 2014).

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References

Agency for Healthcare Quality and Research. 2016. "Prevention Quality Indicators Technical Specifications Updates – Version 6.0" [accessed on March 10, 2016]. Available at https://qualityindicators.ahrq.gov/Modules/PQI_TechSpec_ICD09_v60.aspx

American Association for Public Opinion Research. 2011. "Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys." Deerfield, Illinois.

Baker, L. C., M. K. Bundorf, and D. P. Kessler. 2014a. "Vertical Integration: Hospital Ownership of Physician Practices Is Associated with Higher Prices and Spending." *Health Affairs (Millwood)* 33 (5): 756–63.

Baker, L. C., M. K. Bundorf, A. B. Royalty, and Z. Levin. 2014b. "Physician Practice Competition and Prices Paid by Private Insurers for Office Visits." *Journal of the American Medical Association* 312 (16): 1653–62.

Berenson, R. A., P. B. Ginsburg, J. B. Christianson, and T. Yee. 2012. "The Growing Power of Some Providers to Win Steep Payment Increases from Insurers Suggests Policy Remedies May Be Needed." *Health Affairs (Millwood)* 31 (5): 973–81.

Blumenthal, D., B. Chernof, T. Fulmer, J. Lumpkin, and J. Selberg. 2016. "Caring for High-Need, High-Cost Patients — An Urgent Priority." *New England Journal of Medicine* 375: 909–11.

Burns, L. R., J. C. Goldsmith, and A. Sen. 2013. "Horizontal and Vertical Integration of Physicians: A Tale of Two Tails." In *Annual Review of Health Care Management: Revisiting the Evolution of Health Systems Organization*, edited by L. Friedman, J.

Goes, and G. T. Savage, pp. 39–117. Bingley, UK: Emerald Group Publishing Limited.

Casalino, L. P. 2006. "Which Type of Medical Group Provides Higher-Quality Care?" *Annals of Internal Medicine* 145 (11): 860–1.

———. 2017. "The Medicare Access and CHIP Reauthorization Act and the Corporate Transformation of American Medicine." *Health Affairs (Millwood)* 36 (5): 865–9.

Casalino, L. P., M. F. Pesko, A. M. Ryan, J. L. Mendelsohn, K. R. Copeland, P. P. Ramsay, X. Sun, D. R. Rittenhouse, and S. M. Shortell. 2014. "Small Primary Care Physician Practices Have Low Rates of Preventable Hospital Admissions." *Health Affairs (Millwood)* 33 (9): 1680–8.

Centers for Medicare and Medicaid Services. 2016a. "Planned Readmission Algorithm" [accessed on March 10, 2016]. Available at https://www.cms.gov/medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html

Centers for Medicare and Medicaid Services. 2016b. "Geographic Variation Public Use File" [accessed on March 10, 2016]. Available at https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Geographic-Variation/GV_PUF.html

Conti, R. M., and P. B. Bach. 2013. "Cost Consequences of the 340B Drug Discount Program." *Journal of the American Medical Association* 309 (19): 1995–6.

Cross, D. A., G. R. Cohen, C. H. Lemak, and J. Adler-Milstein. 2017. "Outcomes for High-Needs Patients: Practices with a Higher Proportion of These Patients Have an Edge." *Health Affairs (Millwood)* 36 (3): 476–84.

Crosson, F. J. 2005. "The Delivery System Matters." *Health Affairs (Millwood)* 24 (6): 1543–8.

Cummings, S. M., L. A. Savitz, and T. R. Konrad. 2001. "Reported Response Rates to Mailed Physician Questionnaires." *Health Services Research* 35 (6): 1347–55.

Cutler, D. M. 2014. "Who Benefits from Health System Change?" *Journal of the American Medical Association* 312 (16): 1639–41.

Friedberg, M. W., M. B. Rosenthal, R. M. Werner, K. G. Volpp, and E. C. Schneider. 2015. "Effects of a Medical Home and Shared Savings Intervention on Quality and Utilization of Care." *Journal of the American Medical Association Internal Medicine* 175 (8): 1362–8.

Gaynor, M., F. Mostashari, and P. B. Ginsburg. 2017. "Making Health Care Markets Work: Competition Policy for Health Care." *Journal of the American Medical Association* 317(13): 1313–14.

Goldman, L. E., P. W. Chu, H. Tran, M. J. Romano, and R. S. Stafford. 2012. "Federally Qualified Health Centers and Private Practice Performance on Ambulatory Care Measures." *American Journal of Preventive Medicine* 43 (2): 142–9.

Goldsmith, J. C., L. R. Burns, A. Sen, and T. Goldsmith. 2015. "Integrated Delivery Networks: In Search of Benefits and Market Effects." Washington, DC.

Gurewich, D., K. R. Tyo, J. Zhu, and D. S. Shepard. 2011. "Comparative Performance of Community Health Centers and Other Usual Sources of Primary Care." *Journal of Ambulatory Care Management* 34 (4): 380–90.

Joynt, K. E., J. F. Figueroa, N. Beaulieu, R. C. Wild, E. J. Orav, and A. K. Jha. 2016. "Segmenting High-Cost Medicare Patients into Potentially Actionable Cohorts." *Healthcare* 5 (1–2): 62–7.

Klabunde, C. N., G. B. Willis, and L. P. Casalino. 2013. "Facilitators and Barriers to Survey Participation by Physicians: A Call to Action for Researchers." *Evaluation and the Health Professions* 36 (3): 279–95.

Kralewski, J., B. Dowd, D. Knutson, J. Tong, and M. Savage. 2015. "The Relationships of Physician Practice Characteristics to Quality of Care and Costs." *Health Services Research* 50 (3): 710–29.

Lammers, E. J., C. G. McLaughlin, and M. Barna. 2016. "Physician EHR Adoption and Potentially Preventable Hospital Admissions among Medicare Beneficiaries: Panel Data Evidence, 2010–2013." *Health Services Research* 51 (6): 2056–75.

Lanham, H. J., R. F. Palmer, L. K. Leykum, R. R. McDaniel Jr, P. A. Nutting, K. C. Stange, B. F. Crabtree, W. L. Miller, and C. R. Jaen. 2016. "Trust and Reflection in Primary Care Practice Redesign." *Health Services Research* 51 (4): 1489–514.

Long, P., M. Abrams, A. Milstein, G. Anderson, K. L. Apton, M. L. Dahlberg, and D. Whicher. 2017. *Effective Care for High-Need Patients: Opportunities for Improving Outcomes, Value, and Health.* Washington, DC: National Academy of Medicine.

Mafi, J. N., C. C. Wee, R. B. Davis, and B. E. Landon. 2017. "Association of Primary Care Practice Location and Ownership with the Provision of Low-Value Care in the United States." *Journal of the American Medical Association Internal Medicine* 117 (6): 838–45.

McWilliams, J., M. E. Chernew, A. M. Zaslavsky, P. Hamed, and B. E. Landon. 2013. "Delivery System Integration and Health Care Spending and Quality for Medicare Beneficiaries." *Journal of the American Medical Association Internal Medicine* 173 (15): 1447–56.

McWilliams, J. M., L. A. Hatfield, M. E. Chernew, B. E. Landon, and A. L. Schwartz. 2016. "Early Performance of Accountable Care Organizations in Medicare." *New England Journal of Medicine* 374 (24): 2357–66.

Mostashari, F. 2016. "The Paradox of Size: How Small, Independent Practices Can Thrive in Value-Based Care." *Annals of Family Medicine* 14 (1): 5–7.

Muhlestein, D. B., and N. J. Smith. 2016. "Physician Consolidation: Rapid Movement from Small to Large Group Practices, 2013–15." *Health Affairs (Millwood)* 35 (9): 1638–42.

Mukamel, D. B., L. M. White, R. S. Nocon, E. S. Huang, R. Sharma, L. Shi, and Q. Ngo-Metzger. 2016. "Comparing the Cost of Caring for Medicare Beneficiaries in Federally Funded Health Centers to Other Care Settings." *Health Services Research* 51 (2): 625–44.

Neprash, H. T., M. E. Chernew, A. L. Hicks, T. Gibson, and J. M. McWilliams. 2015. "Association of Financial Integration between Physicians and Hospitals with Commercial Health Care Prices." *Journal of the American Medical Association Internal Medicine* 175 (12): 1932–9.

O'Malley, A. S., A. M. Bond, and R. A. Berenson. 2011. "Rising Hospital Employment of Physicians: Better Quality, Higher Costs?" Washington, DC.

Pesko, M. F., A. M. Ryan, S. M. Shortell, K. R. Copeland, P. P. Ramsay, X. Sun, J. L. Mendelsohn, D. R. Rittenhouse, and L. P. Casalino. 2017. "Spending per Medicare Beneficiary Is Higher in Hospital-Owned Small- and Medium-Sized Physician Practices." *Health Services Research.* doi.org/10.1111/1475-6773.12765

Reschovsky, J. D., and E. Rich. 2015. "Hospital Acquisition of Physician Groups: On the Road to Value-Based or Higher-Priced Care?" *Journal of the American Medical Association Internal Medicine* 175 (12): 1939–41.

Rittenhouse, D. R., L. P. Casalino, S. M. Shortell, S. R. McClellan, R. R. Gillies, J. A. Alexander, and M. L. Drum. 2011. "Small and Medium-Size Physician Practices use few Patient-Centered Medical Home Processes." *Health Affairs (Millwood)* 30 (8): 1575–84.

Schneider, E. C., and C. J. Hall. 2017. "Improve Quality, Control Spending, Maintain Access - Can the Merit-Based Incentive Payment System Deliver?" *New England Journal of Medicine* 376 (8): 708–10.

Scott, K. W., E. J. Orav, D. M. Cutler, and A. K. Jha. 2017. "Changes in Hospital-Physician Affiliations in U.S. Hospitals and Their Effect on Quality of Care." *Annals of Internal Medicine* 166 (1): 1–8.

Sinaiko, A. D., M. B. Landrum, D. J. Meyers, S. Alidina, D. D. Maeng, M. W. Friedberg, L. M. Kern, A. M. Edwards, S. P. Flieger, P. R. Houck, P. Peele, R. J. Reid, K. McGraves-Lloyd, K. Finison, and M. B. Rosenthal. 2017. "Synthesis of Research on Patient-Centered Medical Homes Brings Systematic Differences into Relief." *Health Affairs (Millwood)* 36 (3): 500–8.

Stange, K. C. 2016. "In This Issue: Size Matters." *Annals of Family Medicine* 14 (1): 2–3.

Tollen, L. 2008. *Physician Organization in Relation to Quality and Efficiency of Care: A Synthesis of Recent Literature.* New York: Commonwealth Fund.

Unruh, M. A., H. Y. Jung, J. R. Vest, L. P. Casalino, and R. Kaushal. 2017. "Meaningful Use of Electronic Health Records by Outpatient Physicians and Readmissions of Medicare Fee-for-Service Beneficiaries." *Medical Care* 55 (5): 493–9.

Weeks, W. B., D. J. Gottlieb, D. J. Nyweide, J. M. Sutherland, J. Bynum, L. P. Casalino, R. R. Gillies, S. M. Shortell, and E. S. Fisher. 2010. "Higher Health Care Quality and Bigger Savings Found at Large Multispecialty Medical Groups." *Health Affairs* 29 (5): 991–7.

Wiley, J. A., D. R. Rittenhouse, S. M. Shortell, L. P. Casalino, P. P. Ramsay, S. Bibi, A. M. Ryan, K. R. Copeland, and J. A. Alexander. 2015. "Managing Chronic Illness: Physician Practices Increased the Use of Care Management and Medical Home Processes." *Health Affairs (Millwood)* 34 (1): 78–86.

SUPPORTING INFORMATION

Additional supporting information may be found online in the supporting information section at the end of the article:

Appendix SA1: Author Matrix.

Appendix SA2: National Survey of Physician Organizations III.

Appendix SA3: Attributing Beneficiaries to Practices.

Table S1: Health Information Technology, Care Management Processes, and Quality Improvement Indices.

Table S2a: Multivariable Analysis of Practice Characteristics and Medicare Spending, Controlled for Hospital Referral Region (HRR) Spending.

Table S2b: Multivariable Analysis of Practice Characteristics and Medicare Spending on Hospital Services, Controlled for Hospital Referral Region (HRR) Spending.

Table S2c: Multivariable Analysis of Practice Characteristics and Medicare Spending on Physician Services, Controlled for Hospital Referral Region (HRR) Spending.

Table S2d: Multivariable Analysis of Practice Characteristics and Medicare Spending on Post-Acute Services, Controlled for Hospital Referral Region (HRR) Spending.

Table S2e: Multivariable Analysis of Practice Characteristics and Medicare Spending on All Other Services, Controlled for Hospital Referral Region (HRR) Spending.

Table S2f: Multivariable Analysis of Practice Characteristics and 30-Day Unplanned Hospital Readmissions, Controlled for Hospital Referral Region (HRR) Spending.

Table S2g: Multivariable Analysis of Practice Characteristics and Ambulatory Care–Sensitive Admissions, Controlled for Hospital Referral Region (HRR) Spending.

Table S3a: Multivariable Analysis of Practice Characteristics (Reduced Set) and Medicare Spending.

Table S3b: Multivariable Analysis of Practice Characteristics (Reduced Set) and Medicare Spending on Hospital Services.

Table S3c: Multivariable Analysis of Practice Characteristics (Reduced Set) and Medicare Spending on Physician Services.

Table S3d: Multivariable Analysis of Practice Characteristics (Reduced Set) and Medicare Spending on Post-Acute Services.

Table S3e: Multivariable Analysis of Practice Characteristics (Reduced Set) and Medicare Spending on All Other Services.

Table S3f: Multivariable Analysis of Practice Characteristics (Reduced Set) and 30-Day Unplanned Hospital Readmissions.

Table S3g: Multivariable Analysis of Practice Characteristics (Reduced Set) and Ambulatory Care–Sensitive Admissions.

Table S4a: Multivariable Analysis of Practice Characteristics and Medicare Spending on Hospital Services.

Table S4b: Multivariable Analysis of Practice Characteristics and Medicare Spending on Physician Services.

Table S4c: Multivariable Analysis of Practice Characteristics and Medicare Spending on Post-Acute Services.

Table S4d: Multivariable Analysis of Practice Characteristics and Medicare Spending on All Other Services.

Table S5: Multivariable Analysis of Practice Characteristics and Ambulatory Care–Sensitive Admissions.

Table S6: Multivariable Analysis of Practice Characteristics and Medicare Spending (Showing Coefficients for Beneficiary Characteristics).

Table S7: Multivariable Analysis of Practice Characteristics and 30-Day Unplanned Hospital Readmissions (Showing Coefficients for Beneficiary Characteristics).

Table S8: Practice Characteristics and Medicare Spending, Controlled for Interaction between Practice Size and Practice Ownership.

Table S9: Practice Characteristics and 30-Day Unplanned Hospital Readmissions, Controlled for Interaction between Practice Size and Practice Ownership.

Table S10: Practice Characteristics and Ambulatory Care–Sensitive Admissions, Controlled for Interaction between Practice Size and Practice Ownership.