

ORIGINAL RESEARCH

Characteristics of Primary Care Providers Who Adopted the Hospitalist Model From 2001 to 2009

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BACKGROUND: The characteristics of primary care providers (PCPs) who use hospitalists are unknown.

METHODS: Retrospective study using 100% Texas Medicare claims from 2001 through 2009. Descriptive statistics characterized proportion of PCPs using hospitalists over time. Trajectory analysis and multilevel models of 1172 PCPs with ≥ 20 inpatients in every study year characterized how PCPs adopted the hospitalist model and PCP factors associated with this transition.

RESULTS: Hospitalist use increased between 2001 and 2009. PCPs who adopted the hospitalist model transitioned rapidly. In multilevel models, hospitalist use was associated with US training (odds ratio [OR] 1.46, 95% confidence interval [CI]: 1.23-1.73 in 2007-2009), family medicine specialty (OR: 1.46, 95% CI: 1.25-1.70 in 2007-2009), and having high outpatient volumes (OR: 1.32, 95% CI: 1.20-1.44 in 2007-2009). Over time, relative hospitalist use decreased among female PCPs (OR: 1.91, 95% CI: 1.46-2.50 in 2001-

2009; OR: 1.50, 95% CI: 1.15-1.95 in 2007-2009), those in urban locations (OR: 3.34, 95% CI: 2.72-4.09 in 2001-2003; OR: 2.22, 95% CI: 1.82-2.71 in 2007-2009), and those with higher inpatient volumes (OR: 1.05, 95% CI: 0.95-1.18 in 2001-2003; OR: 0.55, 95% CI: 0.51-0.60 in 2007-2009). Longest-practicing PCPs were more likely to transition in the early 2000s, but this effect disappeared by the end of the study period (OR: 1.35, 95% CI: 1.06-1.72 in 2001-2003; OR: 0.92, 95% CI: 0.73-1.17 in 2007-2009). PCPs with practice panels dominated by patients who were white, male, or had comorbidities are more likely to use hospitalists.

CONCLUSIONS: PCP characteristics are associated with hospitalist use. The association between PCP characteristics and hospitalist use has evolved over time. *Journal of Hospital Medicine* 2015;10:75-82. © 2015 Society of Hospital Medicine

Although primary care physicians (PCPs) have traditionally treated patients in both ambulatory and hospital settings, many relinquished inpatient duties to hospitalists in recent decades.¹ Little is known about the PCPs who relinquished inpatient care duties or how the transition to the hospitalist model occurred. For example, what are the characteristics of PCPs who change? Do PCPs adopt the hospitalist model enthusiastically or cautiously? Characterizing PCPs who adopted the hospitalist model can help hospitalists understand their specialty's history and also inform health services research.

Much of the interest in the hospitalist model has been generated by studies reporting improved outcomes and lower hospital lengths of stay associated with hospitalist care.²⁻⁵ Conversely, detractors of the model point to reports of higher post-acute care utilization among hospitalist patients.⁶ Although these

studies usually adjusted for differences among patients and hospitals, they did not account for PCP characteristics. As patients' access to PCPs and their PCP's capabilities are both plausible factors that could influence hospital length of stay (eg, decisions to complete more or less of a workup in the hospital), quality of care transitions, and postdischarge utilization, it is important to determine if PCPs who use hospitalists differ systematically from those who do not to correctly interpret health system utilization patterns that currently are attributed only to hospitalists.^{7,8}

We conducted this study to determine if observable PCP factors are associated with patients' use of hospitalists and to describe the trajectory by which PCPs referred their patients to hospitalists over time.

METHODS

Source of Data

We used claims data from 100% of Texas Medicare beneficiaries from 2000 to 2009, including Medicare beneficiary summary files, Medicare Provider Analysis and Review (MedPAR) files, Outpatient Standard Analytical Files (OutSAF), and Medicare Carrier files. Diagnosis related group (DRG)-associated information, including weights, and Major Diagnostic Categories, were obtained from Centers for Medicare & Medicaid Services (<https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/index.html>) and the *Federal Register* ([*Address for correspondence and reprint requests: Romsai T. Boonyasai, MD, Johns Hopkins University School of Medicine, 1830 East Monument Street, Room 8047, Baltimore, MD 20201; Telephone: 410-614-1761; Fax: 410-502-0923; E-mail: romsai@jhmi.edu](https://www.</p></div><div data-bbox=)

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federalregister.gov/). Provider information was obtained from the American Medical Association (AMA) Physician Masterfile.

Establishment of the Study Cohort

Using the MedPAR file, we first selected hospital admissions from acute care hospitals in Texas for each year of the study period. We excluded beneficiaries younger than 66 years old, with incomplete Medicare Parts A and B enrollment, or with any health maintenance organization enrollment in the 12 months prior to the admission of interest. For patients with more than 1 admission in a given year, we randomly selected 1 admission. We then attempted to assign each patient to a PCP. We defined a PCP as a generalist (general practitioner, family physician, internist, or geriatrician) who saw a given beneficiary on 3 or more occasions in an outpatient setting in the year prior to the admission of interest.⁹ We identified outpatient visits using Current Procedural Terminology (CPT) codes 99201 to 99205 (new patient encounters), and 99211 to 99215 (established patient encounters) from Carrier files. If more than 1 generalist physician saw the beneficiary on 3 or more occasions in a given year, the physician with more than 75% of the total outpatient evaluation and management (E&M) billings was classified as the beneficiary's PCP. Using these criteria, approximately 66% of patients were assigned to a PCP.

For cross-sectional analyses, we restricted our cohort to beneficiaries whose PCPs were associated with at least 20 inpatients in a given year. To study trends in PCP practice patterns over time, we further restricted the cohort to beneficiaries whose PCPs were associated with at least 20 inpatients in every year of the study period, resulting in 1172 PCPs for the trajectory analyses. The reliability of PCPs' practice profiles increases as the number of patients in their panel increases. We chose 20 inpatients as the minimum because PCPs with 20 hospitalized patients per study year would achieve a reliability of 0.9 for estimating the proportion of their patients that received care from hospitalists.¹⁰

Identification of Hospitalists

We defined hospitalists as generalists who had at least 100 E&M billings in a given year and generated at least 90% of their total E&M billings in the year from inpatient services.¹ Inpatient E&M billings were identified by CPT codes 99221 to 99223 (new or established patient encounters), 99231 to 99233 (subsequent hospital care), and 99251 to 99255 (inpatient consultations).¹

Patient Measures

Patient demographic information including, age at admission, gender, race/ethnicity, and Medicaid eligibility were obtained from Medicare beneficiary

summary files. We used the Medicaid indicator as a proxy for low socioeconomic status. Information on weekday versus weekend admission, emergent admission, and DRG were obtained from MedPAR files. The DRG category (circulatory system, digestive system, infectious disease, nervous system, respiratory system, or other) was determined based on its Major Diagnostic Category. We determined residence in a nursing facility in the 3 months before the admission of interest from the MedPAR files and by E&M codes 99304 to 99318 (nursing facility services) from Carrier files.¹¹ Comorbidities were identified using the claims from MedPAR, Carrier, and OutSAF files in the year prior to the admission of interest.¹² Total hospitalizations and outpatient visits in the prior year were identified from MedPAR files and Carrier files, respectively.

PCP Measures

We categorized PCPs by specialty (general practice, family practice, geriatric medicine, or internal medicine), years in practice, gender, US- versus foreign-trained, metropolitan statistical area (MSA) of their practice location, and board certification status. The specialty was identified from Carrier files and the other information from AMA data. For each PCP, the total number of outpatient visits and total number of patients seen as outpatients in each year was calculated based on E&M codes (99201–99205, 99211–99215) from Carrier files. For each year, we computed the average outpatient age, gender, race, and outpatient comorbidity for each PCP's patient panel. We computed hospital volumes using the number of hospitalized patients associated with each PCP in the study cohort.

Study Outcome

To determine whether hospitalized patients received care from hospitalists during a given hospitalization, we identified all inpatient E&M bills from generalist physicians during the admission of interest by linking MedPAR and Carrier files. If more than 50% of the generalist inpatient E&M billings from generalist physicians were from 1 or more hospitalists, the patient was considered to have received care from hospitalists.

Statistical Analyses

Multilevel analyses were used to account for the clustering of patients within PCPs. All multilevel models were adjusted for patient characteristics including age, race/ethnicity, gender, Medicaid eligibility, emergency admission, weekend admission, DRG weight, DRG category, any nursing home stay in the prior 3 months, number of comorbidities, number of hospitalizations, and number of physician visits in the year prior to the admission of interest. To analyze trends in practice patterns, we first used

TABLE 1. PCP Characteristics in Cross-Sectional Analyses of Cohorts 2001 and 2009, and in Trajectory Analysis for the 2001 to 2009 Study Period

PCP Characteristics	Cross-Sectional Analysis		Trajectory Analysis, 2001–2009
	2001	2009	
Overall, no. (%)	2,252 (100%)	2,387 (100%)	1,172 (100%)
Specialty, no. (%)			
General practice	39 (1.7%)	34 (1.4%)	15 (1.3%)
Family practice	948 (42.1%)	1,089 (45.6%)	466 (39.8%)
Internal medicine	1,255 (55.7%)	1,249 (52.3%)	688 (58.7%)
Geriatrics	10 (0.4%)	15 (0.6%)	3 (0.3%)
Gender, no. (%)			
Male	1,990 (88.4%)	2,015 (84.4%)	1,072 (91.5%)
Female	262 (11.6%)	372 (15.6%)	100 (8.5%)
Trained in the United States, no. (%)			
Yes	1,669 (74.1%)	1,738 (72.8%)	844 (72.0%)
No	583 (25.9%)	649 (27.2%)	328 (28.0%)
Metropolitan statistical area, no. (%)			
99,999 or less	—	417 (17.5)	237 (20.2)
100,000–249,000	—	438 (18.3)	234 (20.0)
250,000–999,999	—	381 (16.0)	216 (18.4)
1,000,000 or more	—	1,151 (48.2)	485 (41.4)
Board certification, no. (%)			
Yes	—	1,657 (69.4%)	800 (68.3%)
No	—	730 (30.6%)	372 (31.7%)
Years in practice, 2001, mean ± SD (Q1–Q3)	22.3 ± 10.6 (15.0–28.0)	—	21.2 ± 8.9 (15.0–27.0)
Years in practice, 2009, mean ± SD (Q1–Q3)	—	25.0 ± 10.2 (17.0–32.0)	29.2 ± 8.9 (23.0–35.0)
Total no. of Medicare outpatient visits, 2001, mean ± SD (Q1–Q3)	1,624.8 ± 879.2 (1,057.5–1,970.0)	—	1,883.3 ± 948.5 (1,236.5–2,240.5)
Total no. of Medicare outpatient visits, 2009, mean ± SD (Q1–Q3)	—	1,733.8 ± 1,053.3 (1,080.0–2,048.0)	2,020.5 ± 1,200.9 (1,334.5–2,373.0)
Total no. of Medicare outpatients, 2001, mean ± SD (Q1–Q3)	418.6 ± 186.9 (284.0–522.0)	—	473.4 ± 189.5 (338.0–580.5)
Total no. of Medicare outpatients, 2009, mean ± SD (Q1–Q3)	—	448.7 ± 217.8 (300.0–548.0)	508.7 ± 238.2 (350.5–615.0)
No. of hospitalized patients, 2001, mean ± SD (Q1–Q3)	46.0 ± 25.0 (27.0–57.0)	—	53.0 ± 28.0 (32.0–66.0)
No. of hospitalized patients, 2009, mean ± SD (Q1–Q3)	—	44.0 ± 24.0 (26.0–52.0)	52.0 ± 27.0 (33.0–65.0)
Average outpatient age, 2001, mean ± SD (Q1–Q3)	72.8 ± 2.3 (71.5–74.2)	—	72.8 ± 2.1 (71.7–74.1)
Average outpatient age, 2009, mean ± SD (Q1–Q3)	—	72.1 ± 2.8 (70.6–73.9)	72.8 ± 2.7 (71.4–74.5)
Average outpatient gender (% male), 2001, mean ± SD (Q1–Q3)	38.1 ± 7.0 (35.5–42.3)	—	38.5 ± 6.4 (36.2–42.3)
Average outpatient gender (% male), 2009, mean ± SD (Q1–Q3)	—	40.2 ± 7.6 (37.6–44.8)	41.0 ± 6.5 (38.6–44.8)
Average outpatient race (% white), 2001, mean ± SD (Q1–Q3)	84.3 ± 16.4 (79.2–95.5)	—	85.4 ± 14.3 (79.9–95.7)
Average outpatient race (% white), 2009, mean ± SD (Q1–Q3)	—	85.2 ± 14.4 (79.8–95.2)	86.3 ± 12.9 (80.8–95.6)
Average outpatient comorbidity, 2001, mean ± SD (Q1–Q3)*	1.6 ± 0.5 (1.2–1.8)	—	1.6 ± 0.4 (1.2–1.8)
Average outpatient comorbidity, 2009, mean ± SD (Q1–Q3)*	—	2.2 ± 0.6 (1.8–2.5)	2.2 ± 0.6 (1.7–2.5)

NOTE: Abbreviations: PCP, primary care provider; SD, standard deviation; Q1–Q3, interquartile range.

*Estimated from patients with complete enrollment in the prior year.

multilevel models to calculate the proportions of inpatients cared for by hospitalists each year for each of the 1172 PCPs with at least 20 patients. Then we employed an SAS procedure (PROC TRAJ) developed by Jones et al. to classify these PCPs into groups based on their trajectories.¹³ This group-based trajectory modeling allowed us to identify relatively homogeneous clusters within a heterogeneous sample population.¹⁴ We chose a model that classified the PCPs into 4 groups.¹⁵ With 4 groups, the average of the posterior probabilities of group membership for the PCPs assigned to each group exceeded 0.93, indicating a low rate of misclassification among these 4 distinct groups. For the 1172 PCPs, we tested interactions between year of hospitalization and PCP characteristics while adjusting for patient characteristics in order to investigate whether or not the impacts of PCP characteristics on how likely their patients being cared for by hospitalists

differed with time. All analyses were performed with SAS version 9.2 (SAS Institute Inc., Cary, NC).

RESULTS

During the 2001 through 2009 study period, between 2252 and 2848 PCPs were associated with at least 20 hospitalized beneficiaries in any single year. Among these, 1172 PCPs were associated with at least 20 hospitalized beneficiaries in every year of the study period. These 1172 PCPs were associated with 608,686 hospitalizations over the 9 years.

Table 1 presents the characteristics of the PCPs who contributed to the cross-sectional analyses in 2001 (N = 2252) and 2009 (N = 2387), as well as the 1172 PCPs for whom we had data for all 9 years for the longitudinal analyses. Most PCPs were male, trained in the United States, and were board certified. The average number of Medicare patients seen by

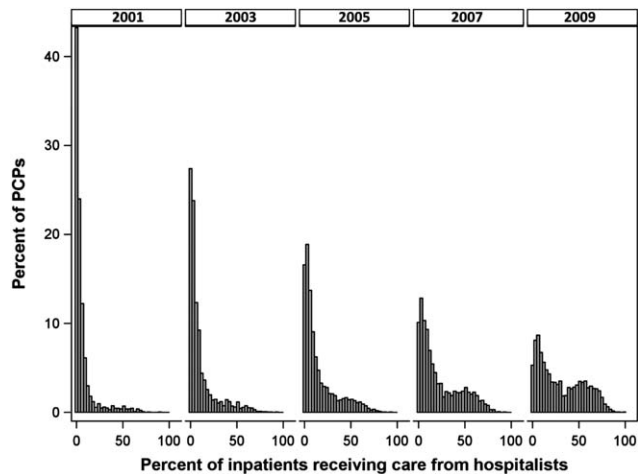


FIG. 1. Distribution of PCPs according to the proportion of their patients who received care from hospitalists when they were hospitalized and how it changed from 2001 through 2009. Each histogram represents the average practice patterns of PCPs over a 1-year period of time. Shown is the increase in proportion of PCPs whose patients received care from hospitalists in recent years. Abbreviations: PCP, primary care provider.

these PCPs and number of outpatient Medicare visits went up about 7% between 2001 and 2009.

Figure 1 graphs the percentage of PCPs as a function of what percent of their hospitalized patients received care from hospitalists, and how that changed from 2001 to 2009. For 70.9% of PCPs, fewer than 5% of their hospitalized patients received hospitalist care in 2001. By 2009, the percent of PCPs in this category had decreased to 15.2%. In contrast, in 2001, more than half of the patients for 2.1% of PCPs received hospitalist care, and the percent of PCPs in this category increased to 26.3% by 2009.

The pattern in Figure 1 shows that PCPs' use of hospitalists changed continuously and gradually over time. However, this pattern describes the PCPs as a group. When examined at the individual PCP level, different patterns emerge. Figure 2, which presents selected individual PCPs' use of hospitalists over time, shows several distinct subpatterns of PCP practice behaviors. First, there are PCPs whose use of hospitalists was high in 2001 and stayed high or increased over time (eg, PCP A). There also were PCPs whose use of hospitalists stayed low over the entire study period (eg, PCP B). Finally, there were PCPs whose use of hospitalists was low in 2001 but high in 2009 (eg, PCP C). For this last group, the pattern of change in hospitalist utilization over time was discontinuous; that is, most of the increase occurred over a 1- or 2-year period, instead of increasing gradually over time.

Among the 1172 PCPs associated with ≥ 20 hospitalized beneficiaries each year in all 9 years of the study period, group-based trajectory modeling classified their practice patterns into 4 distinct trajectories (Figure 3). Among PCPs in group 1, more than one-third of their hospitalized patients were cared for by hospitalists in 2001, and this increased to 60% by 2009. PCPs in groups 2 and 3 rarely used hospitalist

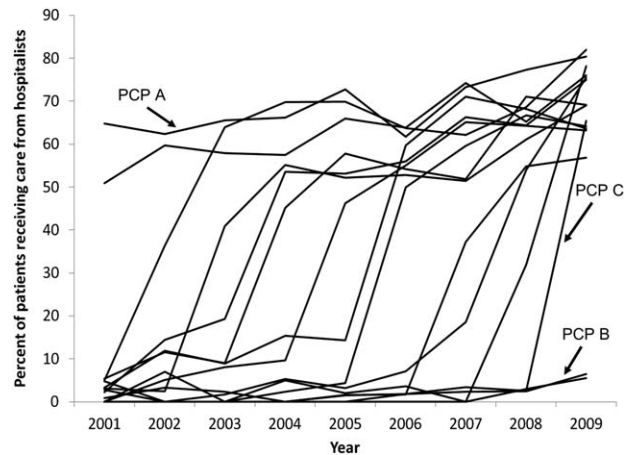


FIG. 2. Selected example trajectories for 15 PCPs, each with at least 20 patients hospitalized in each year from 2001 through 2009. Each line illustrates the unadjusted percent of the PCPs' hospitalized patients who received care from 1 or more hospitalists. PCP A, B, and C are examples used to illustrate different types of practice patterns. Abbreviations: PCP, primary care provider.

care in 2001 but increased their use over time. The increase started early in the period for PCPs in group 2 and later for those in group 3. PCPs in group 4 were associated with little hospitalist use throughout the study period.

We constructed a model to describe the odds of a patient receiving care from hospitalists during the study period using patients associated with these 1172 PCPs. After adjusting for patient characteristics, the residual intraclass correlation coefficient for PCP level was 0.334, which indicates that 33.4% of the variance in whether a hospitalized patient received care from a hospitalist is explained by which PCP the patient saw. When adjusting for both patient and PCP characteristics, the overall odds of a patient receiving hospitalist care increased by 30% (95% confidence interval [CI]: 1.29-1.30) per year from 2001 through 2009.

There were also significant interactions between year of hospitalization and several PCP characteristics. These interactions are illustrated in Table 2, which stratifies each of those PCP characteristics by 3 time periods: 2001 to 2003, 2004 to 2006, and 2007 to 2009. In all time periods, patients were more likely to receive hospitalist care if their PCP was US trained (US vs international medical graduate: odds ratio [OR]: 1.42, 95% CI: 1.19-1.69 in 2001-2003; OR: 1.46, 95% CI: 1.23-1.73 in 2007-2009), or specialized in family medicine (family medicine vs internal medicine: OR: 1.46, 95% CI: 1.25-1.72 in 2001-2003; OR: 1.46, 95% CI: 1.25-1.70 in 2007-2009). Over time, the relative odds of a patient receiving care from hospitalists decreased if their PCP was female (female vs male: OR: 1.91, 95% CI: 1.46-2.50 in 2001-2003 vs OR: 1.50, 95% CI: 1.15-1.95 in 2007-2009) or practiced in an urban area (largest vs smallest MSA: OR: 3.34, 95% CI: 2.72-4.09 in 2001-

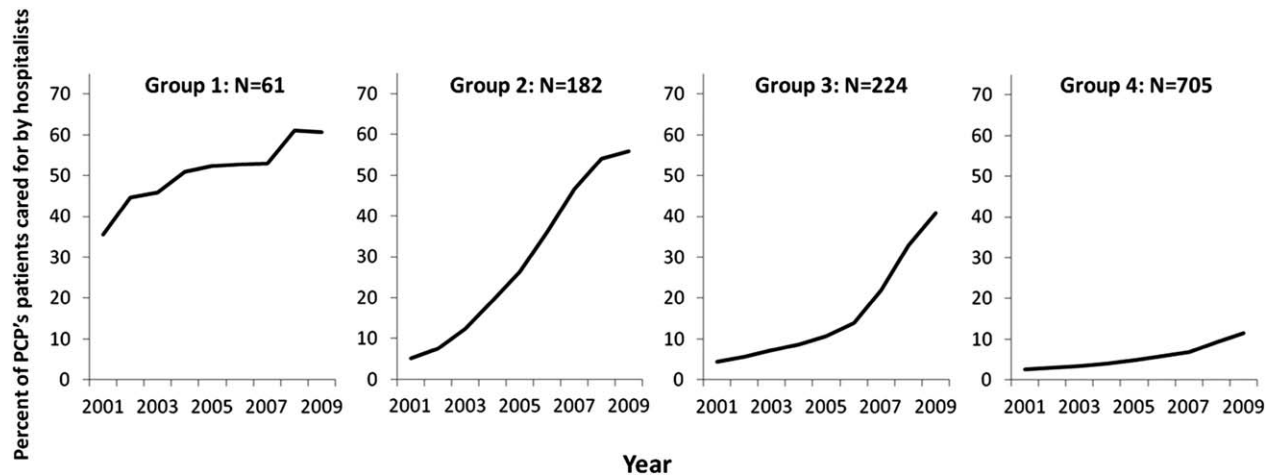


FIG. 3. Care trajectory groups categorized by rates of the PCP's patients receiving hospitalist care over time. The model adjusts for patient characteristics including age at admission, gender, race/ethnicity, Medicaid eligibility, emergency admission, weekend admission, diagnosis related group (DRG) category (circulatory system, digestive system, infectious disease, nervous system, respiratory system, or other), DRG weights, any nursing home stay in the prior 3 months, number of comorbidities, number of hospitalizations, and number of physician visits in the prior year before admission. N represents the number of PCPs in the group. Abbreviations: PCP, primary care provider.

2003; OR: 2.22, 95% CI: 1.82-2.71 in 2007–2009). Although the longest-practicing PCPs were most likely to use hospitalists in the early 2000s, this effect disappeared by 2007 to 2009 (most vs least years in practice: OR: 1.35, 95% CI: 1.06-1.72 in 2001–2003 vs OR: 0.92, 95% CI: 0.73-1.17 in 2007–2009).

In terms of PCP workload, patients of PCPs with high outpatient activity were more likely to receive hospitalists care throughout the study period, although the association had decreased by 2007 to 2009 (highest vs lowest outpatient volume: OR: 1.46, 95% CI: 1.30-1.63 in 2001–2003 vs OR: 1.32, 95% CI: 1.20-1.44 in 2007–2009). In contrast, PCPs with the lowest inpatient volumes became more likely to use hospitalists by the end of the study period (highest vs lowest inpatient volume: OR: 1.05, 95% CI: 0.95-1.18 in 2001–2003 vs OR: 0.55, 95% CI: 0.51-0.60 in 2007–2009).

The characteristics of PCPs' practice panels also were associated with patients' likelihood of receiving care from hospitalists. PCPs whose practice panels consisted of patients who were predominantly male, white, or with more outpatient comorbidities were consistently more likely to use hospitalists throughout the study period. PCPs with older patient panels were less likely to use hospitalists in 2001 to 2003, but by 2007 to 2009, they were slightly more likely to do so (oldest vs youngest average outpatient panel age: OR: 0.72, 95% CI: 0.64-0.81 in 2001–2003 vs OR: 1.15, 95% CI: 1.05-1.26 in 2007–2009).

CONCLUSIONS

Prior studies of the hospitalist model have shown that the likelihood of a patient receiving inpatient care from hospitalists is associated with patient characteristics, hospital characteristics, geographic region, and

type of admission.^{1,16,17} We found that PCP characteristics also predict whether patients receive care from hospitalists and that their use of hospitalists developed dynamically between 2001 to 2009. Although many factors (such as whether patients were admitted to a hospital where their PCP had admitting privileges) can influence the decision to use hospitalists, we found that over one-third of the variance in whether a hospitalized patient received care from a hospitalist is explained by which PCP the patient saw. In showing that systemic differences exist among PCPs who use hospitalists and those who do not, our study suggests that future research on the hospitalist model should, if possible, adjust for PCP characteristics in addition to hospital and patient factors.

Although this study identifies the existence and magnitude of differences in whether or not PCPs use hospitalists, it cannot explain why the differences exist. We only can offer hypotheses. For example, our finding that PCPs with the most years of practice experience were more likely to use hospitalists in the early 2000s but not in more recent years suggests that in hospital medicine's early years, long-practicing generalist physicians were choosing between practicing traditionalist medicine and adopting the hospitalists model, but by 2009, experienced generalist physicians had already specialized to either inpatient or outpatient settings earlier in their careers. On the other hand, the decreasing odds of urban PCPs using hospitalists may reflect a relative growth in hospitalist use in less populated areas rather than a change in urban PCPs' practice patterns.

PCPs trained in family medicine have reported less inpatient training and less comfort with providing hospital care,^{18,19} thus it is unsurprising that family physicians were more likely to refer patients to

TABLE 2. Association of PCP Characteristics With the Odds of Their Patients Receiving Care From Hospitalists in Different Time Periods

PCP Characteristics	2001–2003, OR (95% CI)	2004–2006, OR (95% CI)	2007–2009, OR (95% CI)
Family practice* vs. internal medicine [†]	1.46 (1.25–1.72)	1.50 (1.28–1.76)	1.46 (1.25–1.70)
Female vs male	1.91 (1.46–2.50)	1.43 (1.09–1.86)	1.50 (1.15–1.95)
United States trained (yes vs no)	1.42 (1.19–1.69)	1.53 (1.28–1.81)	1.46 (1.23–1.73)
Metropolitan statistical area			
99,999 or less	1.00	1.00	1.00
100,000–249,000	0.83 (0.65–1.05)	1.00 (0.79–1.25)	1.13 (0.90–1.41)
250,000–999,999	0.92 (0.72–1.17)	1.03 (0.82–1.31)	0.98 (0.77–1.23)
1,000,000 or more	3.34 (2.72–4.09)	2.90 (2.37–3.54)	2.22 (1.82–2.71)
Years in practice, 2001			
Q1 (lowest)	1.00	1.00	1.00
Q2	0.89 (0.71–1.12)	0.83 (0.67–1.04)	0.92 (0.74–1.14)
Q3	1.06 (0.84–1.34)	0.99 (0.79–1.24)	1.03 (0.82–1.29)
Q4	1.25 (0.99–1.59)	1.13 (0.89–1.42)	1.15 (0.92–1.45)
Q5 (highest)	1.35 (1.06–1.72)	1.05 (0.83–1.33)	0.92 (0.73–1.17)
Total no. of outpatient visits [‡]			
Q1 (lowest)	1.00	1.00	1.00
Q2	1.21 (1.12–1.30)	1.07 (1.00–1.14)	1.13 (1.07–1.19)
Q3	1.42 (1.30–1.54)	1.18 (1.09–1.27)	1.14 (1.07–1.22)
Q4	1.34 (1.21–1.47)	1.34 (1.23–1.46)	1.25 (1.16–1.35)
Q5 (highest)	1.46 (1.30–1.63)	1.33 (1.21–1.47)	1.32 (1.20–1.44)
No. of hospitalized patients [‡]			
Q1 (lowest)	1.00	1.00	1.00
Q2	1.07 (1.00–1.15)	0.91 (0.86–0.96)	0.85 (0.81–0.89)
Q3	1.00 (0.92–1.08)	0.87 (0.82–0.93)	0.74 (0.70–0.79)
Q4	0.89 (0.81–0.97)	0.76 (0.71–0.82)	0.62 (0.58–0.67)
Q5 (highest)	1.05 (0.95–1.18)	0.67 (0.61–0.73)	0.55 (0.51–0.60)
Average outpatient age [‡]			
Q1 (lowest)	1.00	1.00	1.00
Q2	0.94 (0.87–1.01)	1.15 (1.08–1.23)	1.18 (1.11–1.25)
Q3	0.82 (0.76–0.90)	1.05 (0.97–1.13)	1.17 (1.09–1.25)
Q4	0.71 (0.65–0.79)	1.03 (0.95–1.12)	1.10 (1.02–1.19)
Q5 (highest)	0.72 (0.64–0.81)	1.12 (1.01–1.23)	1.15 (1.05–1.26)
Average outpatient gender (% male) [‡]			
Q1 (lowest)	1.00	1.00	1.00
Q2	1.10 (1.02–1.18)	1.19 (1.10–1.27)	1.27 (1.18–1.37)
Q3	1.12 (1.03–1.22)	1.27 (1.17–1.37)	1.43 (1.32–1.54)
Q4	1.36 (1.25–1.48)	1.49 (1.37–1.61)	1.52 (1.40–1.65)
Q5 (highest)	1.47 (1.34–1.61)	1.84 (1.68–2.00)	1.68 (1.54–1.83)
Average outpatient race (% white) [‡]			
Q1 (lowest)	1.00	1.00	1.00
Q2	1.08 (0.98–1.20)	1.01 (0.92–1.10)	1.23 (1.13–1.34)
Q3	1.27 (1.13–1.43)	1.06 (0.95–1.18)	1.21 (1.09–1.34)
Q4	1.47 (1.29–1.67)	0.97 (0.86–1.09)	1.33 (1.18–1.48)
Q5 (highest)	1.39 (1.21–1.59)	1.18 (1.04–1.34)	1.25 (1.10–1.42)
Average outpatient comorbidity [‡]			
Q1 (lowest)	1.00	1.00	1.00
Q2	1.26 (1.19–1.35)	1.23 (1.16–1.31)	1.22 (1.14–1.30)
Q3	1.62 (1.49–1.75)	1.61 (1.50–1.72)	1.43 (1.34–1.54)
Q4	1.96 (1.79–2.15)	1.86 (1.72–2.02)	1.59 (1.47–1.72)
Q5 (highest)	1.79 (1.59–2.01)	2.20 (2.00–2.41)	2.03 (1.85–2.22)

NOTE: The interactions between time and PCP characteristics were examined in the same model adjusted for patient characteristics. All characteristics had significant interactions with time, except for PCP specialty ($P = 0.479$) and United States trained ($P = 0.072$).

Abbreviations: CI, confidence interval; OR, odds ratio; PCP, primary care provider.

*Including 15 general practitioners.

[†]Including 3 geriatricians.

[‡]At the year of index admission.

hospitalists. Although a recent study reported that family physicians' inpatient volumes remained constant, whereas those of outpatient internists declined between 2003 and 2012, the analysis used University Health Consortium data and thus reflects practice

patterns in academic medical centers.²⁰ Our data suggest that outside of academia, family physicians have embraced the hospitalists as clinical partners.

Meltzer and Chung had previously proposed an economic model to describe the growing use of

hospitalists in the United States. They posited that decisions to adopt the hospitalist model are governed by trade-offs between coordination costs (eg, time and effort spent coordinating multiple providers across different settings) and switching costs (eg, time spent traveling between the office and the hospital or the effort of adjusting to different work settings).¹⁶ The authors hypothesized that empirical testing of this model would show PCPs are more likely to use hospitalists if they have less available professional time (ie, work fewer hours per week), are female (due to competing demands from domestic responsibilities), have relatively few hospitalized patients, or live in areas with high traffic congestion. Our findings provide empirical evidence to support their division-of-labor model in showing that patients were more likely to receive hospitalist care if their PCP was female, practiced in an urban location, had higher outpatient practice volumes, or had lower inpatient volumes.

At first glance, some of our findings appear to contradict our earlier study, which showed that younger, black, male patients are more likely to receive inpatient care from hospitalists.¹ However, that study included patients regardless of whether they had a PCP. This study shows that when patients have a PCP, their PCPs are more likely to refer them to hospitalists if they are older, white, male, and have more comorbid conditions. A potential explanation for this finding is that PCPs may preferentially use hospitalists when caring for older and sicker hospitalized patients. For example, commentators often cite hospitalists' constant availability in the hospital as a valuable resource when caring for acutely ill patients.^{21,22}

Another potential explanation is that despite their preferences, PCPs who care for younger, minority patients lack access to hospitalist services. One large study of Medicare beneficiaries reported that physicians who care for black patients are less well-trained clinically and often lack access to important clinical resources such as diagnostic imaging and nonemergency hospital admissions.²³ Similarly, international medical graduates are more likely than their US-trained counterparts to care for underserved patients and to practice in small, independent offices.^{24–26} As hospitalist groups often rely on cross-subsidization from sources within a large healthcare organization, independent PCPs may have less access to their services when compared with PCPs in managed care organizations or large integrated groups. Viewed in this context, our findings imply that although hospitalists often care for socioeconomically vulnerable patients (eg, younger, uninsured, black men) who lack access to primary care services,¹ they also appear to share care responsibilities for more complex hospitalized patients with PCPs in more affluent communities. Further research may determine if the availability of hospitalists influences racial disparities in hospital care.

Our study has limitations. It is an observational study and thus subject to bias and confounding. As our cohort was formed using fee-for-service Medicare data in a single, large state, it may not be generalizable to PCPs who practice in other states, who care for a younger population, or who do not accept Medicare. Our findings also may not reflect the practice patterns of physicians-in-training, PCP populations with high board-certification rates, those employed in temporary positions, or those who interrupt their practices for personal reasons, as we restricted our study to established PCPs who had been in practice long and consistently enough to be associated with ≥ 20 hospitalized patients during every year of the study. For example, the lower proportion of female PCPs in our cohort (15.6% in our study in 2009 vs 27.5% reported in a nationally representative 2008 survey²⁷) may be explained by our exclusion of women who take prolonged time off for childcare duties. We also did not establish whether patient outcomes or healthcare costs differ between PCPs who adopted the hospitalist model and traditionalists. Finally, we could not examine the effect of a number of PCP factors that could plausibly influence whether or not PCPs relinquish inpatient care to hospitalists, such as their comfort with providing inpatient care, having hospital admitting privileges, having office-based access to hospitals' electronic medical records, or the distance between their office and the hospital. However, this study lays the groundwork for future studies to explore these factors.

In summary, this study is the first, to our knowledge, to characterize PCPs who relinquished inpatient responsibilities to hospitalists. Our findings suggest that some groups of PCPs are more likely to refer patient to hospitalists, that the relationship between hospitalists and PCPs has evolved over time, and that the hospitalist model still has ample room to grow.

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