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SPECIAL ARTICLE

Outcomes of Care by Hospitalists, General Internists, and Family Physicians

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Article Figures/Media

Abstract

BACKGROUND

The hospitalist model is rapidly altering the landscape for inpatient care in the United States, yet evidence about the clinical and economic outcomes of care by hospitalists is derived from a small number of single-hospital studies examining the practices of a few physicians.

METHODS

We conducted a retrospective cohort study of 76,926 patients 18 years of age or older who were hospitalized between September 2002 and June 2005 for pneumonia, heart failure, chest pain, ischemic stroke, urinary tract infection, acute exacerbation of chronic obstructive pulmonary disease, or acute myocardial infarction at 45 hospitals throughout the United States. We used multivariable models to compare the outcomes of care by 284 hospitalists, 993 general internists, and 971 family physicians.

RESULTS

As compared with patients cared for by general internists, patients cared for by hospitalists had a modestly shorter hospital stay (adjusted difference, 0.4 day; P<0.001) and lower costs (adjusted difference, $268; P=0.02) but a similar inpatient rate of death (odds ratio, 0.95; 95% confidence interval [CI], 0.85 to 1.05) and 14-day readmission rate (odds ratio, 0.98; 95% CI, 0.91 to 1.05). As compared with patients cared for by family physicians, patients cared for by hospitalists had a shorter length of stay (adjusted difference, 0.4 day; P<0.001), and the costs (adjusted difference, $125; P=0.33), rate of death (odds ratio, 0.95; 95% CI, 0.83 to 1.07), and 14-day readmission rate (odds ratio, 0.95; 95% CI, 0.87 to 1.04) were similar.

CONCLUSIONS

For common inpatient diagnoses, the hospitalist model is associated with a small reduction in the length of stay without an adverse effect on rates of death or readmission. Hospitalist care appears to be modestly less expensive than that provided by general internists, but it offers no significant savings as compared with the care provided by family physicians.

Introduction

SINCE THEY WERE FIRST DESCRIBED LITTLE MORE THAN A DECADE AGO, hospitalists have emerged as one of the fastest growing physician groups in the United States.[1-3] Recent data suggest that 29% of hospitals, including 55% of hospitals with 200 or more beds, have hospitalists on their medical staffs, and more than 12,000 hospitalists practice in the United States.[4] If the hospitalist model of inpatient care becomes predominant, it has been estimated that hospitalists will eventually number as many as 30,000 — approximately the same as the number of cardiologists in the United States.[5]

As compared with traditional inpatient care, the hospitalist model offers many potential advantages.[6] First, their availability all day (and sometimes around the clock) allows hospitalists to respond quickly to acute symptoms or new test results, reducing delays and potentially improving outcomes. Second, physicians who are based within a hospital may learn to navigate its complex environment more efficiently. Third, hospitalists may develop greater clinical expertise as a result of added experience.[7] Fourth, the financial support provided by many hospitals to meet the operating expenses of hospitalist programs is often associated with explicit or implicit incentives to reduce the length of hospital stay and costs.[8] Finally, the presence of hospitalists allows primary care physicians to increase their availability and productivity in the office setting because they no longer need to travel to the hospital to see one or two patients. Being allowed to focus on one clinical setting may also improve the quality of work life for physicians who refer patients to hospitalists.

At the same time, the hospitalist model introduces handoffs at the time of admission and at discharge, transitions during which the risk of errors and adverse events is high.[9-14] These discontinuities, coupled with a lack of previous knowledge of a patient's care, may lead hospitalists to order excessive diagnostic tests, resulting in higher costs with no benefit to hospitalized patients. Concerns regarding the potentially negative effect of hospitalist programs on the satisfaction of primary care physicians and patients have not been borne out.[15-18]

Although hospitalists have captured the attention of both medical and lay audiences,[19] knowledge regarding their effect on outcomes is derived from a small number of studies of academic centers and is based on the practices of few hospitalists.[15,18,20-27] Given the effect the hospitalist model has had on inpatient care, we sought to address the limitations of previous studies by comparing the outcomes for patients treated by a large number of hospitalists, general internists, and family physicians throughout a wide range of practice settings.

Methods

SETTING AND PARTICIPANTS

We conducted a retrospective cohort study using data from hospitals that participate in Perspective (Premier Healthcare Informatics), a database developed for the measurement of health care use and quality. In addition to the elements that are available in standard hospital discharge data, three quarters of the hospitals that participate in the Perspective database report actual costs, and the remainder provide cost estimates calculated with the use of Medicare cost-to-charge ratios. Participants in the Perspective database represent all regions of the United States, are predominantly small-to-midsize nonteaching facilities, and serve a largely urban patient population.

Among participants in the Perspective database, we identified 45 hospitals that used an expanded set of physician-specialty codes that included an option to categorize attending physicians as hospitalists. Information provided to these hospitals had defined hospitalists as physicians, usually internists, who specialize in treating hospitalized patients. Hospitals that reported having hospitalists on their staffs were similar to the entire group of participants in the Perspective database in terms of size, teaching status, urban or rural location, and geographic region.

Patients were included in our analysis if they were admitted to the hospital between September 1, 2002, and June 30, 2005; if they were 18 years of age or older; and if they were cared for by an attending physician classified as being a general internist, family physician, or hospitalist. Given the administrative nature of our data set, we were unable to determine whether patients treated by an attending physician who was not a hospitalist were actually cared for by their own primary care physician or by a covering physician. In order to focus on a set of conditions commonly encountered by all three physician groups and on a group of diagnoses associated with a range of expected lengths of stay and in-hospital mortality, we further limited our patient population to those admitted with a principal diagnosis of pneumonia, acute exacerbation of chronic obstructive pulmonary disease, ischemic stroke, chest pain, acute myocardial infarction, heart failure, or urinary tract infection, as defined by the *International Classification of Diseases, Ninth Revision, Clinical Modification* criteria. The institutional review board at Baystate Medical Center in Springfield, Massachusetts, approved the study.

DATA ELEMENTS

In addition to the patients' age, sex, race or ethnic group, insurance information, and principal diagnosis, we recorded the presence of coexisting conditions using Healthcare Cost and Utilization Project Comorbidity Software, version 3.1 (Agency for Healthcare Research and Quality); this software is based on work by Elixhauser et al.[28] Data on the length of stay, cost, in-hospital deaths, and all-cause readmission rates at the index hospital at 14 days were obtained from the Perspective discharge file. In addition, we identified the specialty of each attending physician and the hospital's bed size, teaching status, geographic region, and whether the institution served an urban or rural population.

STATISTICAL ANALYSIS

Summary statistics were constructed at the patient level with the use of means, standard deviations, medians, and interquartile ranges for continuous data and frequencies and percentages for categorical data. Chi-square tests of association were used to evaluate differences in proportion according to physician specialty for each categorical factor; Kruskal–Wallis analysis of variance was used to compare specialties for each continuous-scale factor. To estimate the effect of physician specialty independent of patient volume, we calculated an annualized case volume for each physician by dividing his or her reported patient count by the total number of months that the physician contributed patients to the data set. This figure was multiplied by 12 to estimate the physician's annualized case volume for the seven conditions under study.

Physicians from each group with annualized case volumes that met or exceeded the 25th percentile for hospitalists (i.e., a volume attained by 75% of all hospitalists) were categorized as being high-volume providers. This threshold provided a comparison group of general internists and family physicians whose inpatient volumes approached those of a mainstream group of hospitalists. In exploratory analyses, we examined the effect of changing the threshold to the 50th percentile for hospitalists. These analyses yielded similar effect estimates with greatly reduced power as a result of the small numbers of internists and family physicians who met this volume threshold.

We developed a series of multivariable models to assess the independent effect of physician specialty on the length of stay, cost, inpatient mortality, and rate of readmission; these models were adjusted for principal diagnosis, all other patient characteristics, all hospital characteristics, and the annualized physician case volume. Generalized estimating equations (the GENMOD procedure in SAS software, version 9.1; SAS Institute) were used to account for the clustering of patients with physicians and physicians with hospitals. An interaction term between physician specialty and principal diagnosis was included in all models. Logit-link generalized estimating equations were used to assess in-hospital mortality and 14-day readmission. Analyses of length of stay and costs were restricted to cases with values within 3 SD of the mean because of the extremely skewed nature of these data, and identity-link normal-distribution generalized estimating equations were used to assess log-transformed length of stay and cost.

In a secondary analysis, we generated a propensity score derived from a nonparsimonious multinomial logit model performed with the GLIMMIX procedure in SAS software, version 9.1 (SAS Institute). This model used attending-physician specialty as the outcome variable, thereby producing three predicted probabilities, each representing the likelihood of being assigned to one of our physician groups (and summing to 100%). Because these probabilities are a linear combination of each other, two scores were then used as additional covariates in subsequent propensity-adjusted multivariable models.

To explore the relationship among physician specialty, case volume, and outcome, we developed models that excluded case volume, as well as models that included an interaction term between the annualized volume and specialty. In addition, all regression models were repeated with an interaction term to examine whether the effect of physician specialty varied according to hospital teaching status.

Using the estimates from our models, we present differences in adjusted length of stay and costs between hospitalists and general internists and between hospitalists and family physicians at the individual-hospital level. All analyses were carried out with the use of SAS software, version 9.1 (SAS Institute).

Results

CHARACTERISTICS OF PATIENTS AND HOSPITALS

Table 1.

Table 1. Characteristics of Hospitals and of Patients Cared for by Hospitalists, General Internists, and Family Physicians at 45 Hospitals.*

Characteristic	Care Provided by Hospitalists (N=24,772)	Care Provided by General Internists (N=13,341)	Care Provided by Family Physicians (N=18,813)	P Value
Patients				
Age				<0.001

18–49 yr — no. (%)	3,870 (15.6)	3,862 (11.6)	2,523 (13.4)	
50–64 yr — no. (%)	5,978 (24.1)	6,853 (20.6)	4,365 (23.2)	
65–74 yr — no. (%)	4,963 (20.0)	6,881 (20.6)	3,913 (20.8)	
75–84 yr — no. (%)	6,122 (24.7)	9,598 (28.8)	4,875 (25.9)	
≥85 yr — no. (%)	3,839 (15.5)	6,147 (18.4)	3,137 (16.7)	
Mean — yr	67.29±16.18	70.05±15.18	68.49±15.63	<0.001†
Median — yr (interquartile range)	70.0 (56.0–81.0)	73.0 (60.0–82.0)	71.0 (58.0–81.0)	
Sex — no. (%)				<0.001
Male	11,010 (44.4)	14,285 (42.8)	7,758 (41.2)	
Female	13,762 (55.6)	19,056 (57.2)	11,055 (58.8)	
Race or ethnic group — no. (%)‡				<0.001
White	15,501 (62.6)	22,807 (68.4)	12,342 (65.6)	
Black	3,864 (15.6)	4,525 (13.6)	2,446 (13.0)	
Hispanic	2,320 (9.4)	1,429 (4.3)	550 (2.9)	
American Indian	256 (1.0)	333 (1.0)	450 (2.4)	
Asian or Pacific Islander	112 (0.5)	163 (0.5)	89 (0.5)	
Other	2,719 (11.0)	4,084 (12.2)	2,936 (15.6)	
Principal diagnosis — no. (%)				<0.001
Pneumonia	6,956 (28.1)	9,460 (28.4)	5,160 (27.4)	
Heart failure	4,024 (16.2)	5,672 (17.0)	3,145 (16.7)	
Chest pain	3,835 (15.5)	5,325 (16.0)	3,446 (18.3)	
Ischemic stroke	3,290 (13.3)	3,946 (11.8)	2,059 (10.9)	
Urinary tract infection	2,355 (9.5)	3,032 (9.1)	1,794 (9.5)	
Chronic obstructive pulmonary disease, acute exacerbation	2,239 (9.0)	3,067 (9.2)	1,770 (9.4)	
Acute myocardial infarction	2,073 (8.4)	2,839 (8.5)	1,439 (7.6)	
Coexisting conditions — no. (%)				
Hypertension	14,920 (60.2)	20,187 (60.5)	11,020 (58.6)	<0.001
Diabetes	7,520 (30.4)	10,116 (30.3)	5,732 (30.5)	0.95
Fluid and electrolyte disorders	7,982 (32.2)	9,335 (28.0)	5,220 (27.7)	<0.001
Chronic lung disease	6,053 (24.4)	8,682 (26.0)	4,998 (26.6)	<0.001
Deficiency anemias	4,550 (18.4)	5,922 (17.8)	3,251 (17.3)	0.01
Hypothyroidism	2,976 (12.0)	4,448 (13.3)	2,440 (13.0)	<0.001
Congestive heart failure	2,837 (11.5)	4,297 (12.9)	2,381 (12.7)	<0.001
Depression	2,405 (9.7)	3,421 (10.3)	2,286 (12.2)	<0.001
Obesity	2,199 (8.9)	2,682 (8.0)	1,766 (9.4)	<0.001
Neurologic disorders	1,973 (8.0)	2,666 (8.0)	1,475 (7.8)	0.62
Peripheral vascular disease	1,831 (7.4)	2,675 (8.0)	1,442 (7.7)	0.02
Renal failure	1,662 (6.7)	2,304 (6.9)	1,037 (5.5)	<0.001
Payer category — no. (%)				<0.001
Medicare				
Traditional	13,880 (56.0)	21,637 (64.9)	11,865 (63.1)	
Managed care	2,035 (8.2)	2,077 (6.2)	893 (4.7)	
Medicaid				
Traditional	1,212 (4.9)	1,336 (4.0)	767 (4.1)	
Managed care	533 (2.2)	423 (1.3)	209 (1.1)	
Private insurance				
Managed care	3,762 (15.2)	4,485 (13.5)	3,164 (16.8)	
Commercial	953 (3.8)	1,113 (3.3)	821 (4.4)	
Self-pay	1,465 (5.9)	1,028 (3.1)	471 (2.5)	
Other	932 (3.8)	1,242 (3.7)	625 (3.3)	
Hospitals				
Beds — no. (%)				<0.001
<200	3,477 (14.0)	4,474 (13.4)	3,120 (16.6)	
200–399	7,301 (29.5)	11,859 (35.6)	7,598 (40.4)	
≥400	13,994 (56.5)	17,008 (51.0)	8,095 (43.0)	
Region — no. (%)				<0.001
South	19,459 (78.6)	22,762 (68.3)	12,889 (68.5)	
Midwest	1,843 (7.4)	6,900 (20.7)	3,554 (18.9)	
West	2,432 (9.8)	2,133 (6.4)	1,658 (8.8)	
Northeast	1,038 (4.2)	1,546 (4.6)	712 (3.8)	
Location — no. (%)				<0.001
Urban	19,768 (79.8)	24,036 (72.1)	13,460 (71.5)	
Rural	5,004 (20.2)	9,305 (27.9)	5,353 (28.4)	
Teaching status — no. (%)				<0.001
Teaching	6,688 (27.0)	8,625 (25.9)	5,488 (29.2)	
Nonteaching	18,084 (73.0)	24,716 (74.1)	13,325 (70.8)	
Outcomes				
In-hospital deaths — no. (%)	1,073 (4.3)	1,507 (4.5)	771 (4.1)	0.08
Discharge disposition among survivors — no./total no. (%)				<0.001
Home	17,902/23,699 (75.5)	23,641/31,834 (74.3)	13,719/18,042 (76.0)	
Non-acute care facility	4,842/23,699 (20.4)	6,970/31,834 (21.9)	3,735/18,042 (20.7)	
Acute care facility	549/23,699 (2.3)	722/31,834 (2.3)	345/18,042 (1.9)	
Hospice	406/23,699 (1.7)	501/31,834 (1.6)	243/18,042 (1.3)	
Readmission within 14 days — no./total no. (%)	1,496/23,699 (6.3)	2,191/31,834 (6.9)	1,212/18,042 (6.7)	
Length of stay — days				<0.001†
Mean	4.7±6.0	5.2±6.3	4.8±4.8	
Median (interquartile range)	3.0 (2.0–6.0)	4.0 (2.0–6.0)	4.0 (2.0–6.0)	
Cost — U.S. $				<0.001†
Mean	8,078±12,846	8,003±12,316	7,077±9,305	
Median (interquartile range)	4,775 (3,000–8,275)	4,941 (3,119–8,423)	4,548 (2,898–7,639)	

* Plus-minus values are means ±SD. P values were calculated with the use of chi-square tests of association unless otherwise indicated.
† This P value was calculated with the use of the Kruskal–Wallis analysis of variance.
‡ Race and ethnic group were reported by the hospitals in the study.

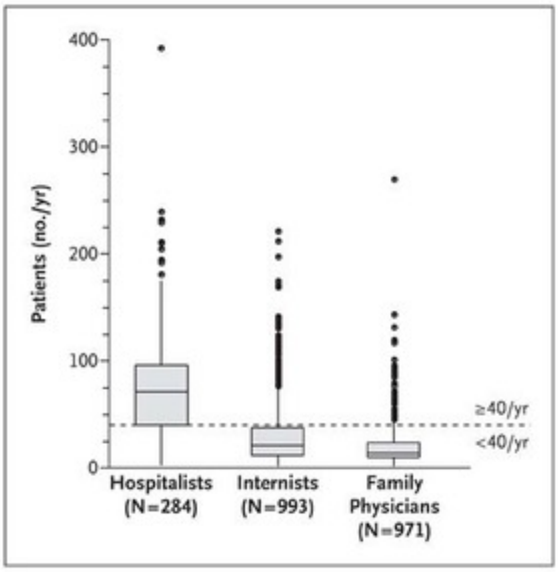
Characteristics of Hospitals and of Patients Cared for by Hospitalists, General Internists, and Family Physicians at 45 Hospitals.

Between September 2002 and June 2005, a total of 76,926 patients 18 years of age or older were discharged with a principal diagnosis of pneumonia, heart failure, chest pain, ischemic stroke, urinary tract infection, acute exacerbation of chronic obstructive pulmonary disease, or acute myocardial infarction from 1 of 45 hospitals that contributed data on hospitalists. Of these patients, 32% were cared for by 284 hospitalists, 43% were cared for by 993 general internists, and 25% were cared for by 971 family physicians. The mean age of the patients was 69 years, 57% were women, and 66% were white (Table 1). Pneumonia accounted for 28% of cases. Overall, the mean length of stay was 4.9 days, costs averaged $7,796, and approximately three of four patients were discharged home. A total of 3351 patients (4.4%) died during hospitalization, and 6.7% were readmitted within 14 days after discharge.

More than half of the hospitals were located in the South, 74% served an urban population, 35% had 200 to 399 beds, and one quarter were involved in the training of house staff. As compared with the hospitals included in the 2003 annual survey of the American Hospital Association, the hospitals included in our analysis were larger, more often urban, and more likely to be engaged in the training of house staff.

PRACTICES OF HOSPITALISTS, GENERAL INTERNISTS, AND FAMILY PHYSICIANS

Figure 1.



Estimated Annual Inpatient Case Volume for the Seven Diagnoses According to Physician Group.

On average, physicians categorized as family physicians cared for approximately 20 patients with one of the seven selected diagnoses each year, general internists cared for 30, and hospitalists cared for 75 (Figure 1). As compared with patients cared for by general internists or family physicians, patients cared for by hospitalists tended to be younger, were more likely to be male, black or Hispanic, and enrolled in a managed-care plan (Table 1). Patients treated by hospitalists were more likely to receive care at larger hospitals, in urban settings, and in the South and not in the Midwest. There were few clinically significant differences in the case mix and coexisting conditions of patients cared for by the three physician groups, and unadjusted in-hospital death rates were similar. Fourteen-day readmission rates ranged from 6.3% among patients cared for by hospitalists to 6.9% for those cared for by general internists. The mean length of stay ranged from 4.7 days for patients cared for by hospitalists to 5.2 days for those cared for by general internists. Mean costs ranged from $7,077 per case for patients cared for by family physicians to $8,078 for those cared for by hospitalists.

RESULTS OF MULTIVARIABLE ANALYSES

Table 2.

Table 2. Regression-Model Estimates for Length of Hospital Stay and Cost.

Variable	Length of Stay (days)	Cost (U.S. $)
	adjusted mean (95% CI)*	
Physician specialty		
Hospitalist	2.9 (2.8–3.0)	5,129 (4,895–5,375)
Internist	3.3 (3.2–3.4)	5,397 (5,203–5,599)
Family physician	3.3 (3.2–3.4)	5,254 (5,046–5,471)
Physician specialty according to primary diagnosis		
Pneumonia		
Hospitalist	3.3 (3.2–3.4)	4,993 (4,747–5,251)
Internist	3.9 (3.8–4.0)	5,400 (5,200–5,608)
Family physician	3.9 (3.7–4.0)	5,143 (4,910–5,387)
Heart failure		
Hospitalist	3.2 (3.0–3.3)	5,505 (5,236–5,788)
Internist	3.7 (3.6–3.8)	5,858 (5,621–6,106)
Family physician	3.6 (3.5–3.8)	5,607 (5,349–5,877)
Chest pain		
Hospitalist	1.6 (1.6–1.7)	3,731 (3,533–3,939)
Internist	1.8 (1.7–1.8)	3,711 (3,565–3,863)
Family physician	1.8 (1.7–1.8)	3,705 (3,550–3,866)
Ischemic stroke		
Hospitalist	3.6 (3.4–3.7)	6,067 (5,766–6,384)
Internist	3.9 (3.8–4.1)	6,222 (5,954–6,501)
Family physician	4.0 (3.9–4.2)	6,365 (6,058–6,689)
Urinary tract infection		
Hospitalist	2.7 (2.6–2.9)	3,796 (3,614–3,985)
Internist	3.1 (3.0–3.2)	3,899 (3,730–4,077)
Family physician	3.1 (3.0–3.3)	3,823 (3,630–4,026)
Acute myocardial infarction		
Hospitalist	3.3 (3.1–3.5)	8,952 (8,249–9,715)
Internist	3.7 (3.5–3.9)	9,635 (9,082–10,223)
Family physician	3.7 (3.5–3.9)	9,141 (8,619–9,694)
Chronic obstructive pulmonary disease, acute exacerbation		
Hospitalist	3.0 (2.9–3.2)	4,419 (4,159–4,694)
Internist	3.7 (3.5–3.8)	4,861 (4,652–5,078)
Family physician	3.6 (3.4–3.7)	4,653 (4,431–4,885)

* Means reported in original units (days or dollars) are the antilog of the mean values for each physician specialty, adjusted for all covariates. See the Supplementary Appendix for the full regression model.

Regression-Model Estimates for Length of Hospital Stay and Cost.

Table 3.

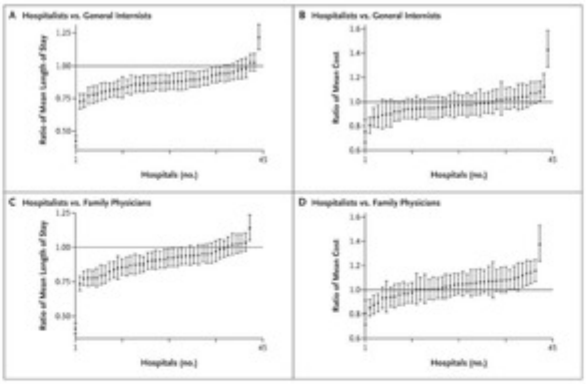
Table 3. Model-Adjusted Length of Stay, Cost, and Outcomes of Care.*

Diagnosis	Length of Stay		Cost		Death		Readmission within 14 Days	
	Ratio (95% CI)†	P Value	Ratio (95% CI)†	P Value	Odds Ratio (95% CI)‡	P Value	Odds Ratio (95% CI)‡	P Value
All seven diagnoses								
Hospitalist vs. general internist	0.88 (0.86–0.90)	<0.001	0.95 (0.91–0.99)	0.02	0.95 (0.85–1.05)	0.29	0.98 (0.91–1.05)	0.55
Hospitalist vs. family physician	0.88 (0.85–0.91)	<0.001	0.98 (0.93–1.02)	0.33	0.95 (0.83–1.07)	0.39	0.95 (0.87–1.04)	0.28
Pneumonia								
Hospitalist vs. general internist	0.85 (0.82–0.88)	<0.001	0.92 (0.88–0.97)	0.001	0.99 (0.86–1.14)	0.87	1.05 (0.92–1.19)	0.48
Hospitalist vs. family physician	0.86 (0.82–0.90)	<0.001	0.97 (0.92–1.03)	0.30	0.90 (0.76–1.06)	0.22	1.02 (0.87–1.19)	0.81
Heart failure								
Hospitalist vs. general internist	0.86 (0.83–0.90)	<0.001	0.94 (0.89–0.99)	0.02	0.83 (0.66–1.04)	0.10	0.86 (0.72–1.02)	0.09
Hospitalist vs. family physician	0.87 (0.83–0.91)	<0.001	0.98 (0.93–1.04)	0.53	1.29 (0.97–1.72)	0.08	1.06 (0.76–1.16)	0.58
Chest pain§								
Hospitalist vs. general internist	0.94 (0.90–0.98)	0.002	1.01 (0.96–1.06)	0.84	NA		0.89 (0.67–1.19)	0.44
Hospitalist vs. family physician	0.94 (0.90–0.98)	0.004	1.01 (0.96–1.06)	0.80	NA		0.84 (0.61–1.16)	0.28
Ischemic stroke								
Hospitalist vs. general internist	0.91 (0.88–0.95)	<0.001	0.98 (0.92–1.03)	0.40	0.92 (0.72–1.17)	0.48	0.90 (0.69–1.18)	0.46
Hospitalist vs. family physician	0.88 (0.86–0.93)	<0.001	0.95 (0.89–1.02)	0.14	1.14 (0.84–1.55)	0.41	0.87 (0.64–1.19)	0.39
Urinary tract infection								
Hospitalist vs. general internist	0.89 (0.85–0.93)	<0.001	0.97 (0.92–1.03)	0.34	0.80 (0.49–1.29)	0.33	0.88 (0.68–1.13)	0.31
Hospitalist vs. family physician	0.88 (0.83–0.92)	<0.001	0.99 (0.93–1.06)	0.82	0.80 (0.47–1.36)	0.41	0.78 (0.59–1.04)	0.10
Acute myocardial infarction								
Hospitalist vs. general internist	0.89 (0.84–0.95)	<0.001	0.93 (0.85–1.02)	0.11	1.06 (0.83–1.34)	0.63	0.98 (0.76–1.26)	0.85
Hospitalist vs. family physician	0.89 (0.84–0.95)	<0.001	0.98 (0.89–1.07)	0.65	1.07 (0.81–1.42)	0.62	1.02 (0.75–1.37)	0.91
Chronic obstructive pulmonary disease, acute exacerbation								
Hospitalist vs. general internist	0.83 (0.79–0.87)	<0.001	0.91 (0.85–0.97)	0.002	0.93 (0.69–1.45)	0.75	0.97 (0.76–1.23)	0.78
Hospitalist vs. family physician	0.85 (0.81–0.89)	<0.001	0.95 (0.89–1.02)	0.13	0.80 (0.49–1.30)	0.36	0.91 (0.69–1.20)	0.51

* Models were adjusted for the patients' sex, age group, payer category, and race and for adjusted annual case volume (>40 vs. ≤40 patients per year), primary diagnosis, coexisting conditions, hospital region, number of beds, teaching status, population, and the interaction between specialty and primary diagnosis. NA denotes not available.
† The ratio is the cost or length of stay for patients cared for by hospitalists as compared with the cost or length of stay for patients cared for by internists or family physicians.
‡ Odds ratios are for hospitalists as compared with internists and for hospitalists as compared with family physicians.
§ Patients with chest pain were excluded from the mortality models.

Model-Adjusted Length of Stay, Cost, and Outcomes of Care.

Figure 2.



Model-Adjusted Differences in the Length of Hospital Stay and Cost among Patients Cared for by Hospitalists, General Internists, and Family Physicians.

In multivariable models adjusted for the principal diagnosis, patient characteristics, hospital characteristics, case volume, and clustering of patients with physicians and of physicians with hospitals, patients cared for by hospitalists, as compared with those cared for by general internists, had a 0.4-day shorter length of stay (P<0.001) and $268 lower costs (P=0.02) but similar death and readmission rates (Table 2 and Table 3, and Table A of the Supplementary Appendix, available with the full text of this article at www.nejm.org). Differences in length of stay were observed for all seven diagnoses and costs differed significantly for three diagnoses. We noted relatively little variation in these patterns among the 45 hospitals we studied (Figure 2). As compared with the length of stay among patients cared for by family physicians, the length of stay among patients cared for by hospitalists was 0.4 day shorter (P<0.001), and costs, rates of death, and readmission rates were similar.

In propensity-adjusted models, the estimated difference in the length of stay for patients cared for by hospitalists as compared with patients cared for by general internists decreased (adjusted difference, 0.3 day [P<0.001]; adjusted ratio, 0.90; 95% confidence interval [CI], 0.88 to 0.93), and although costs remained lower for patients with some diagnoses, the differences were no longer significant in aggregate (adjusted difference, $191 [P=0.11]; adjusted ratio, 0.96; 95% CI, 0.92 to 1.01) (Table B of the Supplementary Appendix). Differences in the length of stay for patients cared for by hospitalists as compared with those cared for by family physicians were also reduced (adjusted difference, 0.3 day [P<0.001]; adjusted ratio, 0.91; 95% CI, 0.86 to 0.96), and minor cost differences were not significant (adjusted difference, $156 [P=0.25]; adjusted ratio, 0.97; 95% CI, 0.92 to 1.02). In general, propensity adjustment did not alter effect estimates for rates of death or readmission; however, it did suggest a reduced rate of readmission among patients treated by hospitalists as compared with patients who received care from family physicians (adjusted odds ratio, 0.89; 95% CI, 0.80 to 0.99).

In models that were not adjusted for volume, the length of stay and cost varied by less than 0.10 day and $15, respectively, as compared with models that included the volume term. Furthermore, cost and length of stay for high-volume hospitalists as compared with high-volume general internists (cost, $251 [P=0.06]; length of stay, 0.4 day [P<0.001]) and for high-volume hospitalists as compared with high-volume family physicians (cost, $330 [P=0.06]; length of stay, 0.6 day [P<0.001]) varied little from estimates produced in models that did not include an interaction term for specialty by volume. Finally, differences in cost and length of stay between patients cared for by hospitalists and those cared for by internists or family physicians did not vary according to the teaching status of the hospital.

Discussion

In this large observational study, we found that hospitalist care was associated with inpatient rates of death and 14-day readmission rates that were similar to the rates for care provided by general internists and family physicians. Furthermore, although we observed small differences in cost between the care provided by hospitalists and that provided by general internists, these findings were not consistent across statistical models, and the costs between hospitalists and family physicians were similar. Nevertheless, patients treated by hospitalists had a length of stay that was modestly shorter than that of patients treated by general internists or family physicians, and these differences persisted even after adjustment for physician caseload, suggesting that other proposed benefits of the hospitalist model, such as on-site availability or the alignment of incentives with the hospital, are more related to reductions in length of stay than is experience.[29] The lack of clear cost savings, despite more than a 10% reduction in the length of stay, suggests that, as compared with their counterparts, hospitalists compress the same or even greater amounts of testing and treatment into a shorter amount of time.

Our study's size (in terms of hospitals, physicians, and patients), diversity of hospitals and settings, and methods distinguish it from previous research on hospitalist care.[18,30] Most of the evidence from previous studies suggested that care provided by hospitalists had strong effects on costs and length of stay, but these studies were performed at single sites and had weak designs or little-to-no adjustment for the severity of illness. Better-designed studies showed the same efficiency advantages as well as a potential for improvement in the rate of death, but they were severely limited by residual confounding[20] or very small numbers of hospitalists.[22] Although we observed reductions in length of stay that were consistent with recent systematic reviews, the cost savings associated with hospitalist care are lower than those in previous reports and were vulnerable to more robust attempts to limit confounding. Furthermore, we found no significant differences in the costs of care associated with hospitalists and family physicians.

Possible reasons for this discrepancy are that the results of previous studies are less generalizable than initially thought, that they primarily compared hospitalists with other internists (both specialists and generalists), and that they did not include enough community-based hospitals. In addition, our study took place several years after these earlier studies, so secular trends toward reduced length of stay and costs may have affected all physicians and their systems of care. Moreover, family practitioners may simply have a less resource-intensive practice style than their colleagues who are general internists or hospitalists.[31] This difference may derive from their patients' preferences or from their specialty training. Finally, the general internists and family physicians in our study may be a self-selected group of physicians who have made the decision to retain responsibilities for inpatient care (or who have been asked to retain their inpatient responsibilities) even after the services of hospitalists were made available.

Our study has several limitations. Although it was observational in nature, we undertook a number of statistical approaches and secondary analyses to reduce the risk of bias. Nevertheless, underlying differences in the patient populations of the three physician groups led us to rely heavily on multivariate adjustment to produce unconfounded results, and factors unaccounted for in administrative data may have served as unmeasured confounders. For example, we lacked information about the age and duration of practice of the physicians in our study; these factors may influence resource use. Furthermore, we had no information about the hospitalist services themselves, particularly how long they had been in place, methods for assigning patients to hospitalists, or organizational features such as explicit incentives for reductions in length of stay. Similarly, we could not measure how often the general internists or family physicians in our study had cared for their own patients, the patients of their partners, or patients without primary care physicians who had been assigned to them through a roster. The relatively similar outcomes we observed among the three physician groups may therefore reflect a large percentage of patients cared for by physicians who did not benefit from a longitudinal relationship with them.

In addition, although our cost data were derived from the cost-accounting systems of participating hospitals, these data were not calculated and reported uniformly among sites, and this inconsistency may have introduced bias. We focused our analysis on several important outcomes; however, we were limited to information concerning in-hospital deaths, and we would not have been able to detect differences in deaths that occurred after discharge. Moreover, although hospitalists were no more likely than other physicians to discharge patients to non–acute care facilities, we were unable to fully assess downstream costs. Although the seven conditions we studied are extremely common, they make up a relatively small percentage of the annual caseload for physicians who care for hospitalized patients. Consequently, there is a risk that our findings may not be generalizable to the full spectrum of inpatient medicine. Finally, we relied on administrative data to identify hospitalists, so we may have misclassified physicians. However, the definition used to identify hospitalists was consistent with that of the Society of Hospital Medicine and produced results that were not affected by adjustment for case volume.

In conclusion, the hospitalist model is associated with relatively modest improvements in efficiency as compared with traditional approaches to caring for hospitalized patients. Given the large and growing presence of hospitalists, there remains a need to understand how hospitalist systems should be structured in order to improve the quality and outcomes of care.

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Supplementary Material

Supplementary Appendix PDF 738KB

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