ORIGINAL RESEARCH

Comparison of Practice Patterns of Hospitalists and Community Physicians in the Care of Patients with Congestive Heart Failure

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OBJECTIVE: The objective of the present study was to compare the practice patterns of hospitalists and community physicians in the care of patients with congestive heart failure.

DESIGN/PARTICIPANTS/SETTING: The study was a retrospective chart review of 342 patients treated for congestive heart failure at a community-based teaching hospital.

MEASUREMENTS: Use of established therapeutic modalities for congestive heart failure and utilization of resources by hospitalists and nonhospitalists were compared. Outcome measures were adjusted length of stay (LOS), costs per case, in-hospital mortality, acute renal failure rate, and readmission rate.

RESULTS: The patients of hospitalist were more likely to receive ACE-I or ARB therapy within 24 hours of admission (86% vs. 72%; $P = .003$), intravenous diuretics (90% vs. 73%; $P < .001$), and social work consultation (48% vs. 29%; $P < .001$). They were less likely to have had serial chest radiographs (4% vs. 13%; $P = .01$) and multiple consultants (8% vs. 16%; $P = .03$). Hospitalists' patients with an illness whose severity was categorized as minor had a 40% reduction in LOS, those with a moderately severe illness had a 20% reduction, and those with an extremely severe illness had a 13% reduction ($P = .002$). Costs per case were reduced by \$1000-\$3100 across all severity categories ($P < .001$). Rates of acute renal failure and readmission were similar between the groups.

CONCLUSIONS: Early use of ACE-I/ARB, aggressive approach to diuresis, greater involvement of social work services and decreased use of chest radiographs and medical consultants were identified as distinct practices of hospitalists in this medical center. These practices may have led to a shorter LOS and lower costs while preserving quality of care and possibly improving clinical outcomes. ***Journal of Hospital Medicine*** **2008;3:35–41.** *© 2008 Society of Hospital Medicine.*

KEYWORDS: hospitalists, congestive heart failure, quality measures, resource utilization.

The use of hospitalists, physicians who specialize in inpatient care, has seen a rapid expansion over the last decade.[1] Several studies have shown that with hospitalists there is a shorter length of stay (LOS) and decreased utilization of resources and that hospitalists play a positive role in medical education.[2–4] However, only a few studies have examined the specific strategies employed by hospitalists to achieve improved efficiency and outcomes.

Congestive heart failure (CHF) is the most common diagnosis of hospitalized patients older than age 65, with more Medicare spending devoted to patients with CHF than to any other diagnosis-related group (DRG).[5,6] Over the last 2 decades hospital dis-

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charges for congestive heart failure increased by 165%.[7] In addition, the rate of hospital readmission of patients with CHF remains high: 2%, 20%, and 50% within 2 days, 1 month, and 6 months, respectively.[8]

Several previous studies have shown that patients cared for by hospitalists had improved clinical outcomes. Meltzer et al. found that 30-day mortality of hospitalists' patients was lower than that of non-hospitalists' patients, 4.2% versus 6.0%, respectively, in the second year of implementation of a hospitalist program.[3] A study by Huddleston et al. showed a reduction of 11.8% in the rate of complications experienced by postsurgical orthopedic patients with the involvement of hospitalists in their care in conjunction with the surgeons.[4]

Many previous studies have pointed to improvements in economic outcomes such as LOS and costs for patients followed by hospitalists. Kulaga et al. showed that patients cared for by hospitalists had reductions of approximately 20% in LOS and 18% in total costs per case compared with those cared for by community-based physicians.[2] Meltzer et al. found a decrease in the average adjusted LOS of 0.49 days in the second year of implementation of a hospitalist program.[3] Rifkin et al. found that patients with pneumonia cared for by hospitalists had a mean adjusted LOS of 5.6 days versus 6.5 days for those cared for by non-hospitalists.[9]

Few previous studies have looked at specific practice patterns of hospitalists that result in improved efficiency and better outcomes. Rifkin et al., who found that patients with pneumonia cared for by hospitalists had a shorter LOS, suggested this finding was a result of the earlier recognition by hospitalists that patients were stable and more rapid conversion to oral antibiotics.[9] Likewise, Stein et al. found that community-acquired pneumonia patients treated by hospitalists had a shorter LOS than those treated by non-hospitalists. However, they were unable to assess the differences in patient management that led to this result because of the design of the study.[10]

Lindenauer et al. compared quality-of-care indicators and resource utilization for patients with congestive heart failure treated by hospitalists and non-hospitalist general internists. They found that patients under the care of hospitalists had a shorter LOS than those cared for by general internists but that the overall costs of care were similar between the groups.[11] They compared the quality indicators developed by the Joint Commission on Accreditation of Healthcare Organizations in the Core Measures Initiative, but did not focus on patterns of practices of hospitalists and nonhospitalists. Moreover, they did not look at full-time hospitalists but focused on physicians who spent at least 25% of their practice caring for inpatients.

We sought to identify distinct, quantifiable practices of full-time hospitalists in the management of their patients with CHF. We hypothesized that hospitalists would adhere more closely to the current congestive heart failure guidelines and would utilize available resources more judiciously, leading to improved clinical and economic outcomes. To identify these practices, we compared utilization of well-established therapeutic and diagnostic modalities such as use of ACE-I, ARB, and beta-blockers; ordering of chest x-rays; measurement of brain natriuretic peptide (BNP); and use of medical subspecialty consultants. We also compared standard clinical and economic outcomes such as in-hospital mortality, readmission rate, LOS, and costs per case between hospitalists and community-based physicians.

METHODS

Design and Setting

The study was a retrospective chart review of 447 patients treated for CHF from July 1, 2003, through June 30, 2004, at the Queen's Medical Center, a 505-bed community-based teaching hospital in Honolulu, Hawaii, and the leading medical referral center in the Pacific Basin. All patients had been cared for by either a community-based physician or a hospitalist. The community-based physicians (referred to as non-hospitalists from here on) were a diverse group of internists and subspecialists, in solo or group practice, who provided inpatient and ambulatory care. The non-hospitalist group included 119 cardiologists (55%), 83 general internists (38%), and 3 family practitioners (1%), with the other 6% made up of clinicians in the medical oncology, pediatrics, pulmonary, radiation oncology, and thoracic/cardiovascular surgery subspecialties.

The hospitalist group comprised 10 full-time internists employed by the hospital who provided care for patients only in the inpatient setting and 3 part-time hospitalists who practiced in the ambulatory setting in addition to providing inpatient night coverage for the group. During the study period, 2 hospitalists left the group, and 2 hospitalists were hired. On average the length of involvement of

a full-time hospitalist in the study was 9 months. Permission to conduct this study was granted by the Queen's Medical Center Institutional Review Board.

Patient Population

Patients were included in the study if they were admitted to Queen's Medical Center during the 18-month study period, were at least 18 years old, and were coded on discharge by the medical records department with a principal diagnosis of congestive heart failure (*International Classification of Diseases, 9th Revision,* codes 428, 428.1, 428.9, 402.01, 402.11, 402.91, 404.01, 404.11, and 404.91). Baseline characteristics of patients collected were age, sex, insurance status, comorbidities, and code status on admission. Comorbidities included coronary artery disease, diabetes mellitus (type 1 or 2), hypertension, chronic renal insufficiency (creatinine $>$ 2 mg/dL), and chronic obstructive pulmonary disease (COPD). Patients were excluded if they had initially been admitted to the medical intensive care unit, required ventilatory support, had end-stage renal disease requiring hemodialysis, or had an LOS greater than 14 days.

Data Collection

Medical records were reviewed by research nurses not directly involved with the hospitalist group. Training to ensure high-level reliability of data collection was provided, and reliability was verified by the primary author (M.M.R.). The following data were collected: use of ACE-I, ARB, and beta-blockers on admission and discharge; use of intravenous and oral diuretics; time to switch to oral diuretic; rates of utilization of medical consultants, physical therapy, dietary consults, social work, and sodium and fluid restriction; and number of repeat chest radiographs, echocardiograms, and BNP measurements. These criteria were developed based on ACC/AHA 2005 guidelines for diagnosis and management of congestive heart failure in adults,[11] several studies delineating the importance of initiating therapy in the inpatient setting, and the experience of the Cardiovascular Hospital Atherosclerosis Management Program (CHAMP) for patients with established coronary artery disease.[13–15] Data on medical resident involvement in patient care were collected for hospitalists and non-hospitalists.

Additional outcomes included in-hospital mortality, rate of acute renal failure, readmission rate, LOS, expense, revenue, and margin per case. Acute renal failure was defined as a doubling of the admission creatinine value. The rate of readmission—defined as readmission to Queen's Medical Center for any reason—was evaluated after 7, 14, and 30 days and was stratified further for readmissions for CHF. Expense was defined as costs directly related to patient care plus costs related to operating a hospital facility. Revenue was defined as the compensation the hospital expected to collect for service rendered adjusted for bad debt/charity care. Margin was defined as revenue minus expense.

Data Analysis

Descriptive statistics are reported for baseline patient characteristics (age, sex, insurance status, etc.), quality-of-care measures (ACE-I, ARB, diuretic, and beta-blocker use, time to oral diuretic, etc.), and outcome measures (readmission rate, in-hospital mortality, LOS, cost data) using frequencies and proportions for categorical variables (eg, sex, ethnicity, insurance status), means and standard deviations (SDs) for continuous variables (age), and medians and interquartile ranges (Q1-Q3) for skewed variables (eg, LOS, cost data). The patients cared for by hospitalists were compared with those cared for by non-hospitalists using the chi-square test or Fisher's exact test for categorical data and the Student t test for continuous data. All-Payer Severity-adjusted Diagnosis Related Groups (APS-DRGs) were used to control for severity of patient illness. The severity of illness codes were taken from 3M APR Benchmarking software for DRGs adjusted for severity of illness and risk of mortality. 3M defined severity of illness as "the extent of physiologic decompensation or organ system loss of function." Each diagnosis was assigned 1 of 4 severity levels: minor, moderate, major, or extreme. Kruskal-Wallis analysis of covariance was used for LOS and cost outcomes, adjusting for age, insurance status, comorbidities, and severity of illness. Multivariate logistic regression was performed for binary outcomes (eg, ACE-I, ARB, beta-blocker use) to adjust for confounding variables. Statistical analysis was performed using SAS version 9 (SAS Institute Inc., Cary, NC). All tests were 2-sided, and differences with a P value $<$ .05 were considered significant.

RESULTS

Patient Characteristics

Table 1 shows the patient characteristic data. There were 447 admissions for congestive heart failure

TABLE 1
Patient Characteristics by Physician Group

	Non-hospitalist cases (%) (n = 216)	Hospitalist cases (%) (n = 126)	*P* value
Age (years, mean ± SD)	73 ± 15	63 ± 16	**< .001**
Male sex	124 (57)	78 (62)	.41
Caucasian ethnicity	41 (19)	30 (24)	.29
Insurance status			
Medicare	119 (55)	58 (46)	.11
Medicaid/Quest	16 (7)	33 (26)	**< .001**
HMSA	68 (31)	19 (15)	**< .001**
Self-pay	3 (1)	7 (6)	**.04**
Other	10(5)	9(7)	.33
Comorbidy			
CAD	127 (59)	53 (42)	**.003**
DM	78 (36)	53 (4)	.27
HTN	139 (64)	80 (63)	.87
CRI	43 (20)	28 (22)	.61
COPD	30 (14)	26 (21)	.10
Prior CHF	120 (56)	56 (44)	**.05**
Full code	174 (81)	113 (90)	**.07**
House staff involvement	42 (19)	20 (16)	.41

HMSA, Hawaii Medical Service Association; CAD, coronary artery disease; DM, diabetes mellitus (type 1 or 2); HTN, hypertension; CRI, chronic renal insufficiency; COPD, chronic obstructive pulmonary disease; CHF, congestive heart failure.

TABLE 2
Use of Therapeutic Modalities and Resource Utilization by Physician Group

	Non-hospitalist cases (%) (n = 216)	Hospitalist cases (%) (n = 126)	*P* value*
ACE-I/ARB within 24 hours	155 (72)	108 (86)	**.001**
Beta-blocker within 24 hours	119 (55)	50 (40)	**.004**
ACE-I/ARB at discharge	147 (69)	95 (75)	.24
Beta-blocker at discharge	116 (54)	52 (41)	**.03**
Echocardiogram ≥ 1	125 (58)	81 (64)	.50
MD Consultants ≥ 2	35 (16)	10 (8)	**.01**
Chest x-ray ≥ 2	27 (13)	5 (4)	**.02**
BNP 1	128 (59)	95 (75)	**.005**
BNP > 1	22 (10)	7 (6)	.14
Physical therapy	35 (16)	17 (13)	.48
Dietary consult	29 (13)	19 (15)	.67
Social work	62 (29)	60 (48)	**.003**
Sodium restriction	184 (85)	102 (81)	.31
Fluid restriction	47 (22)	35 (28)	.21
IV diuretic	158 (73)	114 (90)	**.001**
Time to oral diuretic (days), median (Q1,Q3)	1 (1, 3)	1 (0, 2)	.30

**P* values after adjusting for age, insurance status, comorbidities, and severity.

during the study period, 342 of which met study inclusion criteria. Hospitalists provided care for 126 of these patients and non-hospitalists for 216 patients. Mean age of patients in the hospitalist and nonhospitalist groups was 63 and 73 years, respectively. There were significant differences in insurance status, with hospitalists more frequently caring for patients covered by Medicaid (26% vs. 7%; $P < .001$) and patients who were uninsured (6% vs. 1%; $P = .04$). Patients cared for by hospitalists had a lower incidence of coronary artery disease (42% vs. 59%; $P = .003$) and prior CHF (44% vs. 56%; $P = .05$). The hospitalists' patients were more likely to have a full resuscitation code status on admission; however, this difference did not reach statistical significance (90% vs. 81%; $P = .07$). There were no significant differences between patients cared for by hospitalists and non-hospitalists in sex, ethnic background, other comorbidities, or house staff involvement.

Practice Patterns and Resource Utilization

Practice patterns and resource utilization are shown in Table 2. Hospitalists used more ACE-I/ARBs, with 86% of patients receiving these interventions within 24 hours of admission versus 72% of the patients of non-hospitalists (adjusted $P = .001$). Hospitalists treated fewer patients with beta-blockers on admission and on discharge and more patients with intravenous diuretics (90% vs. 73%; adjusted $P = .001$). The rate of beta-blocker use did not change significantly after controlling for patients with COPD (data not shown).

Hospitalists were less likely to obtain 2 or more chest x-rays (4% vs. 13%; adjusted $P = .02$) or to obtain 2 or more medical consultations (8% vs. 16%; adjusted $P = .01$). In addition, they obtained more initial measurements of BNP; however, there was a trend toward fewer repeat BNP measurements (6% vs. 10%; $P = .14$). There was a significantly higher rate of social work utilization by hospitalists than by nonhospitalists (48% vs. 29%; adjusted $P = .003$). There were no differences between the groups in the rates of obtaining echocardiograms, physical therapy, and dietary consults or in sodium and fluid restrictions.

Outcomes

Significant differences were noted in LOS and cost outcomes between hospitalists and non-hospitalists after adjusting for age, insurance status, comorbidities, and severity of illness (Tables 3 and 4). Patients cared for by hospitalists had a shorter overall LOS than did patients cared for by non-hospi-

TABLE 3
Severity-Adjusted LOS and Costs*

	Severity	Nonhospitalist cases (n = 216)	Hospitalist cases (n = 126)	*P* value
Severity (%)	Minor	40 (19)	30 (24)	.13
	Moderate	99 (46)	64 (51)	
	Major	72 (33)	27 (21)	
	Extreme	5 (2)	4 (3)	
LOS (days)	Minor	5 (3, 6)	3 (2, 4)	**.002**†
	Moderate	5 (3, 7)	4 (3, 6)	
	Major	6 (4,10)	6 (4, 10)	
	Extreme	8 (2, 8)	7 (6, 8)	
Expense ($)	Minor	5792 (4414, 6715)	4164 (2401, 5499)	**< .001**†
	Moderate	6953 (4273, 10,224)	5951 (4301, 8621)	
	Major	13,622 (8219, 28,553)	10,519 (5249, 15,581)	
	Extreme	18,908 (12913, 24,688)	16,192 (6135, 26,147)	
Revenue ($)	Minor	7095 (6611, 7212)	7116 (4160, 7218)	.06†
	Moderate	7118 (7025, 7215)	6893 (3755, 7164)	
	Major	9601 (6972, 16,668)	6743 (4612, 7116)	
	Extreme	11,019 (10,009, 24,897)	9184 (5783, 13,931)	
Margin ($)	Minor	786 (162, 2997)	2290 (−409, 4768)	.14†
	Moderate	256 (−1999, 3366)	−796 (−2741, 1565)	
	Major	−2314 (−7870, 1448)	−3499 (−8818, 1008)	
	Extreme	−1263 (−2904, 4012)	−6537 (−15,617, 3050)	

*LOS and cost data are presented as medians (Q1, Q3).
†Kruskal-Wallis analysis of covariance *P* value for hospitalist versus nonhospitalist cases, adjusting for age, insurance status, comorbidities, and severity.

TABLE 4
Clinical Outcomes

	Nonhospitalist cases (%) (n = 216)	Hospitalist cases (%) (n = 126)	*P* value
Acute renal failure	2 (1)	0 (0)	0.53
In-hospital mortality	9 (4)	0 (0)	**0.03**
Readmission for any reason	53 (25)	35 (28)	0.52*
Readmission for CHF	19 (9)	18 (14)	0.16*

**P* values after adjusting for age, insurance status, comorbidities, and severity.

talists (adjusted $P = .002$). A shorter LOS was noted for patients in the minor (median 3 vs. 5 days), moderate (median 4 vs. 5 days), and extreme (7 vs. 8 days) severity categories. Overall adjusted expense was significantly lower for the care of hospitalists' patients across all severity categories ($P < .001$). There was a trend toward lower adjusted revenue for patients of hospitalists than those of non-hospitalist ($P = .06$). The adjusted profit margin did not significantly differ between the groups ($P = .14$).

In-hospital mortality of patients treated by hospitalists was lower than that of non-hospitalist-treated patients (0% vs. 4%; $P = .03$). Rates of acute renal failure, overall readmissions and readmissions specifically for congestive heart failure did not differ significantly. Notably, severity of illness assessed by APS-DRG did not differ between hospitalists' and nonhospitalists' patients ($P = .13$).

DISCUSSION

Practice Patterns

Our study identified specific practices that hospitalists use more than non-hospitalists in the management of patients with CHF. These practices, which may have resulted in decreased LOS and lower costs, included higher use of ACE-I/ARB within 24 hours of admission and of intravenous diuretics. We hypothesized that earlier and more aggressive use of ACE-I/ARB contributed to afterload reduction and alteration of cardiac remodeling[5] and may have led to faster recovery and improved outcomes. Greater use of intravenous diuretics may signify that hospitalists have a more aggressive approach to managing exacerbations of acute congestive heart failure, which may also lead to faster recovery.

Hospitalists used fewer beta-blockers on admission and at discharge. Reasons for this finding remain unclear; however, it may have been a result of the practice of avoiding beta-blockers during

exacerbations of acute CHF and the subsequent reliance on primary care providers to restart beta-blockers after discharge. Lower use of beta-blockers did not appear to have a negative impact on mortality or readmission rates.

Resource Utilization

Hospitalists used fewer serial chest x-rays, more initial BNP measurements, and more social work consults, and there was a trend toward their using fewer repeat BNP measurements. The less frequent use of serial chest x-rays may be a result of hospitalists being able to assess patients more frequently and to rely less on imaging. Higher rates of initial BNP measurement by hospitalists may reflect the ordering patterns of the emergency room physicians because most patients are admitted to the hospitalists via the emergency room. The trend toward fewer repeat BNP measurements by hospitalists may again reflect their ability to perform more frequent clinical assessments and to rely less on laboratory data. The higher rate of utilization of social workers by hospitalists is likely a reflection of a population in need of such interventions rather than the hospitalists having a lower threshold before requesting a social work consultation. There were no differences in the rates of obtaining echocardiograms, physical therapy, and dietary consults and of sodium and fluid restrictions.

Clinical Outcomes

Severity of illness assessed by APS-DRG did not differ between the patients cared for by hospitalists and those care for by non-hospitalists ($P = .13$) despite the hospitalists caring for a younger population. In-hospital mortality of hospitalist-treated patients was lower (0% vs. 4%), whereas the rates of readmission and renal failure did not differ between the 2 groups. A slight advantage in the mortality rate appears to be in agreement with prior findings[3,4]; however, this may have been a result of the non-hospitalists caring for an older patient population.

Economic Outcomes

The shorter LOS and lower overall costs of patients followed by hospitalists supports previous findings.[2, 3,10] The LOS in our study was found to be shorter for hospitalist-treated patients whose illnesses were in the minor, moderate, and extreme severity categories by 40%, 20%, and 13%, respectively. The median expense per case was less across all severity categories, ranging from $1000 to $3100 for the patients followed by hospitalists compared with those followed by non-hospitalists. There was a trend toward lower adjusted median revenue in all categories except for minor severity for hospitalists' patients ($P = .06$). The profit margin per case did not differ significantly between patients cared for by hospitalists and non-hospitalists. The shorter LOS and lower expenses per case of patients under the care of hospitalists should have led to higher revenue and profit margin. However, our study showed lower revenue and no significant differences in profit margin, which may be explained by the fact that the hospitalists' patients had a worse insurance mix with a higher proportion of uninsured and Medicaid patients. It is also possible that non-hospitalists, in particular, cardiologists, generate higher revenue by performing more procedures such as cardiac catheterizations, thus offsetting the costs.

As noted above, the analysis of LOS, expenses, revenue, and margin controlled for age, comorbidities, severity of illness, and insurance status (Table 3). The results were not significantly affected by adjusting for age, insurance status, and comorbidities after controlling for severity. The difference in age may in part be a result of older patients having established relationships with primary care physicians and being less likely to be admitted by hospitalists. It may also reflect the high prevalence of methamphetamine abuse, which has reached epidemic proportions in Hawaii, and methamphetamine-induced cardiomyopathy in a younger population of patients followed by hospitalists. Further studies would be necessary to estimate the impact of drug-induced congestive heart failure in these populations.

Although our study provided a detailed look at practice patterns of a coherent hospitalist group, it had several important limitations. It was a retrospective study conducted at a single institution, making the findings difficult to generalize to hospitalist practices nationwide. It included an unusually large number of non-Caucasian patients, reflecting the demographics of the state of Hawaii. Data on contraindications to ACE-I/ARB were not collected because the degree of renal dysfunction that would serve as a contraindication was difficult to define. The primary mode of adjustment was APS, which may have been a limiting factor in assessing severity of illness. The inability to follow patients' course

after discharge limited collection of long-term outcomes data.

In agreement with previous studies, we showed a decreased LOS and lower expenses per case of patients cared for by full-time hospitalists while preserving quality of care and improving clinical outcomes. We identified specific practices of hospitalists in the management of patients with CHF that differ from those of non-hospitalists. These practices include early use of ACE-I/ARB, aggressive approach to diuresis, higher utilization of social work services, and decreased utilization of serial chest x-rays, medical consultants, and serial BNP measurements. Our study was not designed to identify a direct causal relationship between hospitalist practices and improved outcomes; however, we believe it to be the first step in understanding practice patterns and the impact of the hospitalist movement.

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