BRIEF REPORTS

Economic Effects of Community Versus Hospital-Based Faculty Pneumonia Care

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To compare the length of stay and charges for patients with pneumonia admitted in 1995 to the teaching and nonteaching services of a Northeastern teaching hospital, we reviewed the charts of 237 patients. Patients cared for by hospital-based generalists working with housestaff (teaching service) were discharged more quickly and with lower or equivalent charges than patients cared for by community-based attending physicians working either with housestaff (private teaching service) or alone (nonteaching service). Academic teaching services staffed by general medicine faculty may provide efficient inpatient pneumonia care.

KEY WORDS: pneumonia, cost of care; hospital-based generalists; community-based generalists; teaching service; hospitalists.

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At a time when managed care contracting has created fiscal pressures at academic centers, hospital stays continue to account for a high proportion of overall patient care costs. Not surprisingly, traditional models of inpatient care at teaching hospitals are being reevaluated.¹

Residency teaching services are thought to be particularly inefficient in providing care. The average cost of hospitalization has been reported to be 30% to 40% higher at academic centers than in nonacademic institutions.² Whether this reported difference derives from overutilization of services, differences in severity mix, or a higher intrinsic cost structure remains unclear. Although medical decisionmaking at teaching hospitals is shared between housestaff and attending physicians, at most programs housestaff independently order tests and arrange for consultations, which may accelerate or impede hospital discharge. Again, it has been assumed that housestaff participation adds to the cost of care, and educational programs targeted at unnecessary diagnostic tests by housestaff have been attempted.³

At Rhode Island Hospital, three models of inpatient care exist, providing the grounds for a natural experiment. Using a single diagnosis, pneumonia, that has a well-defined measure of severity of illness, we compare the economic implications of three models of inpatient care in order to gain insight into practice style differences between housestaff teaching services and a nonteaching service.

METHODS

Rhode Island Hospital is a 719-bed not-for-profit Brown University Medical School teaching hospital located in Providence, Rhode Island, with medical students and housestaff rotating through its teaching services. It also serves as a community hospital for local private internists and family practice physicians.

Patients are admitted in a nonrandom fashion to three services that offer different models of inpatient care. On the General Medicine Teaching Service (GTS), housestaff care for patients under the supervision of full-time, hospital-based faculty of the general medicine division. General medicine faculty each serve at least 3 months on this service every year. On the Private Teaching Service (PTS), community-based private internists care for patients with the assistance of the same, rotating housestaff. On the Non-Teaching Service (NTS), community-based private internists care for patients without housestaff involvement. Housestaff may simultaneously have patients on the GTS and PTS.

Patients are admitted to one of these three services at the discretion of the emergency department attending physician, the patient's private attending physician, housestaff, and the patient's preference, with four exceptions: those who do not have an outpatient doctor; those who have private physicians who do not admit to Rhode Island Hospital; those who are cared for by housestaff in their ambulatory clinics; and those whose attending physician is one of the general internal medicine faculty are admitted to GTS.

The study population was drawn from adults discharged in 1995 with ICD-9-CM codes 480-486, community-acquired pneumonia. We excluded patients who were known to be HIV-positive, those who had a previous hospitalization within 7 days of admission, those transferred

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from another acute care hospital, and those admitted directly to an intensive care unit. We abstracted 237 consecutive records from the 419 discharges in 1995 using standardized forms; records were reviewed in the order of the hospital medical record number. We recorded patient demographics (age, gender, source of admission [emergency department vs direct], race, and type of insurance), as well as those key historical findings (congestive heart failure, coronary heart disease, stroke, cancer), physical examination findings (blood pressure, temperature, heart rate, respiratory rate, mental status), and laboratory findings (albumin, sodium, PaO₂, hemoglobin) at the time of hospital admission needed to complete the *validated* Pneumonia Severity Index (PSI) for each patient.^{4,5} The PSI has been validated in a MedisGroup population with community-acquired pneumonia and provides accurate estimates of hospital mortality (receiver operating characteristic area 0.85).⁴

The PSI score is measured from 0 to 1, with higher values signifying more severe illness. We also recorded whether patients had a do-not-resuscitate order written within the first 48 hours of admission, were transferred to an intensive care unit, or died, and their length of stay (LOS).

Using the hospital administrative database, we recorded whether patients were readmitted for treatment of pneumonia in the 30 days following discharge. This database also provided patient charges, which we divided into laboratory, radiologic, and total charge categories.

The attending physicians on the three services were described using Department of Medicine listings of age and gender. Those who had no subspecialty training were considered general internists.

Bivariate analyses were conducted between clinical service type (GTS, PTS, NTS), patient characteristics (e.g., gender, admission source, race, insurance), and patient outcomes (mortality, readmission), using Fisher's Exact tests, or Student's *t* tests. The relation of service type to severity of pneumonia was calculated using analysis of variance (ANOVA). Because of skewness in the distribution of LOS and charges, we used the natural logarithm of

the observed LOS or charges, and its association with clinical service type was calculated using ANOVA. For LOS comparisons, we used geometric means.

RESULTS

Of 237 patients, 53% were male, 71% were white, and 89% were admitted through the emergency department. Nearly two-thirds of patients were insured by Medicare, 22% had private insurance, and 9% were uninsured. Regarding clinical care, 20% had do-not-resuscitate orders, 1.7% were transferred to an intensive care unit, and 5% died during their stay. There were 114 patients on the GTS, 75 on the NTS, and 48 on the PTS.

There were no significant differences between the three services with regard to any of the aforementioned patient variables other than insurance and age (Table 1). Patients on GTS were more likely to be uninsured or have Medicaid and less likely to have Medicare; GTS patients were also significantly younger (GTS 59 vs NTS 75 vs PTS 72 years old). Characteristics of attending physicians for the three services are also included in Table 1.

As shown in Table 2, patients on the GTS had a significantly higher ($p < .05$) mean PSI score (0.60, SD 0.3) than patients on NTS (mean 0.50, SD 0.3) or PTS (mean 0.45, SD 0.3), signaling higher severity of illness. Despite having higher severity of illness, the GTS patients had a significantly shorter mean LOS of 5.4 days (SD 6.1; range 1–35) than patients on NTS (mean 6.5 days, SD 6.9; range 2–47) or PTS (mean 6.8 days, SD 6.0; range 2–31). The multiple correlation coefficient squared (R^2) for the PSI in predicting LOS was 0.12.

When considering charges, the NTS and the GTS services had similar total charges, and both were significantly lower than the PTS total charges (see Table 1). The NTS had significantly lower laboratory charges than either of the other services, as well as lower radiologic charges. The PTS had the highest charges in all categories, laboratory, radiologic, and overall.

There were no significant differences between the three services in hospital mortality (estimated difference

Table 1. Characteristics of Attending Physicians and Pneumonia Patients for Three Services

Characteristic	Physicians		
	General Medicine	Private	Nonteaching
Attending physicians			
<i>n</i>	16	52	39
Male gender, %	56	89	92
Subspecialist, %	0	15	31
Mean age, years (range)	36 (30–47)	48 (32–75)	46 (30–78)
Patients			
<i>n</i>	114	48	75
Uninsured or Medicaid, %	29	4	5
Medicare, %	49	74	74
Mean age, years	59	72	75

Table 2. Length of Stay and Charges by Model of Care*

Model	PSI (95% CI)	Mean LOS, days (95% CI)	LOS Range	Total Charges, \$ (95% CI)	Lab Charges, \$ (95% CI)	Radiologic Charges, \$ (95% CI)
General medicine teaching (n = 114)	0.60 (0.55, 0.66)	5.4 (4.3, 6.5)	1–35	10,164 (8,612, 11,716)	1,505 (1,315, 1,695)	236 (137, 335)
Non teaching (n = 75)	0.50 (0.43, 0.56)	6.5 (5.2, 7.8)	2–47	9,696 (7,923, 14,469)	908 (743, 1,073)	191 (140, 241)
Private teaching (n = 48)	0.45 (0.36, 0.54)	6.8 (5.4, 9.8)	2–31	13,667 (10,467, 16,866)	1,699 (1,321, 2,076)	332 (201, 464)

*PSI indicates pneumonia severity index; LOS, length of stay.

0.03%; 95% confidence interval [CI]–0.07, 0.1), intensive care unit transfers (estimated difference 0.03%; 95% CI 0.01, 0.04), or 30-day readmission (estimated difference 0.03%; 95% CI –0.34, 0.3) for pneumonia.

DISCUSSION

Traditionally, academic and community hospitals have provided different models of inpatient care. Academic hospitals pair full-time faculty with housestaff to provide care, while community hospitals most often have office-based attending physicians caring for inpatients without residents. In this study, a single hospital allowed for a comparison of these two models of inpatient care, as well as another model in which community-based attending physicians work with house officers. Having three models in a single setting where patients are admitted to the same units, using the same nursing staff and hospital support services, eliminates important potential differences that might influence a study of models of care at different hospitals. Studies on LOS in patients with pneumonia have found wide variation that is not explained by differences in hospital characteristics.^{6,7} We found that patients with pneumonia, cared for by hospital-based generalists working with housestaff, were discharged more quickly than pneumonia patients cared for by community-based attending physicians working alone or with housestaff, and that the full-time generalist service had total charges approximately equivalent to those of the non-teaching service.

To ascertain whether differences in LOS or charges were due to differences in patient mix, we included a severity-of-illness measure to adjust for such differences. We found that pneumonia patients on the general medicine teaching service were in fact more severely ill than those on the other two services, eliminating severity differences as an explanation for shorter stays. Patients on this service were also younger and more likely to be uninsured or have Medicaid, eliminating the possibility that private insurers' utilization review programs were driving down LOS. It is possible that these patients' younger age

allowed them to improve more quickly, despite being more severely ill. However, we speculate that the availability of full-time attending physicians more likely explains the shorter LOS on the GTS service. Private attending physicians most often do rounds once a day and may be less available for patient care decision making. If attending physicians' visits occur only in the morning, late afternoon discharges may be less likely to occur on the private services, which may in turn lead to an additional hospital day. We do not have information on time of discharge or the particular rounding patterns of all attending physicians in this study, but those on the GTS are present on inpatient wards for longer periods each day than are community-based attending physicians who return to their offices after morning visits. Importantly, the shorter LOS on the GTS did not come at the cost of higher readmission rates.

Despite having a day shorter LOS, the GTS had total charges nearly equivalent to those of the NTS, the service with the lowest overall charges. This was because the GTS had higher laboratory and radiologic test ordering charges. Thus, although the availability of GTS faculty may lead to quicker discharges, the influence of housestaff (who do all test ordering on this service) is noted in total charges. The GTS faculty probably has some influence on house officer test ordering, as seen by the fact that on the PTS, laboratory and radiologic charges are even higher.

There are limitations to this study. It is from a single hospital with perhaps an unusual mechanism for admitting patients to three distinct services. Nonetheless, the GTS is similar to inpatient services at most teaching hospitals and the NTS is similar to that found at community hospitals. This allowed for an analysis that if done *between* hospitals could be faulted for the inability to control for hospital-specific factors such as nursing staffs. Second, we studied patients with a single condition. We therefore cannot comment on the generalizability to patients with other diseases or conditions at our hospital or elsewhere. It may be that the process of care for patients with pneumonia is quite different from the process of care for those with congestive heart failure or stroke. Pneumonia

was chosen because it is a common condition with a well-studied severity measure available. Although the severity measure does not include pneumonia etiology (which we did not capture), it allowed us to control for the nonrandom assignments of patients to inpatient services.

Few studies have compared care in academic centers with that in other hospitals, and these have not adjusted for severity of illness, have considered heterogeneous groups of patients with multiple medical conditions, or have relied purely on claims data that lacked clinical detail.^{8,9} In 1996, Cooper et al. noted that teaching hospitals do not appear to provide inefficient care or overutilize a particular procedure, upper endoscopy, when compared with community facilities in the treatment of upper gastrointestinal hemorrhage.¹⁰

Given the other activities of GTS faculty (research, education) and difficulties of caring for poorly insured patients, we expected that academic services would have significantly higher overall charges than their nonacademic counterparts, and they did not; GTS total charges were \$450 higher than NTS but \$3,500 lower than total charges of PTS patients. Our findings do not support the popular contention that "academic" services are inefficient or more costly.¹¹ Indeed, the full-time faculty service was more efficient in terms of LOS. The GTS service physicians are functioning as "hospitalists" according to the job description of Wachter and Goldman,¹ in that all GTS attending physicians run an inpatient service for at least 3 months a year. Whether LOS could be further decreased at our hospital by the creation of a service of full-time attending physicians whose *sole* function is inpatient care remains to be seen. Our findings suggest that such full-time hos-

pitalists may be most efficient in terms of test ordering if they work without housestaff.

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