Does Experience Matter?

A Comparison of the Practice of Attendings and Residents

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OBJECTIVE: To compare the utilization of health care resources and patterns of chronic disease care by patients of medical residents and patients of their attending physicians.

MATERIALS AND METHODS: This study involved a longitudinal cohort of 14,554 patients seen over a 1-year period by 149 residents and 36 attendings located in an urban academic medical center. Data were acquired prospectively through a practice management system used to order tests, write prescriptions, and code ambulatory visits. We assessed resource utilization by measuring the total direct costs of care over a 1-year period, including ambulatory and inpatient costs, and the numbers and types of resources used.

RESULTS: Residents' patients were similar to attendings' patients in age and gender, but residents' patients were more likely to have Medicaid or Medicare and to have a higher burden of comorbidity. Total annual ambulatory care costs were almost 60% higher for residents' patients than for attendings' patients in unadjusted analyses, and 30% higher in analyses adjusted for differences in case mix (adjusted mean \$888 vs \$750; $P=.0001$). The primary cost drivers on the outpatient side were consultations and radiological procedures. Total inpatient costs were almost twice as high for residents' patients compared to attendings' patients in unadjusted analyses, but virtually identical in analyses adjusted for case mix differences (adjusted mean of \$849 vs \$860). Admission rates were almost double for residents' patients. Total adjusted costs for residents' patients were slightly, but not significantly, higher than for attendings' patients (adjusted mean \$1,651 vs \$1,540; $P>.05$). Residents' and attendings' patients generally did not differ in the patterns of care for diabetes, asthma/chronic obstructive pulmonary disease (COPD), congestive heart failure, ischemic heart disease, and depression, except that residents' patients with asthma/COPD, ischemic heart disease, and diabetes were admitted more frequently than attendings' patients.

CONCLUSIONS: Our results indicate that residents' patients had higher costs than attendings' patients, but the differences would have been seriously overestimated without adjustment. We conclude that it costs about 7% more for residents to manage patients than for attendings. On the ambulatory side, the larger number of procedures and consultations ordered for residents' patients appears to drive the higher costs.

KEY WORDS: experience; resource utilization; attendings; residents; costs.

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In the past, teaching hospitals have been found to provide more expensive care than nonteaching hospitals.^{1–3} Within a single facility, care provided by medical residents proved costlier than care that did not involve medical residents; this

suggests that the difference in cost may have been attributable to the inexperience of the medical residents.⁴ This view reflects the common belief that residents lack the clinical expertise to distinguish necessary procedures from unnecessary ones, resulting in higher rates of hospitalization and excessive testing.^{5–7} Alternatively, higher costs have been attributed more to differences in case mix and severity of illness than to a “teaching effect.”⁸ Given the wide agreement that hospitals with residents incur significantly higher costs than nonteaching hospitals, a key question remains unanswered: to what extent are the characteristics of cost attributable to inexperience of residents versus the demographic and clinical differences in patients cared for by residents in hospital-based practices?

The objective of this study was to determine whether patients managed by residents and attendings have higher costs of care or different patterns of chronic disease management compared to patients managed by attendings without residents, adjusting for differences in patient characteristics.

METHODS

Population

This study included all 149 internal medicine residents and 36 attendings who cared for outpatients at the general internal medicine practice of New York Hospital–Cornell Medical Center during a 1-year period beginning December 1, 1993. Of the 36 attendings, 23 were full time in practice and 13 worked part time, between 1 and 3 sessions per week. A total of 4 physicians were senior residents for half the year and attendings for half the year; if they initially saw the patient as a resident, the patients were coded as residents' patients. Categorical medicine residents spent 2 months in ambulatory block rotation when they were full time in the practice, and 1 session per week in the practice during most rotations, except the critical care units. When a patient needed care and their usual resident was not available, a resident assigned to the same attending saw the patient. If the appointment was unscheduled, however, a resident on ambulatory block assigned to see unscheduled patients saw the patient. If initially seen by attendings, the patients were coded as attendings' patients. Patients cared for by nurse practitioners were not evaluated in this study. All patient care by residents was provided under the direct supervision of an attending, who was continuously present during the resident session. All patients who were seen by a resident in the first postgraduate year (PGY-1) were presented to the attending, who personally saw and evaluated the patients. All new patients seen by PGY-2 and PGY-3 residents were also evaluated by the attending. The attendings review and cosign all notes written by the house staff. Patients

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cared for by both residents and attendings will be referred to as "resident patients" subsequently.

Data were obtained from an ambulatory management system, CLIMACS (developed by one of the authors, JPH), which is used by the practice in the daily care of patients. Secretarial staff obtained demographic information as a part of patient registration and appointment scheduling. Physicians coded diagnoses with each visit, developing cumulative diagnosis lists. As a result, CLIMACS prospectively collected data about all aspects of the clinical practice, including patient demographics, appointments, medications, and International Classification of Diseases—Ninth Revision (ICD-9) diagnoses. All physicians used this system to write prescriptions and order laboratory tests, consultations, radiology, and other procedures; therefore, the system had resource utilization data. From the database compiled during the 1-year period, beginning December 1, 1993, we examined the subset of data for the 14,554 patients who had at least 1 visit with a resident or attending. The 632 patients seen by nurse practitioners, social workers, and other health care professionals were excluded from the analysis.

The cumulative diagnostic lists were used to generate the Charlson comorbidity score,⁹ which assesses the overall burden of comorbid disease by assigning weights to specific comorbid conditions. For example, myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease, and diabetes have a weight of 1; hemiplegia, moderate or severe renal disease, diabetes with end organ damage, any tumor, leukemia, lymphoma, a weight of 2; moderate or severe liver disease, a weight of 3; and metastatic solid tumor or AIDS, a weight of 6. For any patient, the total comorbidity score is the sum of the weights and it reflects long-term prognosis, specifically mortality. The Deyo adaptation was used to translate these comorbid conditions to ICD-9 codes.¹⁰

To assess reliability of residents' coding in the database, we compared data from CLIMACS with data from a chart review of the paper medical records regarding the ICD-9 diagnoses for diabetes mellitus, asthma, and chronic obstructive pulmonary disease (COPD). For diabetes the undercoding rate was 0.8%. For asthma and COPD, the undercoding rate was 7.7%.¹¹

Chronic Disease Management

We evaluated the management of patients with several chronic health conditions including diabetes mellitus, asthma, COPD, ischemic heart disease, congestive heart failure (CHF), and depression. For each disease, we examined hospitalization rates to New York Presbyterian Hospital both for exacerbation of the underlying disease as well as admission for any reason. In addition, several performance measures for each of these conditions were evaluated. The majority of these criteria were based on the Health Employer Data and Information Set (HEDIS) 2.0,¹² which specifies several quality-of-care performance indicators.¹³ For diabetics, we assessed hemoglobin A1c (HgA1c) monitoring, referrals to ophthalmology, podiatry, and for diabetic teaching. For patients with asthma or COPD, we evaluated the use of inhaled beta agonists, and inhaled and oral steroids. In patients with CHF, we evaluated the use of angio-

tensin-converting enzyme (ACE) inhibitors. In patients with ischemic heart disease, we assessed the use of beta blockers. Finally, we assessed the use of antidepressants in patients with depression.

Resource Utilization

We examined the resource utilization for both outpatient and inpatient care by assessing the number of different services provided and the cost for those resources. Outpatient resources included actual visits, laboratory work, radiological tests, other procedures, consultations, and other tests; all were obtained from the ambulatory computer management system (CLIMACS). For each category of service, data on charges from the ambulatory system were converted to cost using the specific ratio of cost to charges for each category of service. Inpatient costs were obtained from the hospital cost-accounting system (Transition Systems Inc., Boston, MA), which primarily tracks actual costs; a minority of costs was converted from charges by cost-to-charge ratios.

The total cost for each patient includes the cost of primary care visits, laboratory tests, radiographs, consultations, and the costs generated for any hospitalization during the year, excluding the costs of hospitalization prior to their first outpatient appointment. The total costs did not capture all of the care provided by external providers, including tests ordered by other providers and performed in outside laboratories. Because hospital costs only include those costs at New York Presbyterian Hospital, the costs were not captured if patients were hospitalized elsewhere.

Statistical Analysis

In order to control for the correlation of findings within specific physicians, we compared the demographic and clinical characteristics of patients cared for by residents and attendings using PROC GENMOD¹⁴ in SAS (SAS Institute, Cary, NC) with the specific physician as a random factor. Because 20 different potential covariates were evaluated, a nominal *P* value of .0025 was required for significance.

Assessments of differences between residents and attendings in management of chronic diseases were performed using GENMOD in SAS, controlling for covariates that differed between resident and attending patients at baseline. In these analyses, the specific physician was included as a repeated measure or random factor. Analyses of count data such as the number of hospitalizations or consultations were conducted using PROC GENMOD with a Poisson distribution, while existential (yes/no) data was done with a binomial distribution.

Because the distribution of total costs was positively skewed, all analyses were carried out on the logarithm of total costs, which corrected for the nonnormality in untransformed costs. To aid interpretation, data are presented as total costs rather than the logarithm of costs. Differences between residents and attendings were evaluated with SAS PROC MIXED.¹⁴ The significance levels are from multivariate models considering covariates that differed between resident and attending patients, with individual physicians as a random factor.

Table 1. A Comparison of the Baseline Characteristics of Patients of Residents and Attendings

	Patients of Residents	Patients of Attendings	P Value
Number of patients	6,307	8,247	
Mean age, y $\pm$ SD	49.2 $\pm$ 18.0	49.1 $\pm$ 17.9	ns
Women, %	70	67	ns
Insurance type, %			.0001
Medicare	23	14	
Medicaid	47	11	
Managed care	10	29	
Self-pay	13	38	
Newly referred after hospitalization, %	5	2	.0001
Comorbidity score, %			
0	56	74	
1	27	17	
2	10	5	
3	4	2	
≥ 4	3	2	.002
Specific comorbid illness, %			
Hypertension	33	20	*
Diabetes	9	5	.001
Peptic ulcer disease	15	7	.0001
Ischemic heart disease	8	5	ns
Osteoarthritis	17	11	ns
Cancer	6	3	ns
Asthma	13	8	.001
Depression	8	5	.001
Chronic obstructive pulmonary disease	6	4	ns
Cellulitis/skin ulcer	2	1	.001
Dementia	2	1	.0006

* $P < .05$, but $P > .0025$.

P values are based on bivariate screening using PROC GENMOD with physician as a random factor.

ns, not significant.

RESULTS

Table 1 shows the comparison of patients' demographic and clinical characteristics, according to whether the patients had both residents and attendings or only attendings involved in their care. Patients with both residents and attendings involved in their care will be referred to as resident patients subsequently. Resident patients had been seen in the practice for an average of 1.1 ± 1.4 years, while attending patients had been seen in the practice for an average of 1.0 ± 1.3 years ($P = .075$). In total, 45.8% of resident patients and 47.6% of attending patients were new to the practice during the year. Among the patients who were new to the practice, 4.9% of resident patients and 1.6% of attending patients were referred to the practice and seen as outpatients after hospitalization ($P < .0001$).

Multivariate analysis revealed that resident patients differed from attending patients in type of insurance, with more Medicaid and Medicare and less commercial insurance ($P = .004$) and a higher burden of comorbidity than attending patients ($P = .002$). Similar proportions of resident and attending patients had symptoms such as abdominal pain (9.2% vs 5.5%), chest pain (7.4% vs 4.4%), fatigue (5.7% vs 4.7%), gastrointestinal symptoms (3.9% vs 2.7%), back pain (11.2% vs 6.0%), headaches (6.2% vs 3.0%), and dizziness (3.4% vs 2.6%). Resident and attending patients had similar rates of use of beta blockers (6.9% vs 5.4%), coumadin (1.3% vs 1.3%), and antipsychotic agents (1.0% vs 0.5%). Resident patients were slightly more likely to be taking calcium channel blockers (14.8% vs 8.0%), narcotic analgesics (5.5% vs 3.8%), and prednisone (1.4% vs 0.9%) than attending patients. All these differences were nonsignificant.

Numbers of Primary Care Visits, Ambulatory Tests, and Consults

First we evaluated the total number of primary care visits and blood tests, radiographic tests, and consults ordered in the ambulatory setting for resident and attending patients; then we evaluated the rates per ambulatory visit. When unadjusted primary care visits were evaluated, resident patients had 3.3 primary care visits compared with 2.6 visits for attending patients. However, as shown in Table 2, the adjusted rates were identical; resident and attending patients both had 3.0 primary care visits.

The adjusted total tests ordered by residents and attendings were roughly equal; however, residents ordered more radiology tests and attendings more blood tests per patient ($P = .0001$ for both). If instead the unadjusted total tests were compared, resident patients would have had an average of 2.1 more tests. Residents requested 50% more consultations than attendings did ($P = .0001$); if the rates were unadjusted, the consultation rates would have appeared double for resident patients.

Residents and attendings ordered similar numbers of total tests per visit, but residents ordered about 60% more consults. Hence, resident patients received significantly more consultations ($P = .0001$ for all).

Costs of Care

Table 3 shows the adjusted yearly ambulatory costs. In total, resident patients had adjusted ambulatory annual costs about 30% higher than those for attending patients. Attending

Table 2. The Adjusted Number of Primary Care Visits, Tests, and Consults Ordered in the Ambulatory Setting for Patients of Residents and Patients of Attendings

	Mean Number Ordered			Mean Number Ordered per Visit		
	Patients of Residents	Patients of Attendings	P Value	Patients of Residents	Patients of Attendings	P Value
Primary care visits	2.95 ± 0.04	3.00 ± 0.03	ns			
Tests ordered						
Radiology tests						
Plain radiographs	0.41 ± .02	0.36 ± 0.02	.002	0.16 ± 0.01	0.12 ± 0.01	.0001
Computed tomography	0.03 ± 0.01	0.03 ± 0.01	ns	0.01 ± 0.01	0.01 ± 0.01	ns
Magnetic resonance imaging	0.03 ± 0.01	0.02 ± 0.01	.0001	0.02 ± 0.01	0.01 ± 0.01	.0001
Total radiology	.62 ± 0.03	0.49 ± 0.02	.0001	0.25 ± 0.01	0.18 ± 0.01	.0001
Blood and other tests	6.49 ± 0.09	7.05 ± 0.08	.0001	2.31 ± 0.06	2.62 ± 0.05	.0001
Total tests and procedures	7.93 ± 0.14	8.04 ± 0.12	.ns	3.02 ± 0.06	3.10 ± 0.05	ns
Consultations						
Surgical	0.55 ± 0.02	0.32 ± 0.13	.0001	0.26 ± 0.01	0.15 ± 0.01	.0001
Medicine subspecialties	0.15 ± 0.01	0.10 ± 0.01	.0001	0.06 ± 0.01	0.04 ± 0.01	.0001
Other*	0.19 ± 0.01	0.14 ± 0.01	.0001	0.09 ± 0.01	0.07 ± 0.01	.0001
Total consults ordered	0.95 ± 0.02	0.61 ± 0.02	.0001	0.45 ± 0.01	0.28 ± 0.01	.0001

P values reflect multivariate analysis.

Mean per patient per year (± SD).

The significance levels are from multivariate models considering age, gender, insurance, comorbidity, whether or not the patients were newly referred immediately after hospitalization, and specific illnesses that differed between resident and attending patients as shown in Table 1 (hypertension, diabetes, peptic ulcer disease, asthma, depression, dementia, and skin ulcers/cellulitis), with individual physicians as a random factor.

ns, not significant.

*other consults.

patients had higher laboratory test costs ($P=.0001$). Resident patients had greater costs for radiology tests, for other tests (e.g., vaccinations, tuberculosis screening, and flexible sigmoidoscopies), and for consultations ($P=.0001$ for all). Residents also had a higher cost per visit ($P=.0001$), primarily because of consultations and radiology procedures. Total adjusted inpatient costs for resident patients were virtually identical to those incurred by attending patients, but they appeared almost twice as high without adjustment (\$1,136 vs \$625).

A total of 8.5% of resident patients were hospitalized versus 4.9% of attending patients ($P=.0001$). Moreover, 2.6% of resident patients were hospitalized 2 or more times versus 1.4% of attending patients ($P=.0001$). When admitted, resident patients had a slightly, but not significantly, longer adjusted length of stay than attending patients (10.1 vs 9.2 days) and a slightly, but not significantly, longer length of stay over geometric mean targets (3.3 vs 2.9 days).

When the unadjusted and adjusted total annual costs for resident and attending patients were compared, the total adjusted costs for resident patients were 7% higher than for attendings (\$1,665 vs \$1,563; $P=.38$), but the unadjusted costs appeared to be almost twice as high (\$2,053 vs \$1,210).

Management of Chronic Diseases

There were 1,435 diabetic patients, 72% of resident patients and 59% of attending patients, who required oral agents or insulin ($P=.001$). After controlling for type of medication (insulin vs oral agents), age, gender, insurance status, and the other variables that differed between resident and attending patients, attending patients had more hemoglobin A1c's and fewer ophthalmology consults ($P=.0001$) (Table 4). A higher proportion of resident patients were admitted for control of diabetes ($P=.04$). Attending patients with asthma or COPD were less likely to be maintained on inhaled beta agonists than resident patients, but attending and resident patients did not differ in the use of inhaled or oral corticosteroids after controlling for age, gender, insurance, and other covariates. Admissions of resident and

attending patients for exacerbations of asthma or COPD did not differ significantly; however, fewer attending patients with these conditions were admitted for any reason.

For patients with CHF, there were no differences in the use of ACE inhibitors between resident and attending patients. Rates of admission did not differ significantly between resident and attending patients. Similar proportions of attending and resident patients with ischemic heart disease received beta blockers. Attending patients who had ischemic heart disease had lower overall hospitalization rates ($P=.01$).

Approximately one half of attending and resident patients with a diagnosis of depression received antidepressants. Admission rates for depression or any cause did not differ significantly between resident and attending patients.

DISCUSSION

This study is the first to evaluate differences in resource use for residents and attendings for ambulatory and hospital costs after controlling for patient demographic and clinical characteristics. After adjustment for case mix, resident patients have similar hospital costs but higher ambulatory costs. Higher ambulatory costs result primarily from more consultations and radiology tests obtained on resident patients than attending patients. Unadjusted total costs were compared between resident patients and attending patients; resident patients had almost double the cost. When adjusted, however, the total cost was about 7% higher for resident patients in comparison to attending patients. The performance of care according to HEDIS-like criteria did not differ.

Academic medical centers were 33% to 44% more expensive and other teaching hospitals were 14% to 20% more costly than nonteaching hospitals, ostensibly after adjustment for case mix and the direct costs of graduate medical education.¹⁻³ The higher costs of teaching as opposed to nonteaching hospitals has been attributed to a teaching effect or academic programs per se and practice style as well as to the inexperience of residents.¹⁵ Most of the studies have focused on costs and care for inpatients¹⁶; unmeasured case mix

Table 3. Comparisons of the Adjusted Annual Ambulatory Costs and Ambulatory Costs per Visit for Resident Patients and Attending Patients

	Total Costs per Patient			Costs per Visit		
	Patients of Residents	Patients of Attendings	P Value Multivariate Model	Patients of Residents	Patients of Attendings	P Value
Laboratory tests	\$96 ± 2.9	\$114 ± 2.4	.0001	\$33 ± 1.4	\$44 ± 1.1	.0001
Tests and consults	\$475 ± 8.3	\$356 ± 6.9	.0001			
Primary care visits	\$430 ± 6.6	\$394 ± 5.5	.0001			
Total ambulatory costs	\$888 ± 12.7	\$751 ± 10.6	.0001			
Hospitalization costs	\$849 ± 82	\$860 ± 71	ns			
Total costs	\$1,651 ± 83	\$1,540 ± 72	ns			
Total radiology	\$128 ± 4.1	\$91 ± 3.4	.0001	\$51 ± 1.7	\$33 ± 1.4	.0001
Other tests	\$31 ± 1.5	\$25 ± 1.2	.0001	\$10 ± 0.4	\$8 ± 0.3	.0001
Consultations	\$192 ± 4.4	\$120 ± 3.6	.0001	\$89 ± 2.2	\$54 ± 1.9	.0001
All tests and consults	\$457 ± 8.3	\$356 ± 6.9	.0001	\$190 ± 3.6	\$142 ± 3.0	.0001

Mean per patient per year (± SD).

The significance levels are from multivariate models considering age, gender, insurance, comorbidity, whether or not the patients were newly referred immediately after hospitalization, and specific illnesses that differed between resident and attending patients as shown in Table 1 (hypertension, diabetes, peptic ulcer disease, asthma, depression, dementia, and skin ulcers/cellulitis), with individual physicians as a random factor. ns, not significant.

differences have also been suggested.^{17,18} In addition, researchers have sought to evaluate the cost and quality of care in light of physicians' training and specialties.¹⁹⁻²³

The teaching effect hypothesis is that an attending and a resident jointly caring for a patient generate more utilization than any single physician. However, two studies involving the introduction of residency programs into established emergency departments suggest that neither the use of tests nor the costs of care increased when attendings worked with residents instead of independently.^{24,25} Similar results have been re-

ported with regard to family practice, internal medicine, and pediatrics residents.^{26,27}

Differences in practice style have been hypothesized to drive resource utilization patterns. For example, differences between general internists and family physicians have been suggested to lead to different ambulatory utilization patterns^{28,29}; specifically, a technically oriented style of care has been suggested to increase total charges.³⁰ Differences in inpatient charges have been attributed to variation in practice by attendings.³¹ Such variation has historically been linked

Table 4. Measurements Used to Assess the Management of Chronic Diseases

	Residents	Attendings	P Value
Diabetics requiring treatment with oral agents/insulin, n	585	371	
Mean number of hemoglobin A1c levels ordered	2.5	3.0	.0002
One or more ophthalmology consults ordered, %	30.6	12.6	.0001
Podiatry consult ordered, %	6.5	4.6	ns
One or more diabetic teaching consults ordered, %	11.3	7.3	ns
Admitted for any reason, %	19.3	18.1	ns
Admission for diabetic control, %	2.4	0.3	.04
Admission for cellulitis, %	1.4	0.3	ns
Asthma/COPD management, n	791	580	
Inhaled beta agonists ordered, %	52.8	36.9	.0001
Inhaled steroids ordered, %	19.1	14.5	ns
Oral steroids ordered, %	6.5	5.7	ns
Admitted for any reason, %	15.3	10.4	.01
Hospital admission for asthma, %	3.9	1.4	ns
Congestive heart failure, n	50	62	
ACE inhibitors ordered, %	78.0	64.5	ns
Admitted for any reason, %	50.0	27.4	ns
Admitted for congestive heart failure, %	16.0	9.7	ns
Ischemic heart disease, n	475	449	
Beta blockers ordered, %	33.9	29.2	ns
Admitted for any reason, %	24.8	16.5	.01
Admitted for acute myocardial infarction, %	5.1	2.5	ns
Depression, n	522	370	
Antidepressants ordered, %	45.4	51.1	ns
Admitted for any reason, %	13.0	10.5	ns
Admissions for depression, %	0.4	0.3	ns

Controlling for age, gender, insurance status, comorbidity, and specific illnesses that differed between resident and attending patients as shown in Table 1 (hypertension, diabetes, peptic ulcer disease, asthma, depression, dementia, and skin ulcers/cellulitis).

All measurements are taken over a 1-year period.

COPD, chronic obstructive pulmonary disease; ACE inhibitor, angiotensin-converting enzyme inhibitor; ns, not significant.

closely to cost differences and physicians' propensities to hospitalize their patients³² as well as to physicians' decisions about how long a patient should remain in the hospital.³¹ However, only small amounts of resource use have been found to be attributable to differences in practice styles.^{33,34}

One inevitable hypothesis is that residents' lack of experience leads to higher costs and lower quality, although there are studies to the contrary.^{26,27} For example, a recent study showed no difference in total charges, radiology charges, or laboratory charges between a family practice residency teaching service and a hospitalist group.³⁵

Experienced physicians have been shown to use contextual information about the patients' age, gender, and risk factors to reach more parsimonious diagnoses.³⁶ Ambulatory costs were 30% higher for resident patients, controlling for demographic and clinical factors, including comorbidity and whether patients were newly referred after hospitalization. The costs also rose with increasing visits. Whether this is experience or practice style is arguable, because these findings echo other studies of ambulatory resources showing that physicians who saw patients more frequently also ordered more tests and referrals and generated higher costs.³⁷ Of note, there is remarkably little data about how often ambulatory patients should be seen, and consequently, residents may be given considerable discretion about follow-up intervals for patients.

On the ambulatory side, residents did not obtain more laboratory tests per visit than attendings, but they did obtain more radiology tests, especially magnetic resonance imaging and more consults per visit. It is tempting to suggest that controlling utilization of more expensive radiology tests in resident patients would reduce costs; however, efforts to use radiology consultations to reduce utilization, at least among inpatients, have not been effective.^{38,39} Although we did not have data about consultations for inpatients, the higher rates of ambulatory consultation in resident patients are especially striking and resulted in higher total costs and higher total costs per visit for resident patients. In the absence of directly relevant data or literature, we can only speculate that the increased consultations may reflect the residents' uncertainty coupled with the supervising attendings' reluctance to intercede on this issue. If so, then consultation rates may be reduced if supervising attendings become more directive in this regard. There is some evidence that consultations per se drive utilization; on the inpatient service, specialty consultations have been associated with increased length of stay.⁴⁰

On the other hand, inpatient costs did not differ between resident and attending patients, but resident patients were hospitalized twice as often. In the current study, the total costs for resident patients were higher than for attending patients. Unadjusted comparisons indicate that the cost of the resident patients' care was nearly double that of the attending patients' care, while adjusted comparisons indicate that the cost of the resident patients' care exceeded that of attendings' by 9%.

Our study, in particular, was limited by several factors. First, the data on resource utilization which was prospectively assembled and retrospectively analyzed do not include either hospitalizations or tests ordered outside of New York Presbyterian Hospital. Therefore, if patients of residents or attendings were more likely to have care outside our setting, then resource utilization would have been underestimated in that group. We do not have data that allow us to estimate the potential magnitude of the missing data, nor the direction of bias, if it exists.

Second, although the analyses were adjusted for important demographic and clinical characteristics, especially comorbidity, we may not have captured all of the important factors for the case mix adjustment. Third, the same attendings were involved in caring for their own patients and in supervising residents, thereby potentially limiting the practice decisions made by the two groups. An approach comparing resident patients with patients managed by other providers might provide more definitive contrasts.³⁵ Fourth, attendings were better able to provide continuity for the patients than residents, an inherent problem with resident schedules. Fifth, because data were collected over a 12-month interval from December through November, house officers occupied two different postgraduate years during the study; the comparison of performance of different PGYs was problematic. Sixth, the data were collected over 10 years ago; it may not completely reflect current practice, as the attending-to-resident supervisor ratio is now lower in ambulatory settings.

Our results indicate that resident patients had higher costs than attending patients, but the differences would have been seriously overestimated without adjustment. On the ambulatory side, the larger number of procedures and consults ordered for resident patients appears to drive the higher costs. In conclusion, it costs about 7% more for residents to manage patients than attendings and the higher costs for resident patients resulted from higher ambulatory costs. Without adjustment, the total costs would have appeared almost twice as high.

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