The Influence of a Family Practice Residency on the Costs of Inpatient Diagnostic Testing

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A retrospective review of hospital records for 333 patients admitted to a large community teaching hospital by family physicians and family practice residents was performed to determine whether teaching programs in family practice led to a significant increase in the cost of care to patients. Three patient populations were identified for comparison: (1) patients admitted by private family physicians when residents were not involved in patient care, (2) patients admitted by the same family physicians while they served as attending physicians on the family practice service and allowed residents to participate in the care of their patients, and (3) patients admitted by residents from the patient population at the Family Practice Center.

After taking into account differences in case mix, an analysis of laboratory charges, radiology use, frequency of procedures, and use of consultants showed that the three groups were not different. Family practice residents managed their own patients as cost effectively as physicians in private practice, which suggests that experience alone is not necessary to develop methods of cost-efficient care. When these two groups were combined into a teaching unit, with few exceptions this efficiency was maintained. These results imply that the introduction of family practice residents into patient care does not invariably increase expenses to the patient.

Increases in patient care costs because of graduate medical education stem from two sources: (1) the fixed costs of medical education, such as salaries for residents, faculty, and administration, and (2) variable costs, such as increased length of stay, unnecessary or redundant laboratory testing, increased use of consultants, and other factors that result from the participation of inexperienced physicians in patient care. While the fixed costs of medical education cannot be adjusted without major sacrifices, the additional expenses resulting from variable components are amenable to change and should be kept to a minimum. This study was undertaken to identify whether and how much family practice residents in a large community teaching hospital increased patient costs and to identify any areas that could be adjusted to decrease these expenditures.

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There have been several estimates of the increased costs attributable to resident participation in patient care. The medical teaching units of hospitals have been shown in case-matched studies to order 50 percent more laboratory tests and to rely on consultants twice as often as nonteaching units in the same hospital.[1] Case-matched comparisons between university and community hospitals confirm this finding.[2] Several studies in the early 1970s suggested a significant laboratory overuse by internal medicine house staff,[3,4] although a more recent report indicated that this problem may be decreasing.[5]

The majority of these prior studies were performed using internal medicine house staff at a variety of large, university teaching hospitals. The applicability of these findings to family practice teaching programs is questionable based on a report that shows that non-internal medicine house staff on a general medical service order fewer laboratory and radiology tests than internal medicine house staff when the two are paired on the same teaching unit.[6]

This study attempted to address these questions by using three patient populations that vary in the degree to which residents participate in patient care. The first group consisted of patients admitted by private family

physicians during a time when residents were not involved in the care of these patients (nonteaching group). The second group were patients admitted by these same physicians during a time when these physicians served as attending staff for the family practice inpatient teaching service and when residents comanaged patients along with the private clinicians (teaching group). The final group was composed of patients admitted from the Family Practice Center. In this group, the resident admitting the patient was responsible for all management decisions (family practice group). Thus, the extent to which residents participated in patient management ranged from none (in the nonteaching group) to a total control (in the family practice group), and differences in charges between these groups could be the result of resident inexperience.

METHODS

A list of all patients admitted to Riverside Methodist Hospital between December 1983 through May 1984 was generated and the charts of all patients admitted by the Family Practice Center residents or the eight family physicians who were serving as attending physicians were collected for study. During the period noted above, each family physician served as a teaching attending physician for three months and spent three months without house staff involved in the care of their patients. Patients who were admitted for obstetric or psychiatric care were excluded from the study, as residents did not participate in the management of private patients admitted with these problems.

After excluding psychiatric and obstetric patients, a total of 333 patients remained. Seventy-seven of these were admitted by residents from the Family Practice Center population (family practice group), 140 were admitted by private physicians during their tenure as attending physicians (teaching group), and 116 were admitted by private family physicians while they were not associated with house staff (nonteaching group).

Laboratory charges were calculated from the prices in effect at Riverside Methodist Hospital during the time of the study and did not change during the study's course. Determination of the number of tests was done by counting each test appearing on an order sheet as one test even if the study yielded multiple results. Examples of these types of studies include the chemistry profile (serum sodium, potassium, blood urea nitrogen, glucose, chloride, and bicarbonate), the metabolic profile (a series of twelve enzymatic tests), and the myocardial infarction screen (serum lactate dehydrogenase and creatinine phosphokinase with isozymes drawn at hours 0, 12, 24, and 48). Radiology procedures included all computed tomographic scans, ultrasonic studies, and contrast studies as well as plain roentgenograms. Arteriography, nuclear medicine tests, endoscopic procedures, cardiac catheterizations, Doppler studies, echocardiograms, electroencephalograms, electromyograms, and Holter monitor studies were placed in a category called other procedures. Consultations consisted of any response made by a physician or ancillary staff (such as those in social service, speech therapy, or dietary).

Results were compared using chi-square analysis for all proportions and Student's t test for analysis of means.

RESULTS

Patients were grouped into several diagnostic categories based on the presenting problem according to categorizations previously published (Table 1).[7] The frequency of admitting problems for these populations was quite similar to that reported elsewhere for a large internal medicine teaching service,[7] and the rank order of diagnoses for the study group was consistent with the types of problems encountered by family physicians in a large survey of family practice inpatient experiences.[8,9]

Differences among the three admitting groups were statistically significant for patients with neurologic diagnoses ($P < .05$), while there were no significant differences among admitting groups for all other presenting problems. The reason for a difference in the frequency of patients with neurologic disorders was not readily apparent, but in an effort to reduce the small variations among the three groups in the frequency of presenting problems, comparisons were made only within a specific presenting complaint category.

To gauge the severity of a patient's illness, the groups were compared for the mean patient age and average length of stay (Table 2). The mean age of patients was similar for all groups, and no difference was statistically significant (at $P < .05$). The length of hospital stay varied considerably depending on the type of presenting problem, but again, no statistically significant difference existed among the three study groups. These findings suggest that patients in the three groups should be well matched for the severity of their illness.

The study groups were then compared for the mean laboratory charges per person per hospital stay (Table 3). The only difference to reach statistical significance was seen among patients with pulmonary problems. The teaching group averaged $482 in laboratory charges for these patients compared with $274 for the combined patients of the family practice and nonteaching groups ($P < .02$). Also, the number of laboratory tests was higher in the teaching group than in the other two groups ($P < .05$). The average cost per test for pulmonary patients in the teaching group ($15.43), however, is not different from that of the family practice ($15.33) or nonteaching ($14.88) groups, which implies that the increased laboratory charges incurred by pul-

TABLE 1. PRESENTING PROBLEMS OF PATIENTS IN THE THREE STUDY GROUPS

Type of Complaint	Family Practice No. (%)	Teaching No. (%)	Nonteaching No. (%)
Cardiology	23 (30)	45 (32)	25 (22)
Gastrointestinal	16 (21)	24 (17)	23 (20)
Pulmonary	12 (16)	25 (18)	9 (8)
Neurologic	5 (6)	16 (11)	24 (21)
Hematology/oncology	7 (9)	6 (4)	8 (7)
Others	14 (19)	24 (17)	27 (23)
Total	77 (100)	140 (99)	116 (101)

*$\chi^2 = 8.06$, 2 df, $P < .05$

TABLE 2. PATIENT AGE AND HOSPITAL STAY GROUPED ACCORDING TO MAJOR AREA OF PRESENTING COMPLAINT

Presenting Complaint	Family Practice Mean (SD)	Teaching Mean (SD)	Nonteaching Mean (SD)
Patient Age (years)			
Cardiology	64 (17)	61 (17)	64 (14)
Gastrointestinal	49 (26)	58 (24)	61 (25)
Pulmonary	46 (18)	65 (20)	58 (22)
Neurologic	56 (30)	71 (15)	63 (19)
Hematology/oncology	66 (16)	70 (10)	69 (13)
All patients	57 (22)	63 (19)	62 (20)
Length of Stay (days)			
Cardiology	5.3 (3.3)	5.9 (4.7)	9.4 (8.1)
Gastrointestinal	5.3 (4.4)	6.0 (3.9)	7.3 (6.5)
Pulmonary	6.2 (5.0)	10.4 (6.3)	9.8 (9.3)
Neurologic	13.2 (9.8)	11.5 (12.7)	10.3 (9.8)
Hematology/oncology	7.9 (5.8)	11.3 (10.0)	11.0 (9.0)
All patients	7.2 (6.3)	8.0 (7.4)	9.1 (7.9)

SD, standard deviation

TABLE 3. LABORATORY CHARGES AND NUMBER OF TESTS PERFORMED IN EACH DIAGNOSTIC CATEGORY FOR THE THREE STUDY GROUPS

Presenting Complaint	Family Practice Number (SD)	Teaching Number (SD)	Nonteaching Number (SD)
Laboratory charges per person (dollars)			
Cardiology	254 (178)	292 (236)	344 (353)
Gastrointestinal	219 (160)	212 (170)	225 (259)
Pulmonary	276 (155)	482 (347) *	268 (153)
Neurologic	261 (202)	214 (157)	155 (95)
Hematology/oncology	281 (256)	518 (813)	690 (800)
All patients	271 (194)	297 (258)	273 (304)
Tests per person			
Cardiology	16 (11)	16 (12)	21 (24)
Gastrointestinal	19 (14)	18 (15)	18 (21)
Pulmonary	18 (12)	31 (23) **	18 (11)
Neurologic	17 (12)	17 (11)	12 (7)
Hematology/oncology	20 (18)	34 (47)	39 (45)
All patients	19 (14)	20 (18)	19 (22)

SD, standard deviation
**P < .02 when compared with other two groups (t = 2.55, two-tailed test)*
***P < .05 when compared with other two groups (t = 2.32, two-tailed test)*

TABLE 4. ELECTROCARDIOGRAMS AND RADIOGRAPHS PERFORMED IN DIAGNOSTIC CATEGORY FOR THE THREE STUDY GROUPS

Presenting Complaint	Number of Procedures per Patient		
	Family Practice Mean (SD)	Teaching Mean (SD)	Nonteaching Mean (SD)
Electrocardiograms per patient			
Cardiology	2.5 (2.1)*	3.2 (2.1)**	2.8 (1.7)***
Gastrointestinal	0.9 (1.2)	0.9 (0.6)	1.1 (1.0)
Pulmonary	0.5 (0.5)	1.5 (1.2)	0.9 (0.3)
Neurologic	1.8 (1.6)	1.2 (0.7)	1.1 (1.4)
Hematology/oncology	1.4 (1.6)	1.3 (1.9)	1.1 (1.4)
All patients	1.5 (1.6)	1.8 (2.1)	1.4 (1.3)
Roentgenograms per patient			
Cardiology	2.3 (1.3)	2.1 (1.8)	2.8 (2.6)
Gastrointestinal	1.8 (1.4)	2.5 (1.6)	3.0 (2.3)
Pulmonary	3.5 (5.2)	3.8 (3.7)	2.8 (3.6)
Neurologic	1.8 (0.4)	2.3 (1.5)	2.4 (1.8)
Hematology/oncology	2.3 (1.3)	5.0 (4.8)	4.0 (3.6)
All patients	2.3 (2.4)	2.5 (2.3)	2.8 (3.8)

SD, standard deviation
**P < .001 (t = 3.61, two-tailed test) for cardiology patients compared with all other family practice patients*
***P < .001 (t = 5.18, two-tailed test) for cardiology patients compared with all other teaching patients*
****P < .001 (t = 4.73, two-tailed test) for cardiology patients compared with all other nonteaching patients*

TABLE 5. FREQUENCY OF CONSULTATIONS IN EACH DIAGNOSTIC CATEGORY FOR THE THREE STUDY GROUPS

Presenting Complaint	Number of consultations per Patient		
	Family Practice Mean (SD)	Teaching Mean (SD)	Nonteaching Mean (SD)
Cardiology	0.5 (0.6)	0.7 (0.7)	1.4 (1.1)*
Gastrointestinal	1.3 (1.0)	0.9 (0.7)	1.3 (1.1)
Pulmonary	0.4 (0.9)	0.4 (0.8)	0.9 (1.3)
Neurologic	1.6 (1.5)	0.8 (0.7)	1.3 (1.1)
Hematology/oncology	2.0 (1.8)	1.7 (1.5)	1.5 (1.2)
All patients	0.9 (1.7)	0.8 (0.8)	1.1 (1.2)

SD, standard deviation
**P < .001 (t = 3.58, two-tailed test) for nonteaching patients compared with all other cardiology patients*

monary patients in the teaching group was the result of more frequent use of moderately priced, commonly used tests rather than the use of more expensive laboratory studies. Charges and numbers of tests for all other types of presenting problems were not statistically different. Also, the number and charges for tests performed upon admission for all patients entering the hospital on an elective basis were not different (less than $10 per patient, $P < .05$), so it is doubtful that preadmission testing would have significantly altered the final results.

Other diagnostic modalities were also compared to see whether there were any differences among the study groups. There were no significant differences in the use of electrocardiograms (ECG) and radiographs among the three groups (Table 4). As might be expected, electrocardiograms were utilized more frequently in patients with cardiac problems ($P < .001$), but this increase in ECG usage was similar for all three groups. The use of other diagnostic procedures was also compared, and no differences reached statistical significance (at $P < .05$, data not shown).

Finally, frequency of consultant use was compared, as overreliance on consultants can also increase patient costs. Except for patients with cardiac complaints, patients in all groups were equally likely to be seen by a consultant (Table 5). For patients with cardiac problems, patients in the nonteaching group were more likely to be seen by a consultant ($P < .05$). This finding was contrary to what would be expected if consultations were motivated by inexperience.

DISCUSSION

Previous studies have shown that house staff utilize a large number of laboratory and radiologic tests[1,3,10,11] and that this extravagant test-ordering behavior can be tempered by input from more experienced clinicians.[4,12] These previous results have led to a generally accepted opinion[13] that resident physicians overutilize diagnostic interventions because of inexperience. This study does not support that conclusion. Family practice residents at a large, private teaching hospital were able to manage their own patients just as economically as experienced private clinicians. These data included average length of stay, charges and number of laboratory tests, and the use of electrocardiograms and other diagnostic modalities. Moreover, residents did not employ consultants more often than experienced community practitioners.

The combination of residents and community physicians into a teaching unit, a method of medical education seen frequently not only in family practice but in many other clinical specialties, did increase the mean laboratory charges to patients with certain types of diseases. For the majority of patients, however, this union of experienced and inexperienced physicians had no adverse effects on hospitalization costs. Other patients, those with cardiac complaints, actually benefited from being cared for by a teaching team, as they were less likely to need a cardiology consultation. The decrease in consultations for cardiac patients may be a reflection that residents are more confident in the use of newer drugs or technology, that residents are more accessible than community physicians to care for unstable patients and therefore a consultant is not needed, or that the patients of private physicians when they did not have house staff were actually more ill than those of the other two groups. The last possibility is doubtful, as all patients had similar lengths of stay.

The findings presented here are not in agreement with previous research efforts into the issue of resource utilization by house staff, but this study differs from other reports in several ways. First, this study was conducted using family practice residents in a private hospital rather than internal medicine residents at large, university teaching centers. More tests may be performed at university centers for so-called academic reasons than in a community setting. Furthermore, it has previously been shown that noninternists practicing general medicine tend to be more conservative with diagnostic test use,[6] so this study may be influenced by all house officers being family practice residents. Finally, a follow-up report of laboratory use by house staff in one hospital showed that house staff overutilization of laboratory tests has been declining,[5] and the results presented in this report may be simply a further extension of this trend.

This study hoped to assess the influence of family practice residents on the cost of inpatient health care, and the findings suggest that, at least in a community hospital setting, family practice residents do not invariably increase costs. While these results certainly cannot be generalized to all medical education programs, it is encouraging to note that residency programs can train physicians in cost-efficient health care. This contradicts the notion that experience is the overwhelming factor in the development of cost effectiveness.

References

1. Schroeder SA, O'Leary DS: Differences in laboratory use and length of stay between university and community hospitals. J Med Educ 1977; 52:418-420
2. Martz EW, Ptakowski R: Educational costs to hospitalized patients. J Med Educ 1978; 53:383-386
3. Boice JL, McGregor M: Effect of residents' use of laboratory tests on hospital costs. J Med Educ 1983; 58:61-63
4. Marcy WL, Miller ST, VanderSweeg R: Modification of admission diagnostic test-ordering by residents. J Fam Pract 1981; 12:141-142
5. Griner PF: Use of laboratory tests in a teaching hospital: Long-term trends. Ann Intern Med 1979; 90:243-248
6. Everett GD, Chang P, DeBlois CS, Holets TD: A comparative study of laboratory utilization behavior of "on-service" and "off-service" housestaff physicians. Med Care 1983; 21:1187-1191
7. Meza F, Lapsys FX: Adult medicine inpatient experience: A comparison of family practice and internal medicine residency services. J Fam Pract 1981; 13:701-705
8. Rosenblatt RA, Cherkin DC, Schneeweiss R, et al: The structure and content of family practice: Current status and future trends. J Fam Pract 1982; 15:681-722
9. Medley ES, Halstead ML: A family practice residency inpatient service: A review of 631 admissions. J Fam Pract 1978; 6:817-822
10. Griner PF, Liptzin B: Use of the laboratory in a teaching hospital. Ann Intern Med 1971; 75:157-163
11. Dixon RH, Laszlo J: Utilization of clinical chemistry services by medical housestaff. Arch Intern Med 1974; 134:1064-1067
12. Eisenberg JM: An educational program to modify laboratory use by housestaff. J Med Educ 1977; 52:578-581
13. Williams SV, Eisenberg JM, Pascale LA, Kitz DS: Physicians' perceptions about unnecessary diagnostic testing. Inquiry 1982; 19:363-370