Ordering Decision and Clinic Cost Variation Among Resident Physicians

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Physicians vary considerably in the services they order for their patients. We examined ordering variation among 47 resident physicians during 4,991 continuity clinic visits with patients who had specific, chronic medical problems. We ranked the physicians by their average charge per visit and grouped them into three equal categories. High-charge physicians averaged $164 per visit, medium-charge $124 and low-charge $97. In comparing the frequencies with which physicians in each group ordered a wide array of specific laboratory tests, x-ray studies, medications and miscellaneous items, we found that ordering variation among the physician groups was not confined to certain decisions or categories of services. High-charge physicians ordered a little more of nearly every item or service. Although the magnitude of ordering variation for each item was small, the sum over many items was great, suggesting that cost-containment efforts may have to focus on the "little ticket" decision-making style of expensive physicians.

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An important issue of the cost of medical care is what services physicians order for their patients because these ordering decisions determine 50% to 80% of all medical care expenditures,[1] include the ordering of unnecessary services[2,3] and vary from physician to physician. Substantial physician variation has been described in outpatient care among health maintenance organization physicians,[4,5] private internists,[6,7] academic internists[8,9] and resident physicians.[10] Physicians differ in ordering laboratory tests,[4-9,11] x-rays,[4,5,7,11] medications[7,8,11,12] and consultations[7] and in requesting return visits.[4,7] Previous investigators have described the variation primarily by reporting summary figures—that is, number of tests per visit or average charge per visit—which has left obscure the exact source of the variation. Do some physicians order more of all items, just certain items or more expensive ones and are their ordering habits consistent across diagnoses and categories of services—that is, laboratory tests, x-ray studies, medications and the like?

Perhaps the source of physician variation can be explained by borrowing the "little ticket" hypothesis offered by Moloney and Rogers[13] to explain the cost escalation of health care. They suggested that ordering of the "big ticket" technologies (such as computed tomographic scans) is less costly than the cumulative effect of ordering "thousands of [the] small tests and procedures" that are more frequently used by physicians and that individually cost little. Our study was controlled for diagnosis and we scrutinized physician ordering decisions to evaluate the plausibility of applying the "little-ticket" hypothesis to physician ordering and cost variation.

Methods

The study was conducted in the General Internal Medicine Clinic at the University of New Mexico/

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Bernalillo County Medical Center (Albuquerque). Internal medicine residents attend the clinic a half-day each week and provide continuity of care to patients who have chronic medical disorders. Clinic patients are assigned to resident physicians on a nonselective, first-available-appointment basis and continue to be seen by that physician for the duration of the physician's residency. Data from 4,991 clinic visits between 1,284 patients and 47 resident physicians were obtained in a uniform, prospective manner between October 1978 and April 1980. About 51% of these visits occurred between October 1978 and August 1979; the rest occurred during a cost-containment, educational program carried out in the clinic from August 1979 through April 1980.[14] Data were collected only from visits with patients who had common, chronic disorders: hypertension, congestive heart failure, diabetes mellitus or degenerative joint disease. Visits with new patients—that is, the first two visits—were excluded because extra charges would presumably be associated with the initial clinic evaluation.

Recorded data included visit date, patient and resident identification, patient age, resident year, payment or insurance coverage status, the return appointment interval prescribed by the physician, study diagnosis(es), study diagnosis severity, the number of nonstudy diagnoses and all physician orders. Each item or service ordered was assigned a charge based on the 1978 University of New Mexico (UNM) Hospital list of charges, which was held constant throughout the study. The charges were categorized (clinic visit fee, laboratory charges, radiology charges, medication charges and miscellaneous charges for items such as consultations, electrocardiograms or physical therapy) and totalled. Whenever a consultation was ordered, a fixed amount of $160 was charged to the physician because that was the average first visit charge incurred in 50 consecutive referrals from Internal Medicine Clinic to various specialty clinics. Subsequent specialty clinic charges were excluded. The drug charges for a visit were the charges for the first prescription filled and the expected charges for all prescribed refills until the next appointment ordered by that resident. These methods of assigning consultation and future drug charges to a visit were felt to best reflect the monetary consequences of a physician's ordering decisions for that visit. Additional details about these methods may be found elsewhere.[15]

Patient charges were presumably determined partly by factors that resident physicians could not influence, especially illness complexity. Our most important control of illness complexity was by examining only clinic visits selected by prospectively established criteria, thereby making all patients more uniform. Additional control over illness complexity was retrospectively accomplished before examining actual physician ordering decisions. This control involved adjusting total visit charges to reduce the influence of seven variables (henceforth called covariates): four covariates—study diagnoses or combination thereof, severity rating, number of nonstudy diagnoses and patient age—measured illness complexity and three covariates—resident year, payment or insurance status and whether or not the visit took place before or during the cost-containment educational program—measured other factors study physicians could not influence. (During the intervention a 5% reduction in the average clinic charge was accomplished and is the subject of another detailed article.[15]) The adjustment was made on each one of the 4,991 visits with analysis of covariance. With this method, each total visit charge was adjusted up or down by the influence of each covariate, thereby furthering efforts to make all patients more similar. Combined, the seven covariates accounted for 6.3% (analysis of covariance, $R^2 = .063$) of the charge variation among all clinic visits.

Using adjusted total charges, a mean adjusted charge

TABLE 1.—*Average Charges and Average Physician Ordering Frequencies per Clinic Visit*

Clinic Patient Care	*Resident Physician Charge Category*			*Cost Differences Between Low- and High-Charge Physicians*
	Low	*Medium*	*High*	
Resident physician, No.	16	15	16	
Total clinic patient visits, No.	1,862	1,449	1,680	
Visit fee: Average charge per visit ($)	14.00	14.00	14.00	00.00
Laboratory tests: Average charge per visit ($)	13.58	16.05	24.29	10.71
Visits in which lab tests were ordered (%)	42	50	57	
Average number of tests ordered	2.35	2.43	3.06	
Average charge per test ($)	12.82	13.58	14.31	
X-ray studies: Average charge per visit ($)	3.88	5.95	6.96	3.08
Visits in which x-ray studies ordered (%)	7	12	12	
Average number of x-rays ordered	1.12	1.18	1.28	
Average charge per x-ray ($)	41.19	43.65	46.35	
Drugs: Average charge per visit ($)	48.23	63.89	93.97	45.74
Visits in which drugs were ordered (%)	89	91	91	
Average number of drugs ordered	3.21	3.53	4.01	
Average charge per drug ($)	16.82	20.09	26.04	
Miscellaneous: Average charge per visit ($)	16.83	23.62	24.82	7.99
Visits in which any consultations were ordered (%)	7	11	11	
Visits with more than one consultation (%)	0.5	0.6	1.2	
Total of average charges per visit ($)	96.52	123.51	164.04	67.52
Range	72 to 106	108 to 134	134 to 250	

per visit for each resident was calculated, and residents were then sequentially ranked by these averages. The 47 rank-ordered physicians were arbitrarily divided into low-, medium- and high-charge thirds so that ordering differences between inexpensive (low-charge), in-between (middle) and expensive (high-charge) physicians could be examined and compared. Summary information about the three groups was examined first (Table 1) without statistical testing because by definition the three groups differ at the summary level.

The next analysis step was comparing the frequencies with which physicians in each third ordered a specific laboratory test, x-ray examination, medication or a miscellaneous item. A large number of specific items were chosen for analysis to determine if "little ticket" ordering differences existed. The χ^2 statistic or, where applicable, the partition $\chi^{2[6]}$ was used to determine whether or not the three resident groups were alike in ordering frequency. Also, analyses of covariance and variance were used to examine several confounders.

Results

The total charge per clinic visit varied considerably among the physician groups (Table 1), even after prospectively selecting patients for chronic care of specific illnesses and after retrospectively controlling for several charge-influencing covariates. High-charge physicians average $67.52 (or 70%) more per visit than low-charge physicians, and they generated more charges than low-charge physicians in each category of charges except the visit fee, which was constant. Laboratory and drug category differences between high- and low-charge thirds were substantial ($10.71 and $45.74, respectively) and, when combined, explained 84% of the total $67.52 difference. High-charge physicians ordered laboratory, x-ray and drug category items during more of their visits, ordered more items once any was ordered and ordered more expensive items. They ordered consultations more frequently than low-charge physicians and ordered two or more consultations during a clinic visit with slightly greater frequency.

Next, many specific ordering decisions were examined. Because physician ordering of tests and drugs explained much of the variation among physicians, all 4,991 visits were examined for the ordering of 31 common laboratory tests and 114 common drugs. After grouping the ordered item into 17 laboratory test groups and 17 drug groups (Table 2), χ^2 testing was done. For 19 of the 34 groups of items, significant ($P < .05$) differences among the three resident groups were seen, with more frequent ordering by high-charge physicians. For the remaining 15 groups, high-charge physicians ordered items more frequently than low-charge physicians in eight of the groups and less in only five.

Table 3 displays ordering decisions that specifically relate to one of the four study diagnoses. Physician ordering of laboratory, x-ray, miscellaneous and drug items from 20 groups was subjected to 20 χ^2 tests. In 13 of the tests, significant differences were observed among the physician groups; in only two did low-charge physicians order more than high-charge physicians. Low-charge physicians treated more patients who had hypertension with diuretics alone and treated more patients who had degenerative joint disease with aspirin or acetaminophen rather than with nonsteroidal anti-inflammatory drugs. Both of these choices led to less expensive care.

High-charge physicians ordered an SMA 6 chemistry panel or a potassium measurement during more of the visits for hypertension than did low- and medium-charge physicians. Once they ordered either, they chose the more expensive of the two (serum potassium charge, $5.50; SMA 6 charge, $41.00 [1978 UNM charges]) significantly more often ($P < .001$). For visits for diabetes mellitus, high-charge physicians ordered nonfasting serum glucose testing much more frequently. For visits for congestive heart failure, medium- and high-charge physicians ordered chest x-ray films and serum digoxin measurements more frequently, but use of digoxin medication did not significantly vary among the three groups. Finding variation in the use of blood digoxin measurements prompted us to also examine the ordering of blood theophylline determinations. During visits where theophylline medication was ordered, progressively more blood theophylline measurements were requested across physician groups: low 4.8%, medium 11.1%, high 22.4% (χ^2 $P < .01$).

After doing these analyses, we considered the influence of three potentially confounding factors: physician decisions about when a patient should return to clinic, the number of visits occurring for each patient during the study and physician decisions to admit a patient to hospital during the clinic visit.

Physicians in the high-charge group prescribed a longer return appointment interval (64.1 days) than did medium- (61.1 days) and low- (58.4 days) charge physicians. Conceivably, they were more expensive because they lumped more prescribing and testing activity into fewer visits. However, when the influence of return appointment interval on total visit charges was isolated and examined with analysis of covariance, its separate effect on the per visit charge was only 27 cents per day. Thus, the 5.7-day difference in return appointment intervals between high- and low-charge groups could only account for $1.54 of the per visit charge difference ($67.52) between high- and low-charge physicians.

The average number of visits occurring for each patient during the study varied among the physician groups (high, 3.5 visits per patient, medium, 4.0, and low, 4.2). Because a larger number of visits for each patient might suggest greater illness and expense or, alternately, greater physician familiarity with the patient and less expense, these findings were analyzed further. Analysis of variance results on Table 4 show that when the effects of the number of visits per patient and the physician groups were examined simultaneously, the visit

number did not modify the big differences seen among physician groups in average clinic charges.

Although the study excluded charges resulting from a decision to admit a patient to hospital as part of the clinic visit, that decision could affect other clinic ordering decisions. Because this decision occurred only four times in 4,991 encounters, hospital admission decisions were not felt to be a source of bias.

Finally, several resident physician characteristics were examined. More of the low-charge residents were present both years of the project (they therefore accrued more clinic visits) and more of the high-charge group were third-year residents (they were slightly less expensive before the analysis of covariance adjustment), but the effect of these differences was minimized by the analysis of covariance adjustment. In each third the number of AOA residents (Alpha Omega Alpha—medical school honorary status) and the number eventually completing internal medicine residency were compared and found to be insignificantly different. Using departmental resident evaluations, two faculty members attempted to rank residents by their competence and performance, but agreement between the two raters was so low that it was not feasible to relate competence or performance assessments with clinic charge rankings.

Discussion

We found that the physicians in this study varied considerably in the frequency with which they ordered laboratory and x-ray tests, medications and miscellaneous services for patients with similar chronic health problems. As a result, patients of high-charge physicians incurred 70% more in charges than did those of low-charge physicians, and the average charge per visit for the highest charge physician was 3½ times that of the lowest charge physician. This amount of ordering variation among physicians was consonant with that reported by other authors cited in the introduction.

Our most important contribution was describing more specifically how low-, medium- and high-charge

TABLE 2.—*Ordering Frequencies of Physician Groups (Low-Charge, Medium-Charge and High-Charge) During All Clinic Visits*

Items Ordered	*Percentage of Total Visits During Which Specific Items Were Ordered*			χ^2
	Low	*Medium*	*High*	P *Value*
Total clinic patient visits, No.	1,862	1,449	1,680	
Laboratory tests				
CBC or Hct/Hb	7.7	9.0	15.4	<.0001
SMA 6	6.7	7.2	12.5	<.0001
Serum iron/TIBC, B_{12} or folate	1.7	1.2	1.7	NS
WBC differential	1.3	2.1	2.5	<.05
Platelet count	0.6	0.9	2.0	<.0005
Prothrombin time	1.0	1.3	2.5	<.005
Thyroid function test	3.3	4.6	5.7	<.005
Serum calcium	1.0	1.0	3.3	<.0001
Serum GOT	1.6	1.9	3.4	<.001
Serum creatinine	3.6	3.0	8.2	<.0001
Serum LDH	0.5	0.4	0.4	NS
Serum magnesium	0.2	0.0	0.4	NS
Serum cholesterol/triglyceride	1.2	0.7	0.7	NS
Stool tests for occult blood	1.5	2.2	1.4	NS
Urine analysis	6.8	8.3	9.6	NS
Urine culture	3.5	3.9	5.2	<.05
Creatinine clearance	0.1	0.1	0.2	NS
Drugs				
Allopurinol	1.6	1.0	3.0	<.005
Antacids	7.6	7.1	8.7	NS
Antianxiety and hypnotic agents	7.7	16.0	18.2	<.005
Antibiotics, oral	3.5	4.3	6.1	<.005
Antidepressants	4.0	5.2	5.3	NS
Bronchodilators	3.6	6.7	6.4	<.005
Cardiac medications, excluding digoxin	3.8	5.0	7.0	<.005
Drugs for symptoms of URI	5.1	5.0	9.1	<.0001
Estrogens, oral	1.1	1.2	1.7	NS
Multivitamins	4.5	4.4	4.5	NS
Over-the-counter medications	16.3	14.8	17.2	NS
Steroids, oral	0.8	0.6	0.7	NS
Steroids, topical	1.7	2.4	2.3	NS
Stool softeners	6.4	5.4	8.1	<.01
Thyroid hormones	5.0	7.0	6.2	<.05
Topical, nonsteroid dermatologics	2.7	1.7	2.0	NS
Warfarin	0.5	1.0	1.7	<.005

CBC = complete blood count; Hct/Hb = hematocrit/hemoglobin; SMA 6 = determinations of serum creatinine or glucose, urea nitrogen, chloride, carbon dioxide, sodium and potassium levels; TIBC = total iron-binding capacity; WBC = leukocyte count; GOT = aspartate aminotransferase (glutamic oxaloacetic transaminase); LDH = lactic dehydrogenase; URI = upper respiratory tract infection; NS = not significant

physicians vary. We found the expensive ordering behavior of high-charge physicians spread across all decisions. They ordered items or services during more visits, ordered more items once any were ordered and ordered slightly more expensive items. Even when they ordered some items—such as antianxiety drugs—much more frequently, such differences could only explain 6% of the total charge difference between high and low physician groups. For many of the ordering decisions examined, the magnitude of ordering variation among physicians was small and occasionally insignificant, but these differences occurred so regularly that the sum of the differences was great. We therefore conclude that a reasonable source of expensive ordering behavior is the cumulative cost of ordering "little ticket" items.

In examining ordering and prescribing variation among different physicians, investigators have used a variety of approaches to minimize the variation caused by patient-case mix and illness severity: a large sample size,[4,5,7] differentiating acute and chronic conditions,[4] examining a broad range of decisions,[7] prospectively selecting patients with a uniform diagnosis[9] and using the same patient in two different clinic settings.[11] This investigation combined four of these approaches (prospectively selecting patients by diagnosis, studying the care of only chronic conditions, using a large sample size and examining a broad range of clinical decisions). In addition, retrospective control of several covariates was done before analysis, and, finally, physician differences were examined by comparing physician groups rather than by comparing the highest and lowest charge physicians. Despite all these steps, substantial variation among physicians remained.

It is possible that some of this variation still resulted

TABLE 3.—*Ordering Frequencies of Physician Groups (Low-Charge, Medium-Charge and High-Charge) During Diagnosis-Specific Clinic Visits*

Disorder and Items Ordered	*Percentage of Diagnosis-Specific Visits During Which Specific Items Were Ordered*			χ^2 *P Value*
	Low	*Medium*	*High*	
Hypertension				
Clinic visits, No.	1,191	834	1,007	
Laboratory tests				
SMA 6 or serum potassium	20.7	25.3	30.2	<.0001
SMA 6 (includes potassium)	6.8	8.0	14.2	<.001
Serum potassium	13.9	17.3	16.0	
X-ray films				
Chest	3.8	7.7	6.3	<.001
Miscellaneous				
Electrocardiogram	3.9	4.9	6.1	NS
Drugs				
Potassium	23.8	21.2	21.5	NS
Diuretics only	47.2	48.4	41.7	<.01
Nondiuretic, antihypertensives also	33.7	35.3	40.4	
Diabetes Mellitus				
Clinic visits, No.	507	475	557	
Laboratory				
Urine analysis	10.1	11.2	11.3	NS
Any serum glucose test	56.8	72.4	76.4	<.005
SMA 6 (includes glucose)	7.9	6.9	13.3	<.001
Random	8.9	24.6	20.1	<.0001
Fasting	39.8	39.8	39.9	NS
Two-hour postprandial	0.2	1.1	2.9	<.001
Congestive Heart Failure				
Clinic visits, No.	322	252	266	
Laboratory test				
Digoxin level	6.8	7.9	15.4	<.005
X-ray films				
Chest	20.2	43.1	47.8	<.001
Drugs				
Digoxin	59.3	61.1	55.6	NS
Degenerative Joint Disease (DJD)				
Clinic visits, No.	513	387	582	
Laboratory test				
Antinuclear antibody	0.4	2.0	2.8	<.05
X-ray films				
One or more joint films	3.5	8.0	6.7	<.05
Drugs				
Antacids	12.3	12.9	12.7	NS
Some DJD drug therapy	56.2	59.8	62.7	NS
Aspirin/acetaminophen only	27.1	18.6	11.3	<.0001
Nonsteroidal anti-inflammatory	29.1	41.2	51.4	

SMA 6 = determinations of serum creatinine or glucose, urea nitrogen, chloride, carbon dioxide, sodium and potassium levels; NS = not significant

TABLE 4.—*Charges per Clinic Visit by Physician Groups (Low-Charge, Medium-Charge and High-Charge) and by Number of Visits per Patient*

Number of Visits per Patient During the Study	Average Charge per Clinic Visit (Number of Patients)		
	Low	Medium	High
	$ (No.)	$ (No.)	$ (No.)
1	111 (89)	106 (69)	147 (96)
2	88 (77)	124 (56)	141 (90)
3	99 (72)	121 (84)	149 (76)
4	107 (56)	126 (46)	162 (58)
5	108 (51)	131 (33)	162 (38)
6 or more	105 (134)	126 (85)	168 (74)

Analysis of variance: physician charge group effect, $P<.0001$; number of visits per patient effect, $P=.18$.

from patients' needs or study biases rather than physician decisions. Our measures of and controls for diagnostic and illness complexity were limited to what is obtainable from the medical record, the 1,284 study patients could not be randomly assigned to physicians and physicians were not blind to the investigation. Although imperfect, we feel that our control for bias was the best so far accomplished in this type of investigation and sufficient to conclude that "little ticket" use is primarily due to physician ordering behavior rather than patient needs and wants.

Like illness severity, measuring quality of care is difficult. Inferences about increased or decreased quality among the three groups of residents can be made, but correlating the diffuse ordering characteristics of high-charge physicians with similarly diffuse improvements in quality would be unlikely and difficult to quantitate, especially at the outcome level. In the past, associations between quality variation and ordering variation have not been found[9,17] or have been equivocal.[12]

The "little ticket" ordering habit has implications for cost containment and medical education. Because this ordering behavior pervades all decisions, it suggests that basically different analytic or decision-making styles distinguish expensive and inexpensive physicians. Therefore, cost-containment efforts focused only on specific decisions, such as test ordering, may not have lasting effects. On the other hand, changing an expensive physician's fundamental style would affect the ordering of many services. Analytic or decision-making styles are undoubtedly influenced by many factors,[18,19] including "personality traits."[20] Tolerance of uncertainty is a trait hypothesized to influence expensive ordering habits (intolerance)[5,19,21-23] and, possibly conversely, inexpensive habits (overtolerance ?). Investigators have found less ordering among physicians with greater experience or more training[4,5,12,15,24] and no association between professional characteristics—that is, board certification—and ordering habits.[4,5,8,12,16] This may indicate that professional training cannot or has not adequately addressed these issues. Improved understanding of the relationships among personality, decision-making styles and professional training may be very important in controlling costs without sacrificing quality.

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