special minimum beneficiaries, respectively. Thus, by June 1976, only 4,296 individuals were receiving benefits based on the special minimum PIA. The 5 9-percent benefit increase effective in June 1977 raised the regular PIA for most of the beneficiaries with benefits based on the special minimum PIA in May 1977 After the increase, the special minimum PIA remained advantageous for only 309 individuals

Research Grants Studies

Sections 702 and 1110 of the Social Security Act authorize extramural research projects in the broad areas of social security The Social Security Administration provides funding through grants to nonprofit organizations and through contracts with both nonprofit and profitmaking organizations From time to time, as projects are completed, the BULLETIN publishes summaries of research findings A summary of a completed project (Grant No 57857) is presented below

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EFFECT OF MEDICAL STAFF CHARACTERISTICS ON HOSPITAL COST

This study to examine the feasibility and usefulness of combining data on the characteristics of a hospital's medical staff with data on its costs was conducted by Mark V. Pauly of the Center for Health Services and Policy Research at Northwestern University The fundamental premise of the study was that physicians significantly affect the differences in the use of resources within hospitals Some of those differences might be attributable to identifiable physician characteristics

It was deemed reasonable to assume that a hospital's costs, as well as some other measures of its expensiveness, are a measure of the resources used to provide hospital care To the extent that physicians with different characteristics systematically combine inputs to produce different outputs, hospital costs might be associated with those characteristics

FEASIBILITY OF DATA COLLECTION

The final data base used in this analysis consists of four major sets of information (1) abstracts for 79,615 discharged patients with primary and secondary diagnoses, and other important clinical and demographic characteristics for each inpatient discharged from 50 California community hospitals, for the period April–July 1975, (2) characteristics, expenses, revenues, etc, of the 50 hospitals in which the 79,615 patients were treated, (3) characteristics of 2,861 physicians who admitted, attended, and/or treated 70,013 of the 79,615 patients; and (4) hospital control, facilities, and annual aggregate costs and output data for the 50 hospitals obtained from American Hospital Association *Guide Issue* data

Patient discharge abstracts from the California Health Data Corporation's (CHDC) MR II system were combined with cost data from the Hospital Administrative Services Program of the American Hospital Association to assemble this data set The CHDC combined physician characteristic data from the American Medical Association's *Directory* with patient records Physicians who admitted two or fewer patients per month were not included This deletion reduced the number of physicians whose characteristics were to be documented by nearly half but reduced the number of cases for which physician characteristics were present by only 8 percent

It was thus possible for CHDC to link physician and patient data for almost all patient records in almost all hospitals The final data set contains no identification of individual hospitals, patients, or physicians

CONCEPTUAL FRAMEWORK

The conceptual framework used to analyze the data in this study is based on the theory that the cost incurred in treating any patient is based on the patient's characteristics, the characteristics of the physicians who treat him, and the general characteristics of the hospital and its medical staff. Individual physician characteristics are

thought to measure human capital endowments and so may be expected to affect the efficiency of the hospital production process

The most important observable human capital variables in the data set are the physician's age and his specialty, although some geographic aspects of training are significant also An important general characteristic of the medical staff is the concentration of output among staff physicians, a variable that should reflect, on the basis of the well-known "size principle," both the price incentives to individual physicians and the problems of coordinating physician decisions

A behavioral model of the hospital in which the size principle operates but in which medical staff and administration share power was developed Such a model suggests that, if physicians control the hospital, costs and output concentration will be inversely related but that, if the administration has some power and if it desires costs to be lower than do physicians, output concentration could be directly related to cost

The behavioral-cost-function model is applied to two sets of data One set consists of individual patients and physician characteristics data for patients with 22 common diagnoses Total charges (as well as length of stay) are used as measures of costliness Hospital-wide effects are taken into account by including dummy variables in each regression to represent hospital-specific characteristics.

RESULTS WITH CHARGES AS MEASURES OF COSTLINESS

The results indicate that physician characteristics have significant influences on 'patient charges for many of the selected diagnoses Depending on the set of independent variables, physician characteristics are indicated as being significant by an F test in 8–16 of the 22 diagnoses

The most frequently significant physician characteristic is experience (years of practice or physician age) The hospital bill of a patient whose attending physician has more experience is very likely to be lower than that of a patient whose physician has recently begun practice This difference provides some confirmation of the human capital hypothesis

Graduation by the attending physician from a California medical school or practice elsewhere before coming to California also affects charges fairly frequently but in ways that differ, depending on whether the diagnosis is usually treated surgically or not If the diagnosis is usually treated surgically, bills tend to be lower when either of these characteristics is present. If it is usually not treated surgically, bills tend to be higher when either characteristic is present

General practitioners almost always treat patients in ways that yield charges not significantly different from those for patients with the same diagnosis who are treated by specialists Whatever the other advantages of general or family practice, such physicians do not manage hospitalized patients in less expensive ways Board certification occasionally makes a difference for medical specialties, but no consistent pattern exists A sample of nonobstetrical patients with seven diagnoses in which more than 100 persons were treated by surgical specialists was selected Among surgical specialists, board certification frequently is significantly related to patient bills Charges are lower, for the same diagnosis and set of patient characteristics, if the attending surgical specialist is board-certified than if he is not

Policy Implications

These results have some significance for manpower policy and for the allocation of patients and privileges among physicians Their significance for interhospital variations in overall costs and charges is less clear because the sample of hospitals providing charge data is too small to permit an analysis of how physician characteristics affect average charges Some simulation results are presented, however, that suggest that variation of as much as 51 percent in mean charges can be attributed to physician characteristics, although the modal value of mean charge variation is about 11 percent

When length of stay is entered as an independent variable in the charge function regressions, age-experience has an even more frequent negative effect on charges In 13 out of 22 diagnoses, physician age is negatively related to total charges at a significance level of 0 2 or better The effect is positive and significant at this level in only one diagnosis Finally, when length of

stay itself is used as a dependent variable, physician variables—especially age-experience—are less likely to be significant

The coefficient in the hospital dummy variable measures the systematic variation in charges across hospitals The matrix of coefficients was factor analyzed to extract six factors, and a diagnosis "typical" of each factor was selected The coefficients were then regressed on a set of hospital and medical staff characteristics Urban area location, higher input prices, large hospital size, and a smaller proportion of board certified staff physicians tended to be related positively to these coefficients

RESULTS USING COST FUNCTIONS

The second set of data uses total hospital cost as the measure of costliness An index of nonobstetrical casemix was developed by using relative charges as weights Its usefulness in a hospital cost function was validated with another set of data This index, along with a measure of the proportion of obstetrical discharges, is used to measure diagnostic mix

Regression analysis indicated that both casemix and medical staff characteristics affect hospital costs Both sets of variables are significant The set of casemix variables reduces unexplained variance by 28 percent, but the set of medical staff characteristics variables reduces unexplained variance by 38 percent

Hospital total costs were found to be significantly related to input prices, the volume of hospital admissions (adjusted for outpatient visits), casemix, and two kinds of medical staff characteristics One of these characteristics is the concentration of output among staff physicians This is measured in two ways—by the fraction of output attributed to physicians who treat, on the average, two or fewer cases per month and by an index of the concentration of output among other physicians Both variables suggest strongly that the less concentrated the output among physicians, the higher the costs When these variables are added, apparent decreasing returns to scale in hospitals are changed to approximately constant returns The implication is clear Diffusing a given number of patients among more physicians raises hospital costs Adding the physician

variables, especially the output concentration variables, substantially increases measured returns to scale

The second characteristic is staff specialty. The specialty of attending physicians significantly affects hospital cost when the measured casemix is held constant Costs are significantly higher with larger proportions of pediatricians on a hospital's staff, and they are lower with larger proportions of general surgeons and with specialists who are neither surgical nor medical Otorhinolaryngologists and other surgical specialists do not affect cost The coefficients for internists and obstetricians are reasonably large but are not estimated precisely

Results were approximately the same when an alternative measure of casemix based on 14 diagnostic groups was used When this second measure was used, the estimated negative effect on costs of output concentration among physicians was even stronger If length of stay is included as an independent variable, many physician staff variables and the casemix measures cease to be important Interestingly, the coefficient on length of stay is approximately 1, indicating that the long-run marginal cost of a day's stay is approximately equal to its average cost

Total costs are disaggregated into costs for four hospital departments Nursing, professional (laboratories), general (housekeeping), and administrative The regression analyses of these costs can be viewed either as cost functions for the intermediate outputs or as input demand functions

Medical staff characteristics have the strongest effect, as expected, on the nursing department. The output concentration index and physician specialties are most important here Input prices, of course, are also important Professional services department costs are strongly affected by casemix but not by medical staff characteristics Except for the fraction of output for which the attending physician admits two or fewer cases per month, medical staff characteristics do not have a strong or consistent effect on costs in other departments

A two-stage procedure was also used in which casemix is first regressed on physician and hospital characteristics (the estimated coefficients) and then used to predict casemix, with the resultant predicted casemix used as a cost function

regression This procedure would be appropriate if casemix were to some extent endogenous The two-stage procedure yields a smaller and less precisely estimated coefficient in casemix

Policy Implications

The significance of these staff variables has implications for hospital incentive or prospective reimbursement schemes When other things are equal, those hospitals with "low-cost" physicians on their staffs will lose if payments do not take staff composition into account The precise way in which hospital incentive payments might affect medical staff behavior (if it is affected at all) is not known The importance of these staff effects suggests that it would be desirable to investigate incentives targeted directly on the medical staff, rather than diffused throughout the hospital's corporate structure

Medical staff also has effects on the expenses of individual departments As expected, output concentration has its strongest effect on nursing expense, the costs of which are not itemized in pa-

tient bills Professional services are most strongly affected by casemix, suggesting that increased case complexity increases cost because of its effect on ancillary services Other departments are somewhat affected by medical staff, but the only medical staff characteristic that seems to affect cost in all departments is the proportion of cases for which the primary attending physician admitted two or fewer patients per month

In summary, observable medical staff characteristics do affect charges and costs in statistically important ways that may be important to policy A more detailed investigation is desirable to determine how these effects occur