A Statistical Analysis of the Medicare Hospital Routine Nursing Salary Cost Differential

by J. Michael Fitzmaurice

From July 1971 (but effective retroactively to July 1, 1969) to October 1981, Medicare hospital reimbursement methods assumed that patients in the qualifying categories of the aged, pediatric, maternal, and kidney transplant cases consumed 8.5 percent more routine nursing resources than patients outside these categories. Consequently, the Medicare program paid this nursing differential to hospitals for all its hospitalized beneficiaries in these categories.

The purpose of this study is to investigate whether hospitals with more qualifying Medicare patients do, in fact, have higher per diem *routine nursing salary costs.*

This study tests this hypothesis while attempting to hold constant the influences of other factors such as local area wages, hospital size, occupancy rate, type of control, and geographic region. Using 1979 data from over 4,500 hospitals, and 1977, 1978, and 1979 data from a sample of 1200 hospitals, this study looks at the relationship between per diem *hospital routine nursing salary costs and the proportion of qualifying Medicare routine patient days in two models. Model I incorporates the framework of the Section 223 routine cost limits and Model II incorporates a comprehensive set of variables representing the hospitals' production and output characteristics. The evidence from this study provides little empirical basis to support the existence of a strong or sizeable relationship and, hence, does not support payment of the Medicare routine nursing salary cost differential.*

Prologue

The Medicare routine nursing salary cost differential (MRND) was born out of the elimination of the Medicare 2-percent bonus and out of a study of 55 hospitals showing that patients 65 years of age and over appeared to use more nursing care than younger patients. This bonus was an extra payment to hospitals of 2 percent of their Medicare costs and was initiated when the Medicare program began in 1966. When the bonus was eliminated in 1969, hospitals, disappointed at the loss of revenue, argued that Medicare patients required more nursing care than other patients.

In support of this position was a 1966 study sponsored by the American Hospital Association and funded by the Public Health Service. On July 1, 1971 (but retroactively effective to July 1, 1969), the Medicare program began reimbursing hospitals for the *per diem* hospital inpatient routine nursing salary cost of treating Medicare patients—108.5 of the routine nursing salary cost per routine day for non-Medicare patients.

In 1975, the Medicare program attempted to eliminate the payment of a *per diem* Medicare routine nursing salary cost differential (MRND) by amending the pertinent regulations. In a subsequent law suit brought by the American Hospital Association, the Fifth U.S. District Court invalidated the amended regulations on August 1, 1975, ruling that HCFA could not eliminate the MRND through the regulatory process without a study showing that it should not be paid. This reestablished the 8.5-percent nursing differential and it continued until 1981.

Although some studies surfaced concerning the use of routine nursing services by the aged, none was of sufficient import that opinion was swayed—until this study. Because of the large number of hospitals in the data base, the use of separate hospital data bases in three different years, and the preponderance of evidence not supporting the MRND, this study gained the standing required to initiate the reduction and eventual elimination of the MRND.

Computer support services for this study were provided by Applied Management Sciences of Silver Spring, Md., under Contract No. HCFA-78-0041, and by the Office of Statistics and Data Management and Bureau of Support Services, Health Care Financing Administration.

Reprint requests: J. Michael Fitzmaurice, Health Care Financing Administration, 2-A-14 Oak Meadows Building, 6325 Security Boulevard, Baltimore, MD 21207

Soon after preliminary results of this study were known, Congress directed the Department of Health and Human Services (DHHS) in the Omnibus Reconciliation Act of 1981 (Public Law 97-35) to set the Medicare routine nursing salary cost differential at a level of 5 percent or less. Congress also directed the General Accounting Office (GAO) to investigate the existence of the Medicare routine nursing salary cost differential and to report back in six months.

On January 20, 1982, after reviewing all pertinent studies and industry comments on these studies, GAO reported ". . . we continue to believe . . . that the HCFA study provides relatively strong statistical evidence that an aggregate routine nursing cost differential does not exist. The low explanatory power of the HCFA study is the primary reason we consider it not to be conclusive evidence that a differential does not exist." (General Accounting Office, "Do Aged Medicare Patients Receive More Costly Routine Nursing Services? Evidence Inconclusive." *Report to the Congress,* January 20, 1982, page 20.)

Although GAO proposed its own $8.3 million study of the MRND, it did not receive Congressional appropriation for the study. Six months later, Congress eliminated the MRND in the Tax Equity and Fiscal Responsibility Act of 1982 (Public Law 97-248).

Introduction

In 1980, the MRND applied to maternal and pediatric patient days for the disabled and their dependents who meet the Social Security Act (SSA) requirements, as well as to the aged enrolled in Medicare. When the MRND was first proposed, it was based on studies showing that aged patients consumed more nursing time. Maternal and pediatric patients were not considered in the studies. Further, during the time the MRND had been paid, more and more hospitals began or expanded special care units, where the more seriously ill patients may be treated. This expansion of units for patients needing more intensive care should reduce the demand for nursing care in routine care units.

The *per diem* inpatient routine nursing salary costs (RNS) to which the differential applied included "gross salaries and wages of head nurses, registered nurses, licensed practical and vocational nurses, aides, orderlies, and ward clerks." (See the Medicare Provider Reimbursement Manual, Section 1302, pp. 13-3 to 13-4, for a more comprehensive definition.) Excluded from RNS were administrative nursing personnel, personnel who worked outside general inpatient care areas (such as surgery, delivery rooms, emergency rooms, central supply areas, etc.), and maintenance personnel.

The patient days to which this 8.5 percent MRND payment applied were the routine patient days of Medicare beneficiaries, specifically, the qualifying aged, pediatric, maternal, and kidney acquisition (transplant) patient days. Unless SSA disability beneficiaries, or their dependents, qualified as pediatric or maternal patients, their hospital patient days were reimbursed by the Medicare program but did not receive a nursing salary differential payment.

The computation of the differential imputed an 8.5 percent differential to all the aged (65 years of age or over), maternal (childbirth patients), pediatric (13 years of age or under), and kidney transplant days, regardless of Medicare beneficiary status. But, only patient days of those patients with Medicare beneficiary status received such a payment from the Medicare program, and only those days are the focus of this study.

The MRND payment was not meant to be a bonus for treating Medicare patients; it was an allocation of actual nursing salary expenses away from the costs of non-Medicare patients to Medicare patients to compensate for any additional care Medicare patients (and non-Medicare aged, pediatric, and maternal patients) may have required. The Medicare program assumed that the other payers of hospital costs would make a downward adjustment, so that hospitals would not be overreimbursed for routine nursing costs. Nevertheless, HCFA did not require this adjustment. Under this assumption, if no MRND were paid and the quality of care and technical efficiency remained the same, total hospital nursing salary costs probably would not have changed. Only the allocation of routine nursing salary costs among payers of hospital costs would have changed. With payment of the MRND, a bonus could have occurred. If non-Medicare payers reimbursed RNS at the hospital's average of RNS while Medicare paid an 8.5 percent differential (which works out to be less than 8.5 percent of the total inpatient routine nursing salary cost, because it is paid on less than 100 percent of the total routine inpatient days in a hospital), the hospital received reimbursement for more than 100 percent of RNS.

Of course, whether the MRND payment was, in effect, a bonus depended on the treatment of RNS in hospital cost reimbursement by other payers, as well as on the quantity of nursing resources actually consumed by Medicare beneficiaries. In the 33 States adopting the Medicare reimbursement principles, reimbursement to hospitals of RNS for Medicaid beneficiaries was reduced by the amount of the 8.5 nursing differential for each Medicaid routine patient day. Other non-Medicare payers also had good reason to reduce their payment for nursing salary costs. However, many payers, especially private payers, are charge-based reimbursers of hospital costs and were not likely to consider the MRND payment in determining their reimbursement of hospitals.

The financial incentive of the MRND payment was that, to the extent it incorporated a bonus, hospitals with more Medicare patients had an incentive to increase the magnitude of RNS in order to increase the portion of their overall costs paid by the Medicare program. This was true unless the hospital exceeded the Section 223 limit on Medicare reimbursement of routine costs per day or the proportion of routine days going to Medicare patients approached unity. In the latter case, the Medicare program would pay substantially all the hospital's routine costs anyway, with little or no extra MRND payment. Certainly the desire to economize on routine nursing salary costs is lessened as the proportion that is given cost-based reimbursement rises.

The economic rationale behind the MRND payment was, basically, that aged patients were believed to require more nursing care, even for the routine activities, and that nursing salary payments should be assessed according to the nursing resources consumed by the Medicare beneficiary.

This was to the extent that accounting systems could determine the appropriate Medicare beneficiary resource consumption.

If Medicare beneficiaries really did consume more nursing resources per day than other patients and/or if there was a strong financial incentive to obtain the MRND, it is expected that hospitals with proportionately more Medicare patient days of care will have higher overall routine nursing salary costs per day, all other influences remaining the same. The three models developed in this study test this hypothesis and estimate the size of the MRND.

The purpose of this study is to review past studies of the Medicare routine nursing differential and to present an aggregate statistical approach for detecting any differential use of routine nursing resources by Medicare patients. Previous studies have examined the differential use of nursing resources by the aged using industrial engineering methods—by counting the minutes of direct nursing time spent on a hospital's Medicare and non-Medicare patients. This study focuses on Medicare beneficiaries and examines the Medicare routine nursing salary cost differential using an econometric approach on the routine nursing salary cost data from annual hospital Medicare cost reports (MCR's) for the years 1977, 1978, and 1979.

Models are designed to explain a significant amount of the variation in RNS. The parameters of these models are estimated by using traditional ordinary least squares regression techniques. Among the variables explaining the variation in RNS is the proportion of medicare routine patient days to total routine patient days (PMR). If a cost differential existed in nursing care between Medicare and non-Medicare patients receiving routine, general service care, the estimated coefficient of this variable is expected to be positive and statistically significant.

Two principal models are presented: Model I, showing the influence of the Medicare proportion of routine patient days within the context of the Section 223 Routine Cost limits in the 1981 Medicare hospital reimbursement system, and Model II, showing the Medicare patient influence within a comprehensive model that includes variables representing the hospital's production and output characteristics.

Previous Studies

Industrial Engineering Approaches

Previous studies have not dealt directly with the question: Is there a differential in the cost of routine nursing resources required to treat Medicare patients (or patients 65 years of age and over) compared with non-Medicare patients (or patients younger than 65 years of age)? A handful of studies have used industrial engineering methods to determine if Medicare or aged patients receive a differential amount of nursing when compared to non-Medicare patients, for example, Jacobs (1969); Thompson, *et al.* (1968); Miller & Byrne, Inc. (1977). For the most part they report findings of a positive Medicare/age differential in minutes of nursing care—without regard for the skill level of the nursing personnel providing the care. Although their sample sizes are extremely small, more conclusive information might have been presented in each study if the minutes of care provided by each skill level had been multiplied by the average hourly wage of a person in each skill level to estimate the differential in dollars. (This may have been done in the Miller & Byrne, Inc. study but the report describing their method is unclear.) Nevertheless, these studies do reveal large variations in the size of the differential in minutes among hospitals. The implication drawn from the amount of variation is that a single number, such as 8.5 percent, could disadvantage a large number of hospitals and/or unfairly reward a large number of different hospitals.

Regression Approaches

Levine and Phillip (1975) took a different approach. Using regression analysis, Levine and Phillip linked data from a 1970 American Hospital Association (AHA) survey of nursing personnel to the 1970 AHA Annual Survey of Hospitals, 1970 U.S. Census data, and data from *Health Resources Statistics, 1971*. Then they investigated the influence of county age proportions on six different measures of hospital specific nursing hours per adjusted patient day (adjusted for the volume of outpatient visits) over 3,800 hospitals. With regard to the demographic characteristics, "percent of population under 18" and "percent of population 65 and over," they found (page 45),

"These two variables have appeared with negative regression (or beta) coefficients in eight models. One may hypothesize that patients belonging to the excluded age category—18-64—generally come to the hospital with more serious ailments demanding closer attention by the nursing staff."

Although the regression coefficients of these variables were statistically significant at the 5-percent level, the fact that the county age proportions were used, rather than the age proportions of each hospital's patients, reduces the strength of their implication that the hospital nursing differential for care of aged patients might, in fact, be negative.

A regression analysis by Russell Caterinicchio and Grace Smith (1980) of 1,200 patients in 13 nursing units (including intensive care and coronary care units) in three New Jersey hospitals found that, within diagnosis related groups (DRG's), aged patients consume fewer nursing resources than younger patients. Specifically, "nursing activity is negatively related to age when controlling for the patient's length of stay and surgery." (page 50)

Even though some support for the nonexistence of a Medicare nursing differential within DRG's can be found in their study, it is not conclusive with respect to an overall Medicare nursing differential. Not only is this a small sample of hospitals on which to test for a Medicare nursing differential, it tests the wrong hypothesis for purposes of the Medicare regulation. The relevant hypothesis is a test of the nursing resource consumption by age, over all patients, and without regard to DRG and length of stay. For, if Medicare patients dominate the nursing-intensive DRG's, there could very well be support for a Medicare nursing differential—even if the few non-Medicare (younger) patients consume more nursing resources per patient within these

DRG's. Further, because the MRND applies only to care given in routine general service units, patients in the special care units should be excluded from the analysis.

Summary

Is there a Medicare/age routine nursing differential? Conventional thinking leans in two opposite directions. Older patients generally have more than one health problem when they enter a hospital, and they are not likely to be robust. This can lead to more nursing care in the early stages of hospitalization: additional tests may be needed and aged patients can require more help with feeding and other normal body functions. These factors support the existence of a positive Medicare routine nursing differential.

In the other direction, older patients have longer lengths of stay and the last stages of recovery may require nursing services well below those of an average patient. Because these last stages of recovery may be the dominant influence on the overall amount of nursing services consumed by older patients, the nursing services per day consumed by older patients, on the average, may be little different from those consumed by younger (non-Medicare) patients.

On balance, it is difficult to come to a definitive conclusion in the armchair; scientific tests on a large number of hospitals are needed. This study presents the most comprehensive tests so far: data from over 4,000 hospitals are analyzed for 1 year; sample hospital data from 3 different years are used to examine the validity of the original estimations; and total routine nursing salary costs are analyzed without *a priori* division between direct and indirect costs.

Two Models of Routine Nursing Salary Cost

There is no real consensus in the economic literature on what hospital decision-makers try to maximize, unless it is some of everything: quantity, quality, size of physical plant, prestige, staff physicians' income, and number of interesting cases (Evans, 1971; Davis, 1972). Nevertheless, hospitals must have some resource constraints; health care expenditures are not approaching 100 percent of GNP. Further, decisions on hiring personnel, admitting patients, purchasing equipment, and allowing staff physicians to practice in the hospital do get made. Therefore, hospitals must have some decision-making behavior framework in which limited resources are allocated (Harris, 1977; Pauly and Redisch, 1973).

Given the problems mentioned above, this study does not attempt to construct and estimate a formal model of hospital behavior. It is recognized that hospitals may not be operating most efficiently because they are insulated from the test of the marketplace by third-party, cost-based payers for hospital care. Nevertheless, within the framework of hospital decision-making, it is assumed in this study that there are tendencies to produce efficiently what outputs the hospital decision-makers desire, because more of what they desire can thereby be produced.

Correspondingly, expectations of the effects of differences among hospitals in resource prices, patient case-mixes, and other variables will be formed on the bases of the anticipated reaction of a competitive firm and the results found in the hospital economic literature (for example, see Lave and Lave, 1978).

Before 1981, the 8.5 percent differential was actually paid as an addition to the nursing salary costs per non-Medicare routine day—without any adjustment for the values of other variables which could influence the non-Medicare nursing salary costs. That is, if non-Medicare *per diem* routine nursing costs were higher in a given locality because, for example, of higher area wages, the MRND was 8.5 percent of the higher amount. An identical hospital located in a low wage area was paid 108.5 percent of its lower non-Medicare *per diem* routine nursing costs for each Medicare routine patient day. As can be seen by this example, RNS and the MRND payment might vary for reasons other than variation in PMR.

If, however, PMR and another variable such as area wage levels were incidentally related, a bias could enter into the estimation of the effect of differences in PMR on RNS. For example, if hospitals having a greater proportion of Medicare patients were generally located in high wage localities, the PMR variable could show a strong positive effect on RNS solely because of the relation between PMR and wages. Thus, in the two regression models presented here there is a need to incorporate the influences of other variables that may exert strong influences on both PMR and RNS in order to minimize the potential for biased results.

The Section 223 Reimbursement Model: Model I

The Secretary of the Department of Health and Human Services is authorized to exclude from reasonable cost reimbursement all costs "found to be unnecessary in the efficient delivery of needed health services." This authorization comes from Section 1861(v)(1) of the Social Security Act (42 U.S.C. 1395x(v)(1) as amended by Section 223 of Public Law 92-603, the Social Security Amendments of 1972. The regulations that implemented this authority were published in the Code of Federal Regulations (42 CFR 405.460). In 1977, 1978, and 1979 limits which restricted Medicare reimbursement of hospital routine costs per patient day were published in the Federal Register. Similar routine cost limits had been in effect since 1974.

The reimbursement model examines the existence of the Medicare routine nursing salary cost differential within the context of the routine cost-limiting system under which hospitals' routine costs were reimbursed by Medicare during the 1977-1979 period.

Even though variables such as the occupancy rate, regional location, and others are hypothesized to influence RNS (in Model II of this study), the Medicare program did not, in 1979, consider these variables when reimbursing hospitals for costs for routine services to Medicare patients.

The Medicare program did consider, however, such variables as local area wages, the intensity of care, and combined patient care and teaching activities when setting reimbursement limits on routine costs per patient day (RCPD) under Section 223 routine cost limit regulations.

Routine nursing salary costs are approximately 40 percent of hospital routine costs. Consequently, it is reasonable to expect that, if "*per diem* routine costs" are sensitive to these variables, so should be RNS. Significant findings with regard to the coefficient of PMR may indicate that the Section 223 limit types of adjustments in Model I do not allow for any extra routine nursing resource use for Medicare patients. This could argue for payment of a nursing differential regardless of whether a hospital exceeds its routine cost limits.

A rebuttal, on the other hand, would emphasize that being over the limit is an indication of inefficient cost behavior on the part of the hospital and that inefficient hospitals should not receive the MRND payment for the proportion of costs exceeding the limit.

The reimbursement model specified here searches for the existence of a Medicare routine nursing differential in the context of the Section 223 routine cost limits. In the reimbursement model:

1. The seven Section 223 hospital categories are represented by dummy variables based on hospital size (number of beds) and Standard Metropolitan Statistical Area (SMSA)/non-SMSA location,
   BED1—SMSA, under 100 beds
   BED2—SMSA, 100-404 beds
   BED3—SMSA, 405-684 beds
   BED4—SMSA, 685 + beds
   BED5—non-SMSA, under 100 beds
   BED6—non-SMSA, 100-169 beds
   BED7—non-SMSA, 170 + beds

   For example, the variable

$$BED4 = \begin{cases} 1 & \text{if the hospital is located in an SMSA and has 685 beds or more and} \\ 0 & \text{otherwise;} \end{cases}$$

2. The wage variable (WAGEC) is a combination of the two indices computed by the Bureau of Labor Statistics and used by HCFA for the area wage adjustment under the Section 223 limits. The indices are based either on an aggregation of wages in SMSA counties—for hospitals located in SMSA's—or on a State aggregation of wages in non-SMSA counties—for hospitals located outside of SMSA's. For hospitals in SMSA's, WAGEC equals the index. For hospitals outside of SMSA's, WAGEC equals the non-SMSA index value multiplied by the ratio of the non-SMSA average wage to the SMSA average wage. This adjustment is to make out of the separate indices a comparable single wage variable over all hospital observations;
3. The ratio of interns plus residents (IRES) divided by the number of hospital beds (general + special care), which allows for the costs of combined patient care and teaching activities, is included; and
4. The Section 223 intensity adjustment variable based on Medicare covered days of hospital care (MCDC), which allows a higher routine cost-limit for a presumed higher intensity of routine hospital services *only* in States having a below average number of Medicare covered hospital patient days per 1,000 Medicare Part A health insurance enrollees, is in this model. It is defined as

   MCDC = 1 + .25 (S - N)/S, where
   S = the State average Medicare covered hospital patient days per 1,000 Medicare Part A health insurance enrollees and
   N = the national average Medicare covered hospital patient days per 1,000 Medicare Part A health insurance enrollees.

Hospitals in States with below average covered days, it is argued, save the Medicare program payment for hospital patient days of care by treating only the sicker patients and by releasing patients from the hospitals, resulting in shorter lengths of stays. However, in doing this, they provide more intensive care and, therefore, more expensive care per routine day. The intensity adjustment increases the Section 223 routine cost limit to compensate hospitals in these States for the extra resources expended per routine day and encourages hospitals to continue to "save" Medicare patient days.

The variables included in the reimbursement model account for hospitals being placed into groups of similar hospitals or are adjustment factors which actually allow similar hospitals to have different limits, depending on the values of these variables. Obviously, the Medicare program presumed that routine hospital costs per day are influenced by these variables and that an adjustment in reimbursement is appropriate. If PMR significantly influences RNS within this model, it could be argued that hospitals that have reimbursements limited by Section 223 regulations should have received that portion of the 8.5 nursing differential which would otherwise have been excluded by the limits. The grounds for such argument would be that even after adjustment of the limits for the values of these variables, Medicare patients consume more nursing services than non-Medicare patients.

If an MRND existed in this context, it is expected that when this model's parameters are estimated, hospitals that devote a greater proportion of their routine patient days to Medicare patients will be found to have significantly higher routine nursing salary costs per patient day.

The Comprehensive Model: Model II

The comprehensive model is not constrained to incorporate only the variables which are used in determining the routine cost limits. This model includes not only the proportion of routine patient days consumed by Medicare patients, but also additional explanatory variables which operate to hold constant other factors affecting the routine nursing salary cost per patient day. These other factors are characteristics of hospitals and their outputs which are hypothesized to influence RNS. Since it is impossible to perform a natural experiment where the only explanatory variable that changes is the proportion of Medicare patient days, ordinary least squares regression analysis will be relied on to hold the effects of these other factors constant in a statistical sense.

The variables hypothesized to influence RNS are:

- the proportion of total routine patient days consumed by Medicare patients (PMR),
- the number of general service beds in the hospital (BEDG),
- geographic region (RG1, northeastern States; RG2, north central States; RG3, southern States; RG4, western States),
- type of control (CNTRLN, nonprofit, nongovernment; CNTRLG, State or local government; CNTRLF, for profit),
- the hospital's occupancy rate (OCR),
- a hospital wage rate index—a combination of the two indices used for adjusting Section 223 routine cost limits (WAGEC),
- the hospital's ratio of interns and residents per (general and special care unit) bed (IRES),
- the proportion of Medicare special care unit (SCU) days to total SCU days (PMSCUD),
- an intensity variable (MCDC "YR") based on the foundation of the Section 223 intensity adjustment, MCDC. MCDC79 is the ratio in 1979 of *S/N*, where *S* is the State average Medicare covered hospital patient days per 1,000 Medicare Part A health insurance enrollees and *N* is the national average,
- special care unit patient days divided by routine care patient days (SC/RPD),
- the hospital's 1978 Medicare patient case-mix index (MCMI78), and
- the number of RN's and LPN's per 1,000 bed days for the State in which the hospital is located (NPKBD).

The variables RG1 and CNTRLF are omitted from the regression equations; their effects are included in the estimate of the constant term.

Variable Sources and Expected Influences on RNS

The major source of information for this study is the file of 1979 Medicare cost report data used in computing the Section 223 routine cost-limits. This file was merged with a file containing the 1978 Medicare case-mix index and with the AHA Annual Survey of Hospitals file for 1979. This file contains 4,521 observations and will be termed the 1979 Universe file to distinguish it from Sample files. Note, however, that there were 5,851 short-term, general community hospitals in the U.S. population in 1979 and 5,842 in 1980 (AHA, *Hospital Statistics,* 1979 and 1980). Observations were lost because of incomplete Medicare cost reports, inability to match hospital observations on the three major source files, and missing observations for crucial variables.

A secondary data source is the Office of Research and Demonstrations sample of 1,200 hospital Medicare cost reports for 1977, 1978, and 1979. This sample was drawn from the universe of Medicare certified short-term general hospitals and was stratified into four bed-size groups: 0-99 beds, 100-249 beds, 250-399 beds, and 400+ beds. Hospitals in the larger bed-size groups were sampled at a much greater rate relative to their universe numbers than were smaller hospitals. That is, the sample gives more than proportional representation to large hospitals and less than proportional representation to small hospitals.

The utility of the sample data is that the models may be examined in three different time periods to see if structural changes have occurred and to see if tests of the major hypothesis yield uniform and consistent results.

The means and standard deviations of the Models' variables are shown in Table 1 for the 1979 Universe data base and in Table 2 for the Sample data base. To standardize the data, appropriate variables were annualized (put on a twelve-month basis if the reporting period was not twelve months) and inflated or deflated, if proper, to place the end date of the reporting period at December 31st of the reporting year for all hospitals.

A Medicare Case-mix Index (MCMI78) was developed by HCFA to measure the resource intensity of a hospital's Medicare patient case-mix. Patient hospital claims and hospital discharge abstracts from a 20-percent sample of Medicare beneficiaries in 1978 were linked and arrayed into 383 DRG's. The estimated cost per case in each DRG (over cases in all hospitals) was divided by the DRG's national average cost per case (over cases in all hospitals and all DRG's) to form the DRG's cost weight. Following the development of the cost weights, the proportion of a hospital's sample cases in each DRG was multiplied by the DRG cost weight and the result summed over all the hospital's DRG's to form the hospital's case-mix index (Pettengill and Vertrees, 1980).

The influence of a higher (more resource intensive) Medicare patient case-mix on RNS is expected to be positive. Likewise, larger hospitals are expected to have higher RNS because of the influence of their generally more complex cases (Medicare and non-Medicare) on costs. Hospitals in higher wage areas are expected to have higher RNS because nursing salaries are higher.

The relationship between the occupancy rate (ratio of patient days to bed days available) of a hospital and its RNS is hypothesized to be negative. Hospitals with low occupancy rates may have to overstaff to meet licensing requirements and to be able to handle an unexpected increase in patient load. Hospitals with normally high occupancy rates may be better able to plan the allocation of nursing staff and to shift nurses where they are needed. Naturally, unexpected variations in patient load for high- and low-occupancy hospitals will cause actual staffing to differ from optimal staffing. Hospitals with high occupancy rates are more likely to have already experienced a heavy increase in occupancy and may be stretching their staffs thin, thus operating temporarily during the year below their normal RNS levels.

Geographic location is an important determinant in the consumption of hospital services. Medicare hospital patients in the western portion of the United States experience a shorter average length of stay: 8.7 days versus 10.8 days for the U.S. in 1978 (Goldsteen, 1981). A higher intensity of services per day could account not only for a faster recovery from illness but also imply a higher RNS in the western region. Therefore, the dummy variable for the western region, RG4, is expected to be higher than the dummy variables for the other regions.

TABLE 1

Mean Values and Standard Deviations of Dependent and Explanatory Variables in 1979 Universe

Model Variables	Mean	St. Dev.	Model Variables	Mean	St. Dev.
RNS	48.73	13.27	RG3	0.38	0.49
RNS/RCPD	0.38	0.07	RG4	0.18	0.38
RCPD	131.56	36.60	CNTRLN	0.56	0.50
PMR	0.45	0.13	CNTRLG	0.32	0.47
BED2	0.27	0.45	OCR	0.63	0.18
BED3	0.07	0.25	BEDG	147.73	154.92
BED4	0.02	0.14	NPKBD	2.08	0.30
BED5	0.40	0.49	LOS	6.41	1.57
BED6	0.08	0.27	RMLOS	1.45	0.23
BED7	0.05	0.22	MCDC79	3,673.17	468.37
WAGEC	0.96	0.16	MCMI78	1.00	0.10
MCDC	1.01	0.03	SC/RPD	0.04	0.05
IRES	0.02	0.07	PMSCUD	0.40	0.28
RG2	0.30	0.46			
Observations	4,521	4,521		4,521	4,521

TABLE 2

Mean Values and Standard Deviations of Dependent and Explanatory Variables for the Sample Hospitals

Model	1977		1978		1979	
Variables	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
RNS	31.85	7.61	35.71	8.78	49.38	12.59
RNS/RCPD	0.37	0.06	0.37	0.06	0.37	0.06
RCPD	88.04	23.71	98.76	26.44	136.24	36.14
PMR	0.41	0.12	0.43	0.12	0.43	0.12
BED2	0.27	0.44	0.27	0.44	0.27	0.44
BED3	0.24	0.43	0.23	0.42	0.23	0.42
BED4	0.06	0.24	0.07	0.25	0.07	0.26
BED5	0.22	0.42	0.24	0.43	0.24	0.43
BED6	0.07	0.25	0.06	0.23	0.05	0.22
BED7	0.08	0.28	0.06	0.25	0.07	0.25
WAGES	0.90	0.15	1.00	0.17	0.99	0.16
MCDC	1.01	0.03	1.01	0.03	1.01	0.03
IRES	0.04	0.10	0.04	0.09	0.04	0.10
RG2	0.32	0.47	0.31	0.46	0.32	0.47
RG3	0.35	0.48	0.35	0.48	0.35	0.48
RG4	0.13	0.34	0.14	0.35	0.14	0.35
CNTRLN	0.70	0.46	0.68	0.47	0.67	0.47
CNTRLG	0.23	0.42	0.25	0.44	0.26	0.44
OCR	0.71	0.16	0.69	0.16	0.69	0.17
BEDG	271.19	223.79	265.05	227.60	268.47	228.51
PMSCUD	0.41	0.24	0.42	0.24	0.43	0.24
SC/RPD	0.05	0.09	0.06	0.07	0.05	0.04
MCMI78	1.05	0.10	1.04	0.10	1.04	0.10
Observations	971	971	1,009	1,009	958	958

With regard to variables representing the hospital's type of control, it is expected that for-profit hospitals have incentives to operate with greater efficiency and, therefore, will have lower RNS. Of course, the profit motive could lead to a higher RNS if nursing care is substituted efficiently for other resources. Thus, it is difficult to assert strongly the influence of type of control on one particular resource.

During the 1970's, many hospitals added or expanded special care units. This added capability gives hospitals with SCU's an alternative unit for treating seriously ill Medicare (and other) patients. The Medicare program reimbursed hospitals in full for beneficiary SCU costs, without upper limits such as have been set under the Section 223 routine cost limits regulations. Therefore, hospitals may have placed qualifying Medicare patients having nursing care requirements exceeding 108.5 percent of the average non-Medicare patient in an SCU in order to receive compensation more appropriate to the intense services being delivered to very sick Medicare patients. To the degree that very seriously ill patients are treated in the SCU's, rather than in general service units, RNS should be lower for hospitals having available SCU beds.

Two variables were included in the comprehensive model to measure the effect of SCU availability: the ratio of SCU days to routine patient days and the ratio of Medicare SCU days to total SCU days. Both are anticipated to be negatively related to RNS because the added nursing salary costs of intensively ill patients may be allocated to the SCU (when it is available) rather than general service units, that is, not to RNS. Further, if Medicare patients require more services than non-Medicare patients when they are seriously ill, a higher proportion of Medicare days in the SCU's should reduce routine nursing salary costs even more and increase SCU nursing salary costs.

An offset to these expected influences would occur if hospitals with larger SCU's and greater Medicare SCU use also cared for more seriously ill patients overall. Then the pre- and post-SCU care in the general service areas might be *more* nursing intensive than for the average hospital, causing a positive relation between the two SCU variables and RNS.

In labor market areas where nurses are relatively scarce, hospitals may not be able to hire all the nurses they desire. For hospitals in these areas, it is conjectured, RNS would be higher if the nurses were available. To test this conjecture, the ratio of RN's plus LPN's to available bed days was computed for each State and included in Model II. Thus, a positive impact of NPKBD on RNS is the expectation.

Two additional variables were to be included in the comprehensive model: LOS, the hospital's average length of stay (patient days divided by admissions), and RMLOS, the ratio of the hospital's Medicare beneficiary length of stay to the hospital's overall length of stay. Unfortunately, the statistical reporting of admissions was found to be somewhat unreliable on the Medicare cost report and none of the other sources contained information on Medicare admissions. To avoid losing sample observations, the length-of-stay variables were not part of the sample data base. Nevertheless, because of the effect of these two variables on the coefficient of PMR, Model II-A showing the results of these two variables is included with the 1979 universe results. Definitions of the regression variables are shown in Table 3.

The 1979 Universe Results

In 1979, Medicare cost report data from roughly 5,800 hospitals were used to establish the Section 223 routine cost limits effective July 1, 1981. After file mergers, elimination of missing observations, and data edits, 4,521 observations remained. The models developed in this paper were estimated in natural logarithm and in linear form. The log form is preferred by the author because of its appropriateness for hospital cost function analysis and the ease of interpreting its regression coefficients as elasticities. However, the linear form is also presented for comparison and for determining the sensitivity of the results to the functional form.

The Section 223 Reimbursement Model

The Section 223 reimbursement model, Model I, explains about one-fourth of the total variation in RNS over the 4,521 hospitals in 1979. While an improvement over the one percent explained by a simple regression between RNS and PMR, this model still leaves three-fourths of the variation in RNS unexplained (Table 4).

After adjustment for the influences of the Section 223 limit-adjusting variables on RNS, the influence of PMR on RNS is not significantly different from zero. That is, within the reimbursement model, Medicare patients do not appear to consume more nursing services per day than non-Medicare patients. Therefore, paying hospitals a nursing differential above that permitted by the Section 223 routine cost limits after allowing for the effects of the Section 223 grouping and adjusting characteristics (as do the limits) is not supported by these results. That is, after holding constant the effects of the Section 223 variables, PMR has no additional influence on RNS.

Surprisingly, because RNS is nearly 40 percent of routine costs per day, in the log form of Model I only one of the Section 223 hospital groups has RNS significantly different from BED1, the "below 100 beds, SMSA" hospital group (which has its influence through the constant term). The group of hospitals in non-SMSA areas having fewer than 100 beds, BED5, have significantly higher costs, approximately 10 percent higher. Additionally, only in the linear form are BED2 hospitals, those in SMSA's having 100-404 beds, shown to have significantly lower costs than BED1 hospitals.

The influence of the wage index variable, WAGEC, in this model is significant and shows an elasticity in the log equation of 0.63. Hospitals located in areas having a wage index that is 10 percent higher, are estimated to have routine nursing costs 6 percent higher per day.

The elasiticity of interns and residents per bed with respect to RNS is statistically significant at 0.46, as shown in the logarithmic equation.

The Medicare covered (saved) days of care variable, MCDC, has an elasticity of 2.80 percent in the same equation. A 10 percent higher level of MCDC in Model I is associated with a 28 percent higher level of RNS. Hospitals in

TABLE 3

Definitions of Regression Variables in Model I and Model II.

Model Variables	Definition
BED1	equals 1 if the hospital is in an SMSA and has under 100 beds, 0 otherwise;
BED2	equals 1 if the hospital is in an SMSA and has between 100 and 404 beds inclusive, 0 otherwise;
BED3	equals 1 if the hospital is in an SMSA and has between 405 and 684 beds inclusive, 0 otherwise;
BED4	equals 1 if the hospital is in an SMSA and has more than 684 beds, 0 otherwise;
BED5	equals 1 if the hospital is not in an SMSA and has fewer than 100 beds, 0 otherwise;
BED6	equals 1 if the hospital is not in an SMSA and has between 100 and 169 beds inclusive, 0 otherwise;
BED7	equals 1 if the hospital is not in an SMSA and has more than 169 beds, 0 otherwise;
WAGEC	combined BLS wage index.
IRES	ratio of interns plus residents divided by the number of hospital (general + special care) beds
MCDC	Section 223 intensity adjustment variable based on Medicare covered days of hospital care, only for hospitals in States having a below average number of Medicare covered hospital patient days per 1,000 Medicare Part A Health Insurance enrollees.
PMR	the proportion of total routine patient days consumed by Medicare patients
BEDG	the number of general service beds in the hospital
RG1	equals 1 if the hospital is located in a northeastern state, 0 otherwise
RG2	equals 1 if the hospital is located in a northcentral state, 0 otherwise
RG3	equals 1 if the hospital is located in a southern state, 0 otherwise
RG4	equals 1 if the hospital is located in a western state, 0 otherwise
CNTRLN	the hospital has nonprofit, nongovernment type of control
CNTRLG	the hospital has State or local government type of control
CNTRLF	the hospital has for-profit type of control
OCR	the hospital's occupancy rate (OCR),
WAGEC	a hospital local area wage rate index—a combination of the two indices used for adjusting Section 223 routine cost limits (WAGEC),
IRES	the hospital's ratio of interns and residents per (general and special care unit) bed
PMSCUD	the ratio of Medicare special care unit (SCU) days to total SCU days in the hospital
MCDC"YR"	MCDC79, for example, is the ratio in 1979 of the state average Medicare covered hospital patient days per 1000 Medicare Part A Health Insurance enrollees to the national average for the state in which the hospital is located
SC/RPD	the hospital's special care unit patient days divided by routine care patient days
MCMI78	the hospital's 1978 Medicare patient casemix index
NPKBD	the number of RN's and LPN's per thousand bed days for the State in which the hospital is located

TABLE 4

Regression Results for a Simple Model and Model I Explaining Variation in Routine Nursing Salary Costs per Routine Patient Day (RNS) in 1979

Explanatory Variables	Simple Model Linear	Simple Model Log	Model I Linear	Model I Log	Model I-A Linear	Model I-A Log
CONSTANT	54.22 (74.05)	3.78 (384.83)	−131.34 (20.38)	3.81 (282.11)	39.12 (15.18)	7.78 (34.76)
PMR	−12.21 (7.77)	−0.08 (7.67)	1.01 (0.66)	0.0002 (0.01)	0.65 (0.42)	−0.001 (0.12)
BED2			−1.42 (2.40)	−0.01 (1.22)	−1.48 (2.48)	−0.02 (1.28)
BED3			−0.86 (1.01)	−0.01 (0.67)	−0.96 (1.11)	−0.01 (0.73)
BED4			0.69 (0.47)	0.03 (1.01)	0.15 (0.10)	0.02 (0.73)
BED5			4.85 (7.61)	0.10 (7.65)	5.47 (8.53)	0.11 (8.38)
BED6			−0.66 (0.81)	−0.02 (0.97)	−0.16 (0.20)	−0.01 (0.47)
BED7			−0.55 (0.59)	−0.004 (0.18)	−0.16 (0.17)	0.003 (0.17)
WAGEC			32.91 (20.87)	0.63 (18.65)	36.29 (23.24)	0.68 (20.52)
IRES			20.36 (7.09)	0.46 (6.31)	20.22 (6.95)	0.46 (6.23)
MCDC			144.52 (21.96)	2.80 (19.77)		
MCDC79					−0.0075 (19.14)	−0.48 (17.63)
Observations	4,521	4,521	4,521	4,521	4,521	4,521
F-Ratio (K-1, N-K)	60.43	58.79	183.97	154.26	169.26	144.38
R^2	0.01	0.01	0.29	0.25	0.27	0.24

Note: Unsigned *t*-ratios are in parentheses. P(*t*>1.96) = .05 and P(*t*> 2.58) = .01.

States that "save" more patient days, as measured by MCDC, have higher RNS. While this is an extremely large influence, it should be noted that all hospitals located in States having a level of Medicare covered days of care per 1,000 HI enrollees below the national average, have a value of zero for this routine cost limit adjustment (and a corresponding value of one for MCDC) regardless of their actual State value. Thus, MCDC is not a proper variable for testing hypotheses about Medicare covered days of care.

By including hospitals that receive a positive adjustment with hospitals that receive zero adjustment, the differences among hospitals in their MCDC values are much greater than the actual differences among their State ratios of Medicare covered days of care per 1,000 HI enrollees. As a result, the significant effect of the MCDC variable, a measure of the Section 223 limit adjustment, should not be interpreted to mean that MCDC measures the effect on RNS of hospitals being located in States with above and below average values of Medicare covered days of care per 1,000 HI enrollees.

A more appropriate measure for testing the strength of the influence of variation in Medicare covered days in a State on RNS would be a variable which has the actual, non-zero, value of the State's average Medicare covered hospital patient days per 1,000 Medicare Part A health insurance enrollees for hospitals. MCDC79 is just such a variable.

When this variable is substituted for MCDC in Model I-A, Table 4, there is no substantial change (in size or significance) in the coefficient of any one of the other explanatory variables nor in the proportion of variation explained. The interpretation of the influence of variation in covered Medicare hospital days per 1,000 Medicare beneficiaries is much easier. RNS is indeed sensitive to MCDC79 in this model with a significant elasticity of -0.48. Hospitals in States with MCDC79 10 percent below the national average are, in this model, estimated to have RNS higher by 4.8 percent.

The Comprehensive Model

The Comprehensive Model, Model II, estimated here using the 1979 universe data, explains from 39 (in log form) to 42 percent (in linear form) of the variation in RNS. This is up from 25 percent in Model I.

As seen in Table 5, the coefficient of PMR is not statistically different from zero in either form. Thus, hospitals with proportionally more routine patient days of care for Medicare beneficiaries do not have significantly higher routine nursing salary costs per routine day.

The number of general service beds, BEDG, is significantly related to RNS—negatively in log form and positively (at the 10-percent level of significance) in linear form. The effect of differences in hospital size on RNS, however, is not large. An increase in hospital bed size of 10 percent is estimated to reduce RNS by one-tenth of a percent. Alternatively, from the linear form, an increase in hospital size by 100 beds, is estimated to increase RNS by $0.30.

The case-mix index, MCMI78, was included in the analysis of 1979 hospital data even though it attempts to measure a hospital's Medicare patient complexity for the previous year. No case-mix index has been computed for 1979, and it is assumed here that a hospital's case-mix and the costs of the hospital's techniques for treating its case-mix do not change substantially from one year to the next. A large change in the patient-mix or a large change in the per case cost weights used in forming the index could render a hospital's case-mix index value useless outside the year to which the data applies. In the comprehensive model, MCMI78 was significantly and positively related to RNS. An increase in MCMI78 of 10 percent would be associated with an increase in RNS of 2 percent.

Geographic location is an important characteristic in explaining variation in RNS. Hospitals in the northeast and the south had similar levels of RNS, but hospitals in the north Central and the western regions had levels estimated to be 10 and 15 percent higher, respectively. With regard to type of control, RNS was estimated to be 11 percent higher in nonprofit hospitals, and 12 percent higher in State and local government hospitals, than in for-profit hospitals.

The occupancy rate and the hospital wage variable were discovered to have the most strongly significant influences on RNS. The estimated elasticity of -0.26 implies that a 10-percent increase in OCR is associated with a 2.6-percent drop in RNS. Likewise, a 10-percent increase in the wage variable, WAGEC, is related to a 5.3-percent increase in RNS.

The regression coefficient of MCDC79 was not statistically significant at the customary level of 5 percent, but was significant at the 10 percent level. Its log coefficient would imply, if significant, that hospitals located in States having 10 percent fewer covered Medicare hospital days of care per 1,000 Medicare beneficiaries would have RNS values four-tenths of a percent higher.

The more special care unit patient days a hospital produces relative to general service patient days, SC/RPD, the higher its routine nursing salary costs, according to Model II. The expectation was for just the opposite effect. The alternative hypothesis, that hospitals with more special care unit beds have sicker patients in general service beds, does appear plausible. The proportion of special care unit days going to Medicare patients is also a significant factor in the comprehensive model. A 10-percent increase in PMSCUD results in an increase of four-tenths of a percent in RNS in this model. Finally, the coefficient of the nursing supply variable, NPKBD, was positive and significant with an increase in NPKBD of 10 percent being associated with an increase in RNS of 1.5 percent. Apparently the greater availability of nurses in some States is related to higher routine nursing salary costs per routine day in those States.

Model II-A

A hospital's average length of stay should be an important variable in explaining variation in RNS. Because the most intensive testing and treatment usually comes in the early stages of a patient's stay, it is reasonable to expect that the longer the recuperation, the lower the demand for routine nursing services. Hospitals with longer average lengths of stay are expected to have lower RNS values.

TABLE 5

Regression Results for Model II Explaining Variation in Routine Nursing Salary Costs per Routine Patient Day (RNS) in 1979

Explanatory Variables	Model II Linear	Model II Log	Model II-A Linear	Model II-A Log	Model II-B Linear	Model II-B Log
CONSTANT	18.57	4.17	15.22	4.02	24.81	4.18
	(4.77)	(10.51)	(3.75)	(10.13)	(3.49)	(10.53)
PMR	0.83	−0.002	4.01	0.0166	0.669	0.001
	(0.60)	(0.21)	(2.70)	(1.63)	(0.49)	(0.08)
BEDG	0.003	−0.01	0.005	−0.008	0.004	−0.005
	(1.93)	(2.63)	(3.33)	(1.39)	(3.07)	(0.99)
RG2	4.34	0.10	4.15	0.09	4.42	0.10
	(7.45)	(8.07)	(7.08)	(7.80)	(7.57)	(8.19)
RG3	0.19	0.001	0.04	−0.002	−0.02	−0.005
	(0.31)	(0.10)	(0.07)	(0.15)	(0.03)	(0.44)
RG4	8.77	0.15	8.17	0.14	8.77	0.16
	(10.30)	(8.35)	(9.54)	(7.73)	(10.28)	(8.35)
CNTRLN	4.67	0.11	4.47	0.11	4.70	0.11
	(9.16)	(10.33)	(8.77)	(10.00)	(9.21)	(10.35)
CNTRLG	6.05	0.13	5.76	0.12	5.98	0.12
	(11.42)	(11.48)	(10.87)	(11.02)	(11.28)	(11.34)
OCR	−25.96	−0.26	−24.66	−0.25	−25.11	−0.26
	(22.49)	(21.42)	(20.99)	(20.24)	(22.18)	(20.90)
WAGEC	27.35	0.53	29.20	0.56	27.79	0.54
	(18.65)	(16.82)	(19.47)	(17.47)	(18.98)	(17.17)
IRES	17.17	0.49	18.95	0.54	17.47	0.50
	(6.41)	(7.51)	(7.05)	(8.17)	(6.52)	(7.68)
MCDC79	−0.001	−0.08	−0.001	−0.04	−0.001	−0.08
	(1.73)	(1.67)	(0.82)	(0.81)	(1.80)	(1.81)
SC/RPD	20.54	0.50	19.96	0.51	23.30	0.58
	(4.83)	(4.75)	(4.70)	(4.90)	(5.56)	(5.58)
PMSCUD	−3.62	−0.04	−3.57	−0.05	−3.33	−0.04
	(5.45)	(2.26)	(5.38)	(2.57)	(5.04)	(2.06)
MCMI78	7.54	0.21	9.39	0.24		
	(3.63)	(4.84)	(4.47)	(5.46)		
NPKBD	4.27	0.15	4.39	0.15	4.35	0.16
	(5.44)	(4.46)	(5.61)	(4.48)	(5.55)	(4.51)
LOS			−0.81	−0.09		
			(5.38)	(4.62)		
RMLOS			0.28	0.001		
			(0.37)	(0.03)		
Observations	4,521	4,521	4,521	4,521	4,521	4,521
F-Ratio (K-1, N-K)	217.54	193.10	195.42	172.78	231.51	204.19
R^2	0.42	0.39	0.42	0.39	0.42	0.39

Note: Unsigned *t*-ratios are in parentheses. $P(t>1.96) = .05$ and $P(t> 2.58) = .01$.

To test this hypothesis, LOS was formed as the ratio of total patient days to total admissions with data from the Medicare cost report. Along with LOS, the ratio of the hospital's Medicare patient length of stay to the hospital's overall length of stay (RMLOS) was computed for inclusion in the model. The expected influence of this latter variable is uncertain. If Medicare patients stay much longer than the hospital's average patients, it could be because the Medicare patients are much sicker (increasing RNS) or because hospital practice patterns are causing these patients to be kept for an excessive amount of recovery time (reducing RNS).

Preliminary examination of the LOS and RMLOS data showed evidence that the number of hospital admissions was a variable not reliably reported by some hospitals. This is probably because it is not required for determining Medicare payment to hospitals. To the extent that aberrant observations were edited out of the data base, the problem was solved. However, because some caution remains regarding these variables, and because of their singular influence on the PMR coefficient after the editing, the effects of LOS and RMLOS are estimated in a separate model.

Table 5 presents Model II-A alongside of Model II. Not only are the proportions of variation in the log and linear models the same, but also there are few differences in the corresponding regression coefficients. The most noteworthy difference is the coefficient of PMR which, while not significant at the 5-percent level, is nearly significant at the 10-percent level with a value of 0.0166. Using 0.0166 as the best point estimate of the elasticity of RNS with respect to PMR, it is estimated that an increase in the proportion of Medicare routine patient days by 10 percent would be associated with an increase in RNS of 0.17 percent. If the increase were from zero to unity, it is predicted RNS would increase by 1.7 percent.

In the linear form, the coefficient of PMR is significant at the 1-percent level and yields an estimated elasticity of 0.037 evaluated at the means of RNS and PMR. The estimated influence of PMR on RNS in this form is about twice that of the log form.

Model II-B

It could be argued that the proportion of routine patient days going to Medicare patients would be significant if it were not for the inclusion of the Medicare case-mix index for 1978, MCMI78. That is, PMR might be an important explanatory variable except that MCMI78 measures one of the dimensions of the influence of Medicare patients—their case-mixes. Holding the effects of Medicare case-mix constant across hospitals, it is generally found here that PMR is not significant. But if it is Medicare case-mix difficulty, relative to non-Medicare patients, which accounts for an extra use of resources by Medicare patients, should not MCMI78 be removed so that PMR may have its full effect?

Model II-B in Table 5 presents the comprehensive model without MCMI78. The PMR coefficient is still virtually zero and insignificant. The coefficient of SC/RPD has increased slightly, from 0.50 to 0.58, perhaps picking up a relationship between special care units and case-mix. Also, the BEDG coefficient is cut in half, from −0.01 to −0.05, and is no longer significantly different from zero. There are no other substantive changes in the model estimates.

Further, the simple correlation coefficients between PMR and MCMI78 are −0.19 in log form and −0.27 in linear form. These correlations are statistically significant at the 1-percent level. A possible explanation of these findings is that MCMI78 is measuring the overall case-mix of the hospital to a degree and that hospitals having higher MCMI78 values are associated with having fewer Medicare patients.

The Sample Results

The sample distribution of hospitals by bed-size is different from the universe distribution. By design, the larger hospitals are overrepresented in the sample so that more observations would be drawn where there are more Medicare dollars of reimbursement. The three models of this study were estimated using unweighted ordinary least squares regression analysis on the 1977, 1978, and 1979 Medicare cost report data from the sample of 1200 hospitals (merged with the AHA Annual Survey of Hospital files for the respective years and with the 1978 Medicare case-mix index) to see if the 1979 universe results would be replicated.

The Reimbursement Model

The results of Model I, the reimbursement model, are presented in Table 6. In this model, the variables used in adjusting the Section 223 routine cost limits were included as additional explanatory variables. The proportion of variation in RNS explained by Model I across the 1977, 1978, and 1979 regressions is around 25 percent. Over all regressions, linear and logarithmic forms, in only one of the six equations was PMR positive and significant (the linear form for 1978). In all other Model I equations, PMR was positive but not statistically different from zero at the 5-percent level of significance.

In the reimbursement model, the bed-size/SMSA hospital grouping variables, BED2 through BED7, were not significant with two exceptions. For 1977 data, the group of the largest sample hospitals located in SMSA's had higher RNS levels than the hospitals with fewer than 100 beds located in SMSA's, as also did the hospitals with fewer than 100 beds located outside of SMSA's for 1979 data. There is a hint of diseconomies of scale for SMSA hospitals and economies of scale for non-SMSA hospitals in this model. The lack of statistical significance, however, prohibits much serious discussion of economies of scale here.

The explanatory variables with the strongest influences are IRES, WAGES, and MCDC. IRES was not included in the 1977 estimation because it was not an adjusting variable for the Section 223 limits in that year. But, in 1978 and 1979 regressions, the coefficient of IRES reveals a positive and significant effect of that variable on RNS with elasticities of 0.042 in 1978 and 0.046 in 1979. That is, the logarithmic equations estimate that hospitals having 10 percent higher values of IRES also have, on the average, .47 and .42 percent higher values of RNS for 1978 and 1979, respectively.

WAGES and MCDC were positive and significant in all 3 years and in all regressions. In logarithmic form, the elasticity of RNS with respect to WAGES was estimated at between 0.42 and 0.56. That is, in 1979, hospitals located in

TABLE 6

Regression Results for Model I Explaining Variation in Routine Nursing Salary Costs per Routine Patient Day (RNS) in 1977, 1978, and 1979 for the Sample Hospitals

Explanatory Variables	1977 Linear	1977 Log	1978 Linear	1978 Log	1979 Linear	1979 Log
CONSTANT	−56.76	3.42	−66.40	3.51	−121.57	3.80
	(7.30)	(100.11)	(7.81)	(112.21)	(8.27)	(113.81)
PMR	2.90	0.01	5.00	0.02	0.73	0.02
	(1.39)	(0.70)	(2.12)	(1.02)	(0.20)	(0.95)
BED2	1.40	0.05	0.08	0.01	−0.05	0.03
	(1.36)	(1.74)	(0.07)	(0.45)	(0.03)	(0.88)
BED3	1.48	0.06	0.46	0.02	1.75	0.05
	(1.41)	(1.81)	(0.42)	(0.69)	(1.09)	(1.69)
BED4	4.20	0.13	1.91	0.05	2.62	0.07
	(3.18)	(3.26)	(1.36)	(1.46)	(1.30)	(1.93)
BED5	1.74	0.05	1.62	0.05	5.34	0.11
	(1.60)	(1.56)	(1.44)	(1.59)	(3.18)	(3.47)
BED6	1.69	0.04	−0.25	−0.01	1.74	0.05
	(1.33)	(1.11)	(0.18)	(0.26)	(0.82)	(1.22)
BED7	1.59	0.05	−1.09	−0.03	1.10	0.03
	(1.29)	(1.34)	(0.79)	(0.74)	(0.55)	(0.88)
WAGES	17.06	0.42	16.88	0.45	29.01	0.56
	(9.66)	(8.57)	(8.90)	(8.49)	(9.30)	(9.00)
IRES			14.21	0.42	19.54	0.46
			(4.69)	(4.33)	(4.58)	(4.64)
MCDC	69.55	2.11	80.89	2.21	137.61	2.72
	(9.30)	(8.83)	(9.90)	(9.65)	(9.40)	(9.36)
Observations	971	971	1,009	1,009	958	958
F-Ratio (K-1, N-K)	28.30	25.25	31.15	30.95	32.09	32.43
R^2	0.21	0.19	0.24	0.24	0.25	0.26

Note: $P(t > 1.96) = .05$ and $P(t > 2.58) = .01$. Unsigned *t*-ratios are in parentheses.

areas with WAGES higher than the average by 10 percent are predicted to have RNS higher than the average by 5.6 percent, with the effects of all other variables in the reimbursement model held constant. The MCDC variable had a relatively large impact on RNS. Hospitals located in States with MCDC values 10 percent higher than average are estimated to have RNS values higher than average by 21 to 27 percent during the sample data period. However, extreme caution should be exercised in the interpretation of this finding as was noted in the discussion of the universe results.

The Comprehensive Model

The comprehensive model, Model II, was estimated in linear and in logarithmic form and the results are presented in Table 7. The proportion of the total variation in RNS explained by the comprehensive model ranges from 34 percent in 1977 to 39 percent in 1979. The results with respect to PMR are mixed. In one out of three log equations, the PMR coefficient was positive and significant. In two out of three linear equations the coefficient was positive and significant. Further, in all equations the coefficient of PMR was positive. Because the size and the statistical significance of the PMR coefficient is inconsistent across the years, it is not possible to present a sample finding that Medicare patients consume significantly more routine nursing services within the confines of Model II.

Nevertheless, within Model II there appears to be some weak support for the hypothesis that hospitals with more Medicare patients have higher nursing salary costs when allowance is made for the values of the other variables in the model. In the 1979 log equation, the elasticity of RNS with respect to PMR is estimated to be 0.048. As before, the interpretation of the coefficient is that an increase of, for example, 10 percent in PMR would be associated with an increase in RNS of 0.48 percent.

It should be noted that in the 1979 universe results of Model II the coefficient of PMR was negative and insignificant. This finding could be the influence of the sample stratification rather than a true picture of the nation's community hospitals. This point is pursued later.

The Medicare case-mix index variable, MCMI78, was significantly and positively related to RNS in all 3 years of sample hospital data at the 1-percent level of significance. Hospitals with values of MCMI78 10 percent higher than average, after holding the effects of all the other Model II variables constant, are estimated to have RNS values higher than average by from 3.0 to 4.9 percent. These sample estimates are larger than the 1979 universe estimate of 2.1 percent.

Although MCMI78 attempts to measure case-mix for only the Medicare patients in 1978, the interpretations of the influence of this variable on RNS in 1977 and 1979 assumes that hospital Medicare case-mix does not change substantially from one year to the next. Further, to the extent that severely ill Medicare patients and severely ill non-Medicare patients go to the same hospitals, the results may provide an insight into the effect of varying overall hospital case-mix. Some previous research into the relation between case-mix indices based on Medicare patients and case-mix indices based on non-Medicare patients finds that the relationship is positive but weak. (*Research Report*, Commission on Professional and Hospital Activities under HCFA Contract No. 500-78-0002, 1980.)

The coefficients of the dummy variables measuring the effect of location in the north central and western regions of the country were significant and positive in all but one case (log form in 1977). Western hospitals have the highest RNS levels after the effects of the variables in this model have been taken into consideration. This is consistent with the "shorter length of stay/higher intensity of services" proposition for western hospitals mentioned above. North central hospitals also have RNS values significantly higher than northeastern hospitals, while southern hospitals have the lowest RNS values. This last sample finding for southern hospitals is not statistically significant in 1979.

The regression coefficients for the type of control variables (nonprofit-nongovernment control and State and local government control) were positive and statistically significant in 1977, 1978, and 1979 and support an inference that for-profit hospitals have lower RNS. Judging from the log equations, for-profit hospitals may have RNS values as much as 10 percent lower than not-for-profit hospitals.

The two variables in Model II consistently having the highest *t*-ratios are OCR and WAGES. As predicted, OCR has a negative and highly significant effect on RNS and WAGES has a positive and highly significant effect. The estimated elasticity of RNS with respect to OCR varies from −0.24 to −0.31, and the elasticity of WAGES varies among the logarithmic regressions from 0.32 to 0.52.

The MCDC"YR" variable in this model was statistically significant at the 5-percent level in the sample regressions only for 1978. Its coefficient was always negative, which is consistent with the notion that hospitals in States with lower Medicare patient days per 1,000 beneficiaries have higher RNS.

The estimated influence of SC/RCD on RNS is positive and significant except in the 1977 linear results. Although associated with RNS in the opposite direction than expected, these results coincide with the 1979 universe results. They may be revealing some influence of case-mix not captured by MCMI78. The PMSCD influence on RNS is negative and significant in the 1978 and 1979 sample Model II regressions. This finding also agrees with the 1979 universe results.

Generally, the sample findings agree with and support the results of the 1979 universe model. The inconsistencies are limited to the coefficients of PMR and MCDC"YR". Even there, the signs of the MCDC"YR" variable are always negative. Why the coefficient of PMR should be insignificant for the 1979 universe results and waver between significance and insignificance for the sample equations is puzzling.

TABLE 7

Regression Results for Model II Explaining Variation in Routine Nursing Salary Costs per Routine Patient Day (RNS) in 1977, 1978, and 1979 for the Sample Hospitals

Explanatory Variables	1977		1978		1979	
	Linear	Log	Linear	Log	Linear	Log
CONSTANT	−10.99	4.34	−17.81	5.26	−23.11	4.34
	(2.41)	(6.47)	(3.52)	(7.79)	(2.85)	(5.84)
PMR	4.62	0.02	7.22	0.03	4.18	0.048
	(2.39)	(1.18)	(3.33)	(1.61)	(1.27)	(2.12)
BEDG	0.001	0.007	0.002	0.008	0.004	0.019
	(0.97)	(0.69)	(1.51)	(0.77)	(1.89)	(1.73)
RG2	1.47	0.03	2.92	0.07	3.57	0.07
	(2.35)	(1.72)	(4.12)	(3.57)	(3.39)	(3.72)
RG3	−1.55	−0.07	−0.79	−0.04	−0.75	−0.03
	(2.31)	(3.29)	(1.03)	(1.98)	(0.67)	(1.26)
RG4	4.60	0.12	4.18	0.08	8.17	0.15
	(4.09)	(3.37)	(3.27)	(2.35)	(4.44)	(4.20)
CNTRLN	2.93	0.10	3.56	0.09	3.50	0.07
	(3.43)	(3.71)	(3.72)	(3.64)	(2.66)	(3.06)
CNTRLG	2.95	0.09	3.88	0.10	4.25	0.09
	(3.29)	(3.47)	(3.89)	(3.76)	(3.05)	(3.39)
OCR	−12.36	−0.24	−15.00	−0.25	−26.02	−0.31
	(7.04)	(7.78)	(7.82)	(8.38)	(9.26)	(10.29)
WAGES	13.80	0.32	16.81	0.44	28.17	0.52
	(8.17)	(6.94)	(9.13)	(8.49)	(9.53)	(9.08)
IRES	9.54	0.33	13.19	0.40	19.13	0.47
	(3.89)	(3.76)	(4.57)	(4.50)	(4.56)	(5.11)
MCDC"YR"	−0.001	−0.13	−0.002	−0.24	−0.002	−0.09
	(1.85)	(1.67)	(2.83)	(2.92)	(1.14)	(1.05)
SC/RPD	4.22	0.32	18.02	0.43	20.98	0.45
	(1.79)	(2.58)	(5.74)	(3.79)	(2.24)	(2.29)
PMSCUD	−1.40	−0.04	−3.51	−0.10	−4.37	−0.09
	(1.52)	(0.98)	(3.41)	(2.53)	(2.65)	(2.09)
MCMI78	16.13	0.49	11.74	0.37	13.16	0.30
	(5.67)	(5.29)	(3.74)	(4.05)	(2.70)	(3.06)
Observations	971	971	1,009	1,009	958	958
F-Ratio (K-1, N-K)	35.86	35.78	41.44	40.98	39.02	43.21
R^2	0.34	0.34	0.37	0.37	0.37	0.39

Note: P (t >1.96) = .05 and P (t >2.58) = .01. Unsigned t-ratios are in parentheses.

Partition of the 1979 Universe

One inescapable conclusion is that there may be a differential impact of the influence of PMR on RNS between the two data sets. Because the sample has proportionally more large hospitals than the universe, the directions for further analysis are clear. Hospital data observations in the 1979 universe should be separated into potentially homogeneous groups, such as bed-size categories, and Model II tested to see if the regression coefficients are stable across the partitioned data sets.

The partition selected was the four bed-size categories corresponding to the original stratification of the 1,200 hospital sample:

BED-I	0-99	2,330 hospitals
BED-II	100-249 beds	1,262 hospitals
BED-III	250-399 beds	520 hospitals
BED-IV	400+ beds	409 hospitals

The log and the linear forms of Model II were estimated separately on each group, and then on each combination of the groups. The results of the Chow tests are shown in Table 8. At the 5-percent significance level, the following group estimations are not significantly different from each other. That is, only these groups of hospitals can be combined to form a logarithmic Model II estimation that is statistically stable: BED-II and BED-III, BED-III and BED-IV.

The combination of BED-II and BED-IV is closely rejected at the 5-percent level. All other combinations, including those taken three groups at a time and all four groups together, are rejected by larger margins. Note that the degree of dissimilarity among groups appears to be highest between BED-I and all other groups.

In the linear form, the only combination for which rejection is not significant is: BED-III and BED-IV.

TABLE 8

Analysis of Variance Results (Chow Tests) for the Partition of the 1979 Universe: F-Ratios

Hypothesis Tested	F-Ratio for Model II Linear	F-Ratio for Model II Log
BED-I = BED-II	5.77	5.14
BED-I = BED-III	6.24	5.26
BED-I = BED-IV	4.61	4.39
BED-II = BED-III	2.31	1.46
BED-II = BED-IV	2.58	1.89
BED-III = BED-IV	1.10	1.25
BED-I = BED-II = BED-III	12.56	8.68
BED-I = BED-II = BED-IV	10.97	7.88
BED-I = BED-III = BED-IV	7.46	55.94
BED-II = BED-III = BED-IV	4.38	3.26

Note: $P(F > 1.67) = 0.05$ and $P(F > 2.04) = 0.01$ with 15 and ∞ degrees of freedom. Chow tests were constructed by Cyrus Baghelai, Applied Management Sciences of Silver Spring, Maryland.

Although these regressions are presented in Tables 9 and 10, it is of interest to note that there are no statistically significant coefficients of PMR in the four separate bed-size group Model II regressions except in the linear form for BED-I hospitals, which is negative (−4.88 with a *t*-ratio of 2.37).

It was suspected that the partitioned regressions would reveal larger hospitals to have larger, more positive and statistically significant coefficients for the PMR variable, when compared with hospitals in the smaller bed-size groups. This did not turn out to be the case. Smaller hospitals may tend toward a negative relationship between PMR and RNS in the context of Model II, but this relationship for the hospitals in the larger bed-size groups was not close to significance at the 5-percent level.

TABLE 9

RNS Regression Results for Model II for the Two Smallest Bed Size Groups of the Four Bed Size Groups of the Partitioned 1979 Universe Data

Explanatory Variables	BED I Linear	BED I Log	BED II Linear	BED II Log
CONSTANT	23.89	3.89	10.56	3.80
	(3.98)	(7.08)	(1.69)	(4.77)
PMR	−4.88	−0.01	1.17	−0.01
	(2.37)	(0.84)	(0.45)	(0.75)
BEDG	−0.09	−0.08	0.004	0.04
	(6.50)	(6.67)	(0.69)	(1.75)
RG2	1.45	0.05	6.74	0.14
	(1.36)	(2.34)	(7.75)	(6.73)
RG3	−1.63	−0.04	1.86	0.04
	(1.48)	(1.66)	(2.00)	(1.78)
RG4	6.65	0.11	9.55	0.21
	(4.89)	(4.17)	(6.85)	(5.66)
CNTRLN	3.60	0.07	4.34	0.11
	(4.69)	(5.06)	(5.95)	(6.04)
CNTRLG	5.65	0.11	3.95	0.09
	(7.49)	(7.48)	(4.72)	(4.34)
OCR	−30.74	−0.29	−9.37	−0.13
	(19.51)	(20.28)	(4.42)	(4.15)
WAGEC	26.60	0.44	25.93	0.51
	(10.58)	(9.14)	(12.45)	(9.29)
IRES	5.37	0.20	13.95	0.33
	(0.59)	(0.89)	(2.65)	(2.01)
MCDC79	0.0002	−0.02	−0.001	−0.07
	(0.25)	(0.25)	(1.43)	(0.72)
SC/RPD	12.57	0.42	28.82	0.54
	(1.36)	(2.07)	(4.83)	(2.86)
PMSCUD	0.38	0.04	−2.47	−0.03
	(0.36)	(1.27)	(1.36)	(0.46)
MCMI78	10.75	0.23	6.56	0.16
	(3.32)	(3.96)	(1.95)	(1.91)
NPKBD	3.84	0.17	3.08	0.13
	(3.13)	(3.38)	(2.53)	(2.01)
Observations	2,330	2,330	1,262	1,262
F-Ratio (K-1, N-K)	107.66	107.29	70.05	45.81
R^2	0.41	0.41	0.46	0.36

NOTE: Unsigned *t*-ratios are in parentheses. P ($t > 1.96$) = .05 and P ($t > 2.58$) = .01.

TABLE 10

RNS Regression Results for Model II for the Two Largest Bed Size Groups of the Four Bed Size Groups of the Partitioned 1979 Universe Data

Explanatory Variables	Bed III Linear	Bed III Log	Bed IV Linear	Bed IV Log
Constant	4.75	5.76	13.77	5.60
	(0.45)	(6.09)	(0.98)	(3.58)
PMR	8.25	−0.01	3.68	0.03
	(1.60)	(0.30)	(0.49)	(0.49)
BEDG	−0.01	−0.04	0.00	0.03
	(0.93)	(0.76)	(0.05)	(0.62)
RG2	7.80	0.14	7.64	0.12
	(5.96)	(6.08)	(4.74)	(3.31)
RG3	1.76	0.002	4.36	0.07
	(1.24)	(0.07)	(2.48)	(1.82)
RG4	8.81	0.14	11.30	0.14
	(4.13)	(3.40)	(3.91)	(2.00)
CNTRLN	5.19	0.13	2.88	0.08
	(3.35)	(4.82)	(0.89)	(1.03)
CNTRLG	5.39	0.13	4.70	0.11
	(2.93)	(4.07)	(1.36)	(1.41)
OCR	−13.13	−0.17	−29.91	−0.39
	(3.04)	(3.18)	(5.07)	(3.87)
WAGEC	29.04	0.60	33.80	0.75
	(8.41)	(9.03)	(7.05)	(6.10)
IRES	18.84	0.30	14.73	0.31
	(3.65)	(2.64)	(3.52)	(2.56)
MCDC79	−0004	−0.27	−0.003	−0.28
	(2.33)	(2.51)	(1.38)	(1.54)
SC/RPD	9.63	0.23	2.98	0.12
	(1.02)	(1.15)	(0.27)	(0.40)
PMSCUD	−8.61	−0.10	−8.38	−0.27
	(2.01)	(0.99)	(1.95)	(1.90)
MCMI78	10.55	0.17	10.64	0.19
	(1.96)	(1.65)	(1.47)	(1.01)
NPKBD	9.68	0.36	7.78	0.29
	(4.93)	(4.57)	(3.04)	(2.22)
Observations	520	520	409	409
F-Ratio (K-1, N-K)	40.88	46.09	25.39	16.31
R^2	0.55	0.58	0.49	0.38

Note: Unsigned *t*-ratios are in parentheses. P ($t > 1.96$) = .05 and P ($t > 2.58$) = .01.

Summary

The general findings of this analysis of Medicare cost report data for over 4,500 hospitals in 1979 and for a sample of 1,200 hospitals in 1977, 1978, and 1979 can be summarized as follows:

- The proportion of hospital routine patient days consumed by Medicare patients was weakly associated with routine nursing salary costs (RNS). This association appeared to be positive but often not statistically significant at conventional levels. The size of this association and its lack of consistent statistical significance does not support a Medicare routine nursing differential payment of 8½ percent.
- When the 4,521 hospital observations are divided into four bed-size categories, all significant positive relationships disappear between the Medicare proportion of routine patient days and routine nursing salary costs per routine day.
- Higher values of the 1978 Medicare case-mix index (based on diagnosis related groups (DRG's) and cost weights for Medicare patient cases) are associated significantly with higher hospital routine nursing salary costs per routine day.
- Regional location explains a significant amount of the variation in hospital RNS levels. Ranked from highest to lowest estimated levels of RNS in this model are the regions west, north central, northeast, and south.
- Nonprofit hospitals and those with State and local government control are estimated to have RNS levels 10 percent higher than for-profit hospitals.
- Hospital occupancy rates (OCR) and local area wage levels (WAGEC) exert highly significant influences on routine nursing salary cost levels in the expected directions—negatively and positively, respectively.
- Hospitals with more interns and residents per bed (IRES) have significantly higher routine nursing salary costs per routine day. For each 10-percent increase in IRES, RNS is estimated to increase 4.9 percent.
- Hospitals with a higher ratio of special care unit patient days to routine patient days experience higher routine nursing salary costs per routine day. On the other hand, hospitals with a higher proportion of special care unit days consumed by Medicare patients experience lower routine nursing salary costs per routine day.
- With the constraints of a model representing the Section 223 routine cost limits hospital groupings and adjustments, the Medicare patient proportion of routine patient days did not have a significant effect on routine nursing salary costs per routine day.

Implications

The weak and inconsistent association between PMR and RNS does not support a conclusion that hospitals with proportionately more Medicare patients have significantly higher routine nursing salary costs. This is clear from the results of all models based on 1) the data from the 1979 universe of Medicare-certified community hospitals, 2) the sample hospital data from 1977, 1978, and 1979, and 3) the results of the partitioned 1979 universe regressions. The influence of PMR appears to be positive in Models II and III but generally not significant especially for the log regressions.

In view of the extremely weak support for the existence of a positive and significant relationship between PMR and RNS, it is possible that no Medicare routine nursing differential exists. Correspondingly, this study finds little empirical evidence that it should be paid generally to all hospitals.

If the MRND payment is not appropriate, the Medicare program could be subsidizing care for non-Medicare patients by making this payment. That is, the Medicare program by paying in excess of the routine nursing salary costs of hospital care for Medicare beneficiaries may be reducing costs for non-Medicare patients. This is noteworthy because the Social Security Act forbids such cross-subsidization of patients by Medicare.

The comprehensive model included a 1978 Medicare case-mix measure based on 1) a sample of Medicare cases in each hospital, 2) a grouping of these cases into Diagnosis Related Groups, and 3) the estimated average Medicare cost per case in each group. Although this case-mix measure was an estimate of the expected relative resource consumption by each hospital's average Medicare patient in 1978, it was significantly related to RNS in all Model II regressions for the 1979 universe hospital data and for the 3 years of hospital sample data.

If perfect case-mix adjustments could be made, perhaps by appropriately classifying patients into homogeneous resource consumption groups or by assigning resource demand factors to each patient illness facet, there would be little expectation of an MRND. Ideally, all the patient illness facets that cause hospital resource consumption would be taken into consideration leaving age or Medicare payment status to have little separate medical bearing (and hopefully no unwarranted financial incentives) on resource allocation. Practically, the case-mix index is an attempt to condense the many individual patient influences on case costs to a manageable number of quantifiably distinct groups.

If the characteristics of a patient's illness that affect hospital resource consumption can be identified, quantified, recorded accurately, and combined with accurate resource weights, improvements in reimbursement efficiency can occur. If better hospital case-mix measures are developed in the future, a lessening of the explanatory power of hospital characteristics on routine nursing salary costs is to be expected.

Finally, even if a sizable Medicare routine nursing cost differential had been found, the efficiency implications for a special MRND payment would not be very strong. In the author's opinion, what is important is not whether there is a differential consumption of *routine* nursing resources by Medicare patients. It is whether there is a differential consumption by Medicare patients of *all* hospital resources combined which is not taken into account by the Medicare program. If some hospitals are able to efficiently combine skilled nursing personnel in above average numbers with other resources so that overall Medicare patient consumption of hospital resources is low (relative to other hospitals with the same patient case-mix) it may not matter to society that a Medicare routine nursing salary cost differential payment exists for efficient producers of hospital care for Medicare beneficiaries. In this situation, the payment may lead hospitals to efficient methods of production. If, instead, the additional skilled nursing personnel results in a higher Medicare patient consumption of all hospital resources without sufficient improvement in patient outcome for these hospitals, should these hospitals be rewarded with a nursing differential payment?

Acknowledgments

The author gratefully acknowledges the support of Cyrus Baghelai, Rose Connerton, William Sobaski, Judith Lave, Ken Haber, and John Petrie. Claudia Sanders provided many helpful comments.

References

Ament, R.P., Kobrinski, E.J., Wood, W.R., and Dreachslin, J.L. *Draft Research Report.* Ann Arbor: Commission on Professional and Hospital Activities under HCFA Contract No. 500-78-0002, 1980.

American Hospital Association. *Hospital Statistics.* Chicago: AHA, 1979 and 1980 editions. AHA No. 2452.

Caterinicchio, Russel P. and Grace P. Smith. "The Relationship Between Nursing Activity and Age." *Hospital Topics* (July/August 1980), pp. 49-50.

Davis, Karen. "Economic Theories of Behavior in Nonprofit Private Hospitals." 24, No. 2 (Winter, 1972), pp. 1-13.

Department of Health, Education, and Welfare, Health Care Financing Administration. *Federal Register.* 44, No. 107 (Friday, June 1, 1979), pp. 31802-15.

Department of Health, Education, and Welfare. Health Care Financing Administration. *Medicare Provider Reimbursement Manual (HIM 15-I).* Washington, D.C.: DHEW, January 1979.

Evans, Robert G. "Behavioral Cost Functions for Hospitals." *Canadian Journal of Economics* 4, No. 2 (May 1971), pp. 198-207.

Ganti, Andrew R. "The 65 Dollar Question." *Ohio Management Services Digest.* 2, No. 4 (Winter '79/'80), pp. 2-5.

Goldstein, Raymond. "Medicare: Inpatient Use of Short-Stay Hospitals, 1978." *Health Care Financing Notes.* Health Care Financing Administration, Publication No. 03087, April 1981.

Harris, Jeffrey E. "The Internal Organization of Hospitals: Some Economic Implications." *Bell Journal of Economics.* (Autumn, 1977), pp. 467-482.

"Hospitals, Nurses Oppose Move to Eliminate 8-1/2 Nursing Differential." *Federation of American Hospitals Review.* (April/May, 1980), pp. 14-15.

Jacobs, Stanley E. "Older Patients Get More Care." *Hospitals, JAHA,* 43 (December 16, 1969), pp. 68-73.

Lave, Judith R. and Lester Lave. "Hospital Cost Function Analysis: Implications for Cost Controls." In M. Subkoff, I. Raskin, and R. Hanft (eds.), *Hospital Cost Containment.* New York: Prodist, 1978, pp. 538-571.

Pauly, Marc V. and Michael Redisch. "The Not-for-Profit Hospital as a Physicians' Cooperative." *American Economic Review* 63, No. 1 (March 1973), pp. 77-114.

Levine, Harry D. and Joseph P. Phillip. *Factors Affecting Staffing Levels and Patterns of Nursing Personnel.* Washington, D.C.: U.S. GPO 1741-00080, February 1975.

Meltzer, Alfred J., John L. Ashby, Johnathan D. Tomar, James N. Friedman, and Richard N. Jensen. "Analysis of Routine Nursing Salary Costs." Applied Management Sciences under HCFA Contract 500-78-0041, Task 32, November 13, 1980, J. Michael Fitzmaurice, HCFA Federal Project Officer.

Meltzer, Alfred J., John L. Ashby, Cyrus Baghelai, James N. Friedman, and Richard N. Jensen. "Analysis of Routine Nursing Salary Costs." Applied Management Sciences under HCFA Contract 500-78-0041, Task 39, February 5, 1981; Task 46, May 22, 1981; Task 47, May 22, 1981; Task 48, July 14, 1981; J. Michael Fitzmaurice, HCFA Federal Project Officer.

Miller & Byrne, Inc. "Cost Differential Study—State of Connecticut." Mimeographic (April 1977).

Pauly, Marc V. and Michael Redisch. "The Not-for-Profit Hospital as a Physicians' Cooperative." *American Economic Review* 63, No. 1 (March 1973), pp. 77-114.

Pettengill, Julian and James Vertrees. "New Uses for Old Data: A Medicare Hospital Case Mix Index." HHS/ORDS: Office of Research Working Paper No. OR-23 (December 1980).

Thompson, John D., Stanley E. Jacobs, Naomi R. Patchin, and Glenn L. Anderson, "Age a Factor in Amount of Nursing Care Given, AHA Study Shows." *Hospitals, JAHA.* 42 (March 1, 1968), pp. 33-38.

United States General Accounting Office. *Report to the Congress.* "Do Aged Medicare Patients Receive More Costly Routine Nursing Services? Evidence Inconclusive." HRD-82-32, January 20, 1983.