# Changes in Average Length of Stay and Average Charges Generated following Institution of PSRO Review

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*A five-year review of accounting data at a university hospital shows that immediately following institution of concurrent PSRO admission and length of stay review of Medicare-Medicaid patients, there was a significant decrease in length of stay and a fall in average charges generated per patient against the inflationary trend. Similar changes did not occur for the non-Medicare-Medicaid patients who were not reviewed. The observed changes occurred even though the review procedure rarely resulted in the denial of services to patients, suggesting an indirect effect of review.*

THE federal government, in an attempt at cost containment, has imposed on hospitals caring for patients covered by Medicare and Medicaid a requirement for concurrent admission and length of stay review of each of these patients by a Professional Standards Review Organization (PSRO). The effectiveness of PSRO admission and length of stay review remains controversial. There are reports indicating a significant decrease in length of stay and a reduction of hospital reimbursement following the introduction of PSRO-type review [1,2,3,], but some of them have been criticized for failure to account for other causal factors and for weaknesses in methodology [4]. Other authors find little evidence of effectiveness of PSRO review [5,6,7]. Despite the controversy, the review procedure has been implemented across the country.

It is the purpose of this paper to report that a reduction in average length of stay and, allowing for inflation, in average charges generated per patient appeared immediately after the institution of PSRO review in the accounting records of the teaching hospital where we conducted our study and continued during the subsequent three years. We argue that it is reasonable to believe that these changes resulted from an indirect effect of the PSRO review process. We suggest that the nature of this indirect effect is worthy of further study. A secondary goal of the paper is to demonstrate the usefulness of historical controls and cluster analysis in an area of investigation where traditional experimental design is impossible and where analysis of concomitant variation using the analysis of covariance model is contraindicated because there is interaction between the treatment and the covariate.

In November 1975 the Medical University Hospital, acting through its Utilization Review Committee, initiated

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the mandated program of admission, length of stay, and discharge review of all federally funded patients. The Utilization Review Committee consists of 16 staff physicians and 4 administrative personnel. It has the assistance of 4 full time coordinators, who conduct the reviews. The reviews require an annual expenditure of approximately 360 man-hours by committee members and 6,500 man-hours by review coordinators. As a part of the review process, attending physicians and house officers are required to request and justify in the patient's chart any extension of hospitalization beyond the 50th percentile of southeastern norms.

The number of patients whose admissions are disallowed by the Utilization Review Committee is extremely small, as is the number of denials of extension of length of stay. In fact, during the first year of operation the committee did not disallow a single admission or extension of stay. Subsequently, no more than two or three such denials have occurred per year. It appears, therefore, that the PSRO review process, with its significant use of manpower, has had little or no direct effect on patient management.

In a search for evidence of an indirect effect we turned to the accounting records of the hospital to find out whether average length of stay (ALOS) or average charges generated per patient (ACH) had changed significantly following the initiation of PSRO review. ALOS and ACH were determined monthly for both the Medicare-Medicaid (MM) population and the non-Medicare-Medicaid (NMM) population for January–June 1974 and for January–July 1975, just prior to the institution of PSRO review; and for the same populations for January–July of 1976, 1977, and 1978, when PSRO review was in full operation. The study design allowed us to identify changes in length of stay and average charges generated before and after PSRO review in the Medicare-Medicaid population, and to see the effects of inflationary pressures in the non-Medicare-Medicaid population, which was not subject to review.

Evaluation of changes in the mix of patients—that is, in the severity of their diseases—was not a part of the design of the study. The data source was the business records of the hospital. These had been maintained with the precision characteristic of accountants and were made available to us through computer printout. If we had included an evaluation of clinical records, which are maintained with a different level of precision by attending physicians, junior house officers, and coding clerks, it would have required major modifications in the design of the study. We would have had to review and grade thousands of charts for severity, a process of limited validity.

Furthermore, the causal relationship between length of stay and mix of patients is reversible, and a finding of a decrease in severity of disease in the mix of our patients would have had little effect on our conclusions. It is true that a lesser severity of disease can result in a decrease in average length of stay, but it is also true that a decrease in average length of stay will increase available bed space and permit the less urgent admission of patients with milder disease. Thus, a factor which decreases length of stay may also decrease severity in the mix; mix of patients is therefore not a suitable concomitant variable.

Admissions rather than discharges were used in the calculations because the hospital's accounting records are based on admissions data. Data on discharges are kept by the patient record library in a separate data system that can be out of phase with the accounting system.

**Table 1:**
**Total Number of Beds in the Medical University Hospital as of Each June 30th, Annual Occupancy Rates, and Percentage of Medicare-Medicaid Admissions during the Five Study Periods**

| | 1974 | 1975 | 1976 | 1977 | 1978 |
|---|---|---|---|---|---|
| Total Beds | 474 | 509 | 522 | 521 | 528 |
| Occupancy | 77% | 73% | 72% | 76% | 75% |
| Medicare-Medicaid Admissions | 25% | 29% | 33% | 35% | 36% |

## Methods of Analysis

The site of study was the Medical University of South Carolina. Available beds, occupancy rates, and percentage of Medicare-Medicaid admissions for the study periods are presented in Table 1. The data available from the computerized records of the hospital are monthly totals of admissions, charges generated, and hospital days, separated according to financial class (See Tables 2 and 3). No data were available on admissions for the month of July, 1974.

Average length of stay (hospital days ÷ admissions) and average charges generated per patient (total charges generated ÷ admissions) were calculated by month for the MM and NMM populations for the six-month study period in 1974 and the seven-month periods in 1975–1978. A three-way analysis of variance following a 2 x 7 x 5 factorial design was performed analyzing three factors: type of patient admitted (MM and NMM), month of the year (January–July), and nonoccurrence and occurrence of PSRO review (1974–1975 versus 1976–1978 for the MM population).

Duncan's multiple range test was performed on the means from the study periods. Monthly values for number of MM admissions were paired with corresponding monthly values of ALOS and ACH. Cluster analysis and discriminant function analysis were then performed to determine whether two identifiable, essentially exclusive subpopulations existed among the pairs for ALOS and ACH.

The cluster procedure we used [8] was hierarchical cluster analysis, based on an algorithm outlined by Johnson [9]. The technique forms one cluster for each observation in the analysis. The two closest clusters are then combined into one cluster, the two closest of the new set of clusters are combined into a cluster, and so on. The algorithm computes its own distance matrix. The metric is Euclidean.

For the discriminant analysis [8] we used a classification criterion determined by a measure of generalized square distance [10]. It was based on the individual within-group covariance matrices. It also took into account the prior probabilities of the groups.

## Results

Average length of stay (see Figure 1) for the Medicare-Medicaid population was 9.1 days for the two study periods prior to the institution of review. For the three study periods following the initiation of PSRO review, ALOS for

**Table 2:**
**Monthly Data on Admissions, Charges, and Patient-Days for the Medicare-Medicaid Population during the Five Study Periods**

| | 1974 | | | 1975 | | | 1976 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Admissions | Patient Charges Generated | Patient-Days | Admissions | Patient Charges Generated | Patient-Days | Admissions | Patient Charges Generated | Patient-Days |
| Jan. | 324 | $468,616 | 2,874 | 346 | $529,978 | 2,767 | 500 | $816,095 | 3,783 |
| Feb. | 279 | 415,906 | 2,637 | 294 | 617,065 | 3,216 | 453 | 779,203 | 3,543 |
| Mar. | 306 | 437,455 | 2,982 | 346 | 706,233 | 3,675 | 538 | 867,925 | 3,999 |
| Apr. | 329 | 460,699 | 3,087 | 362 | 647,624 | 3,231 | 500 | 851,821 | 3,940 |
| May | 322 | 496,362 | 2,647 | 372 | 662,861 | 3,322 | 492 | 828,957 | 3,870 |
| June | 288 | 437,889 | 2,643 | 361 | 593,471 | 3,369 | 522 | 764,362 | 3,708 |
| July | — | 533,139 | 2,954 | 475 | 670,487 | 3,447 | 482 | 809,645 | 3,730 |

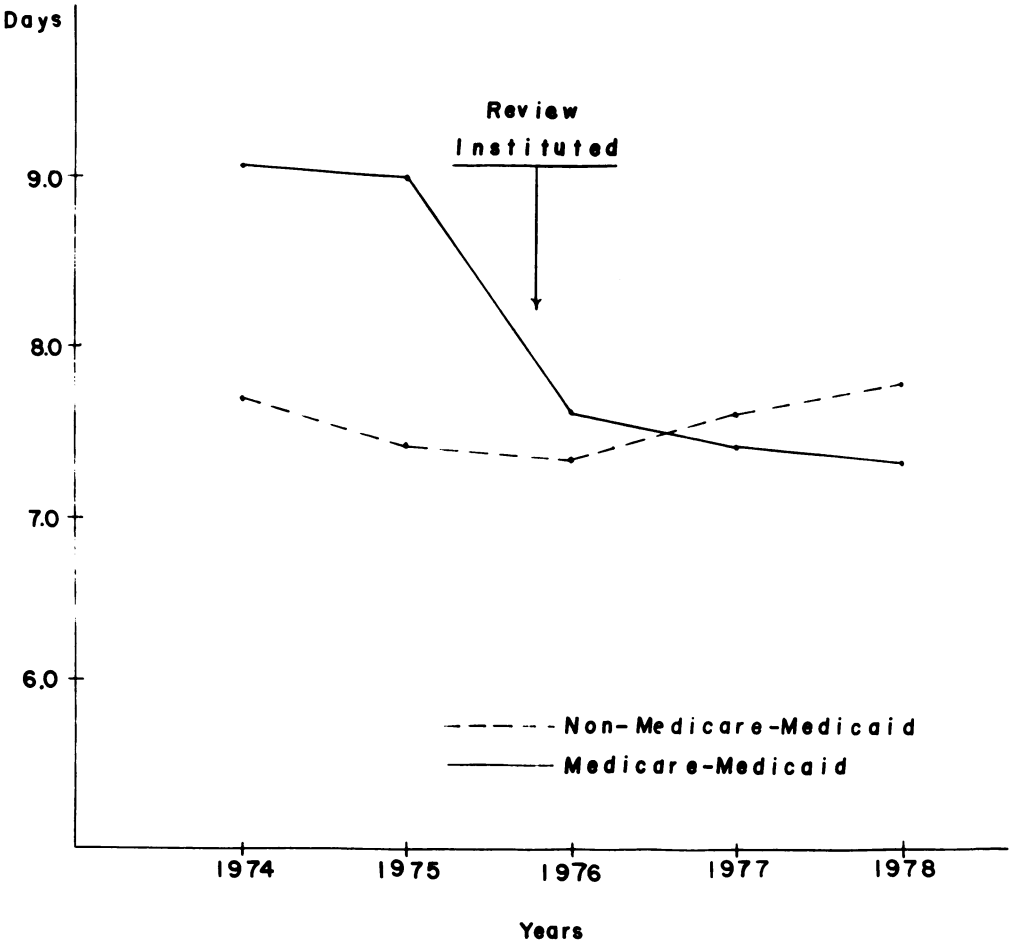
| | 1977 | | | 1978 | | |
|---|---|---|---|---|---|---|
| | Admissions | Patient Charges Generated | Patient-Days | Admissions | Patient Charges Generated | Patient-Days |
| Jan. | 658 | $1,043,111 | 4,118 | 632 | $1,391,758 | 4,645 |
| Feb. | 502 | 1,025,009 | 3,652 | 553 | 1,285,764 | 4,295 |
| Mar. | 545 | 1,259,476 | 4,248 | 657 | 1,509,446 | 4,871 |
| Apr. | 486 | 1,174,813 | 4,137 | 607 | 1,337,336 | 4,461 |
| May | 544 | 1,162,354 | 4,265 | 640 | 1,357,958 | 4,376 |
| June | 615 | 1,112,966 | 4,278 | 631 | 1,361,989 | 4,384 |
| July | 594 | 1,167,024 | 4,241 | 641 | 1,162,354 | 4,800 |

**Table 3:**
**Monthly Data on Admissions, Charges, and Patient-Days for the Non-Medicare-Medicaid Population during the Five Study Periods**

| | 1974 | | | 1975 | | | 1976 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Admissions | Patient Charges Generated | Patient-Days | Admissions | Patient Charges Generated | Patient-Days | Admissions | Patient Charges Generated | Patient-Days |
| Jan. | 1,046 | $1,159,031 | 8,298 | 1,125 | $1,402,756 | 8,269 | 1,061 | $1,551,366 | 7,916 |
| Feb. | 1,092 | 1,183,881 | 8,123 | 1,079 | 1,362,311 | 8,019 | 1,045 | 1,509,356 | 8,155 |
| Mar. | 1,123 | 1,382,788 | 8,970 | 1,067 | 1,401,161 | 8,286 | 1,060 | 1,554,487 | 7,758 |
| Apr. | 1,112 | 1,305,220 | 8,506 | 1,136 | 1,529,699 | 8,031 | 980 | 1,441,349 | 7,462 |
| May | 1,089 | 1,400,204 | 8,749 | 1,082 | 1,533,829 | 8,157 | 1,069 | 1,449,567 | 7,562 |
| June | 1,068 | 1,316,339 | 7,842 | 1,046 | 1,446,435 | 7,814 | 1,069 | 1,573,946 | 7,541 |
| July | — | 1,406,275 | 8,564 | 1,165 | 1,588,041 | 8,499 | 1,193 | 1,864,053 | 8,448 |

| | 1977 | | | 1978 | | |
|---|---|---|---|---|---|---|
| | Admissions | Patient Charges Generated | Patient-Days | Admissions | Patient Charges Generated | Patient-Days |
| Jan. | 1,137 | $2,127,768 | 8,357 | 1,109 | $2,212,376 | 7,833 |
| Feb. | 1,062 | 2,036,264 | 8,216 | 920 | 2,120,542 | 7,540 |
| Mar. | 1,050 | 2,147,879 | 8,381 | 1,019 | 2,131,248 | 7,924 |
| Apr. | 957 | 1,775,593 | 7,377 | 985 | 1,973,342 | 7,689 |
| May | 1,072 | 2,132,795 | 7,933 | 963 | 2,205,800 | 8,019 |
| June | 1,021 | 1,958,345 | 7,631 | 1,099 | 2,366,837 | 8,390 |
| July | 1,148 | 2,273,884 | 8,480 | 1,106 | 2,132,795 | 8,375 |

**Figure 1:**
**Average Length of Stay for the Medicare-Medicaid and Non-Medicare-Medicaid Populations during the Five Study Periods**

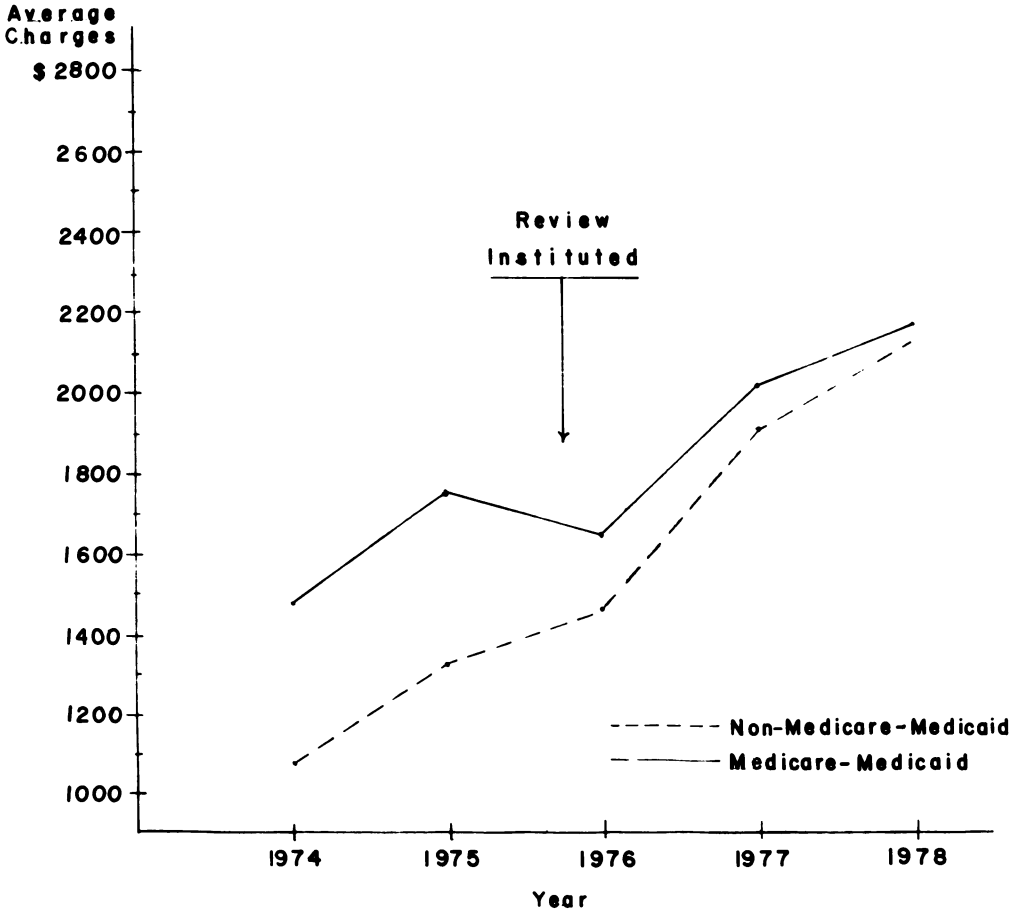



Medicare-Medicaid patients was 7.6, 7.4, and 7.3 days. ALOS for the non-Medicare-Medicaid population, which did not undergo review in any of the study periods, varied between 7.4 and 7.8 days. Table 4 shows that the length of stay of the MM patients for 1974 and 1975 study periods prior to the initiation of review was significantly different from all other values at the 5 percent level.

Average charges per patient for each study period are shown in Figure 2. During the two study periods prior to the institution of PSRO reivew, Medicare-Medicaid ACH rose at roughly the same rate as ACH for NMM patients. In the study period following institution of review, MM charges fell sharply while NMM charges continued to rise. In the last two study periods, ACH for both the MM and NMM populations continued to rise at roughly the same rate, probably reflecting inflation.

The three-way analysis of variance for ALOS and ACH (See Tables 5 and 6) showed a significant ($p < 0.01$) interaction between the initiation of PSRO review and the type of patient (MM versus NMM).

**Figure 2:**
**Average Charges Generated per Patient for the Medicare-Medicaid and Non-Medicare-Medicaid Populations for the Five Study Periods.**




There was a significant effect of month of the year at the 5 percent level. Month of year did not interact significantly with type of patient or with initiation of PSRO review. Because of the balanced design of the study, which used the same seven months of the year for each study period (six months in 1974), and because of the fixed effects of month of the year, we decided to collapse the data over months and apply Duncan's multiple range test.

Table 7 shows the fall in the ACH of the MM population in 1976, following institution of review. Although Duncan's multiple range test showed the difference between the means for 1975 and 1976 not to be significant, the effect of inflation would obscure a significant decrease. If a correction for inflation based on NMM experience is applied to the data, the 1975–76 difference for the MM population becomes significant at the 5 percent level.

Cluster analysis showed that when the MM population was characterized by monthly ALOS and number of admissions (See Figure 3), there existed two separate clusters indentifiable by the presence and absence of the review process. In this analysis, there was a single misclassification. One observa-

**Table 4:**
**Means and Standard Deviations for Monthly Average Length of Stay over the Five Study Periods**

| | | Average Length of Stay | | | | |
|---|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 | 1978 |
| Medicare-Medicaid | Mean | 9.133 | 9.129 | 7.629* | 7.400* | 7.286* |
| | S.D. | 0.528 | 1.295 | 0.293 | 0.707 | 0.344 |
| Non-Medicare-Medicaid | Mean | 7.700 | 7.429 | 7.357 | 7.586 | 7.771 |
| | S.D. | 0.310 | 0.214 | 0.282 | 0.227 | 0.403 |

**Duncan's Multiple Range Test**

| 78MM* | 76NMM | 77MM* | 75NMM | 77NMM | 76MM* | 74NMM | 78NMM | 75MM | 74MM |
|---|---|---|---|---|---|---|---|---|---|
| 7.286 | 7.357 | 7.400 | 7.429 | 7.586 | 7.629 | 7.700 | 7.771 | 9.129 | 9.133 |

*Denotes PSRO review. Duncan's Multiple Range Test shows a significant difference ($p < 0.05$) between the 1974 through 1975 means and all other means.

**Table 5:**
**Analysis of Variance for Average Length of Stay (ALOS)**

| Source of Variance | df | M.S. | *F* | p |
|---|---|---|---|---|
| Type MM vs. NMM | 1 | 5.212 | 19.583 | <0.01 |
| Month | 6 | 0.734 | 2.756 | <0.05 |
| Year | 4 | 3.011 | 11.312 | <0.01 |
| Type × Month | 6 | 0.246 | 0.924 | N.S. |
| Type × Year | 4 | 3.313 | 12.447 | <0.01 |
| Month × Year | 24 | 0.247 | 0.927 | N.S. |
| Error | 24 | 0.266 | | |

**Table 6:**
**Analysis of Variance for Monthly Average Charges Generated per Patient Admitted**

| Source of Variance | df | M.S. | *F* | p |
|---|---|---|---|---|
| Type MM vs. NMM | 1 | 754404.0 | 48.379 | <0.01 |
| Month | 6 | 48661.8 | 3.121 | <0.05 |
| Year | 4 | 1595103.0 | 102.291 | <0.01 |
| Type × Month | 6 | 33839.047 | 2.170 | N.S. |
| Type × Year | 4 | 78662.500 | 5.045 | <0.01 |
| Month × Year | 24 | 19577.523 | 1.255 | N.S. |
| Error | 24 | 15593.707 | | |

**Table 7:**
**Means and Standard Deviations for Monthly Average Charges Generated per Patient Admitted over the Five Study Periods**

| | | Average Charges in Dollars | | | | |
|---|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 | 1978 |
| Medicare-Medicaid | Mean | $1,471 | $1,756 | $1,643* | $2,038* | $2,160* |
| | S.D. | 54.79 | 252.28 | 87.37 | 285.76 | 169.05 |
| Non-Medicare-Medicaid | Mean | $1,186 | $1,333 | $1,462 | $1,940 | $2,110 |
| | S.D. | 78.57 | 62.60 | 60.22 | 68.82 | 147.47 |

**Duncan's Multiple Range Test**

| 74NMM | 75NMM | 76NMM | 74MM | 76MM* | 75MM | 77NMM | 77MM* | 78NMM | 78MM* |
|---|---|---|---|---|---|---|---|---|---|
| $1,186 | $1,333 | $1,462 | $1,471 | $1,643 | $1,756 | $1,940 | $2,038 | $2,110 | $2,160 |

*Denotes PSRO review. Means connected by a bar are not significantly different at the 5 percent level.

tion, made in July 1975 prior to the institution of review, fell within the reviewed cluster. 3

Once the cluster analysis had established the presence of two identifiable clusters, a discrininate function was generated which, when applied to the MM population, showed a single misclassification (July 1975) for both ALOS and ACH when the data were classified by the presence or absence of review. 4

The cluster analysis for ACH and number of admissions (See Figure 4) did not group the data by presence or absence of review, possibly because inflation exaggerated the distances between the 1976, 1977, and 1978 values for ACH. Figures 3 and 4 suggest that within each year there was an inverse relationship between number of MM admissions and both ALOS and ACH.

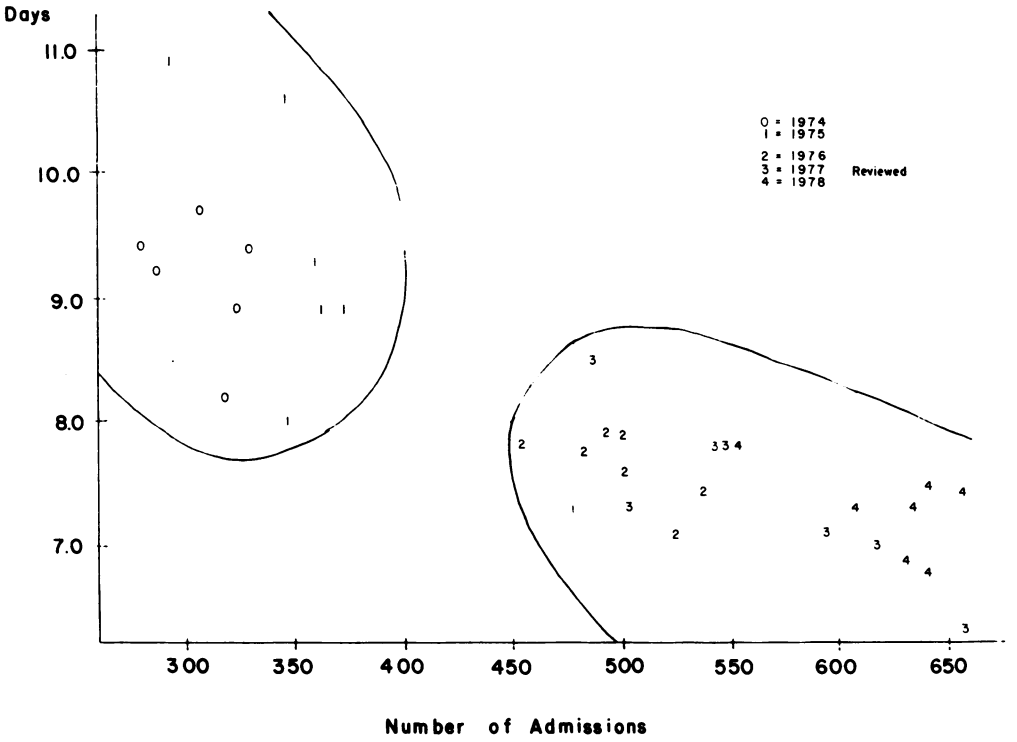
## Discussion

For the design of studies of the impact of new programs on facets of the health care delivery system, coincident controls and double blind treatment, the traditional tools of clinical investigation, are not usually available. The investigator must turn to historical controls. Stability of the dependent variables in the pre- and posttreatment periods, together with significant change that is coincident with treatment, supports a conclusion that either the treatment or some other factor acting simultaneously with the treatment had a causal effect. The probability that the treatment we studied, PSRO review, was a pertinent factor is enhanced by the fact that in the similar though not identical NMM population, which was subject to the same influences as the MM population *but was not reviewed*, there was no significant change in the dependent variable ALOS over the entire five-year period.

An investigator who finds appropriate changes in dependent variables occurring in the treated population upon institution of a program, and not occurring in a parallel untreated population, may certainly draw conclusions from his data, though with somewhat less assurance than the traditional in-

**Figure 3:**
**Monthly Average Length of Stay versus Number of Admissions Plotted by Year for the Medicare-Medicaid Population***

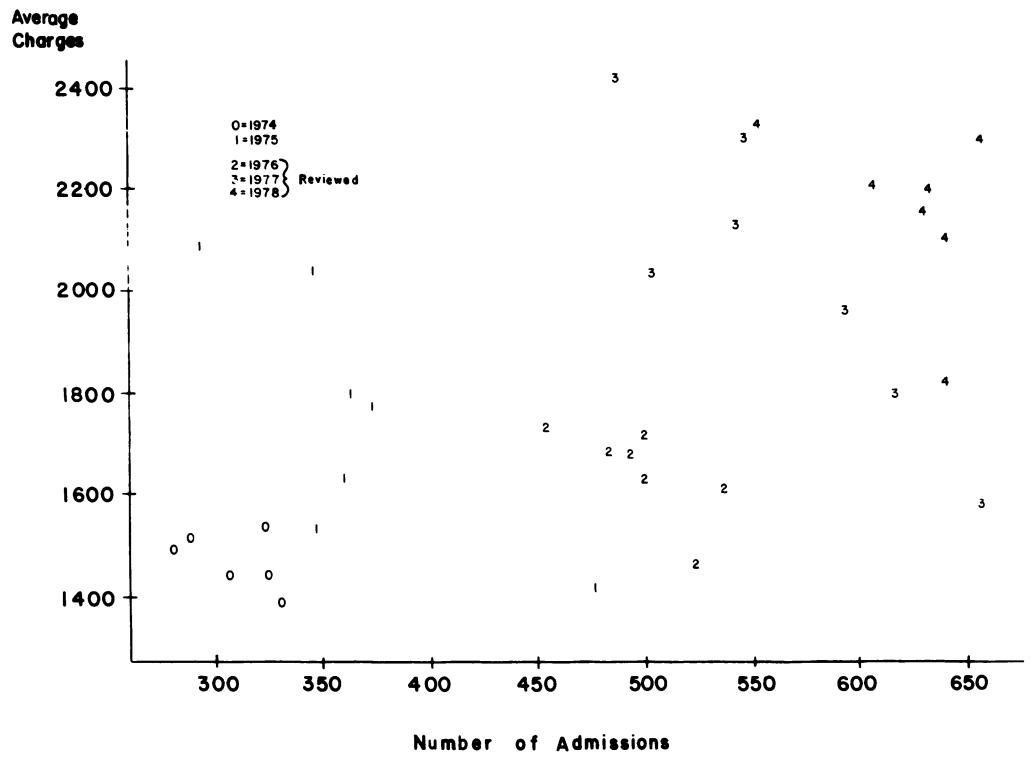
*Cluster analysis identified the two clusters indicated.




vestigator who reports efficacy of a treatment based on a p value of less than 0.05 and who can be confident that randomization or matching of controls has excluded the influence of other factors. Rational decision makers in the field of health services, where traditional study design is rarely possible, may, with appropriate reservations for lack of rigor, accept conclusions drawn from well-designed studies that used retrospective controls.

Figures 1 and 2 show that both average length of stay and average charges generated per patient fell sharply in the MM population after the institution of review, while they showed no similar changes in the NMM population, which did not undergo review. These observations support the hypothesis that PSRO review had an indirect effect in the desired direction on the management of patients hospitalized in this South Carolina teaching center. These are associative findings; they do not imply a causal relationship. The possibility that other events might have caused the changes in ALOS and ACH must be considered. Over a five-year span of time there are going to be many changes in personnel, facilities, equipment, clinical judgment, and other factors. However, we were unable to find any such changes which could have influenced the MM population without influencing the NMM population of patients. The single identifiable change which occurred at a specific time—between the 1975 and 1976 study periods—and which was applicable to the

**Figure 4:**
**Monthly Average Charges Generated per Patient versus Number of Admissions Plotted by Year for the Medicare-Medicaid Population**




MM population only was the institution of PSRO review. Changes in number of beds available, occupancy rates, and number of MM and NMM admissions were not unique to the 1975–76 interval, but the progressive increase observed in the number of MM admissions over the five study periods does present a particular problem in the analysis.

It has been recognized in other studies that, as the number of MM admissions increases, there is a decrease in the average severity of illness and a corresponding decrease in the average length of stay of MM patients. We considered using the analysis of covariance to exclude the influence of changes in number of admissions. However, in a hospital that consistently operates at a 75 percent occupancy rate, any factor that decreases ALOS makes more bed space available; this allows the attending physicians to admit more patients. It follows that if the PSRO review has a primary effect of decreasing ALOS, it will have a secondary effect of increaisng number of admissions. This secondary effect of review on number of admissions is a contraindication for the application of the analysis of covariance. The ACOV should not be used when the treatment and the covariate are related [11].

Instead, we used cluster analysis, a versatile technique [12,13] to determine whether the MM data points characterized by the interrelated variables of monthly ALOS and number of admissions formed two clusters identi-

fiable by the presence or absence of the review process. With a single misclassification, that of July 1975, our analysis identified two clusters, one reviewed and the other not reviewed (Figure 3).

When cluster analysis was applied to ACH and number of admissions, the procedure did not form the same clusters as found for ALOS, probably because of the confounding effect of inflation (Figure 4).

A discriminant analysis that used a generalized squared distance function was applied to establish a means of classifying the observed data under the hypothesis of two populations. This procedure classified both the ALOS/number of admissions and the ACH/number of admissions pairs into subpopulations that differed by the presence or absence of review, with a single misclassification: the unreviewed ALOS/admissions and the ACH/admissions pairs for July 1975 were classified with the reviewed population.

The results of the study show that following institution of review there was a significant decrease in average length of stay and a fall in average charges generated per patient, against the inflationary trend seen in the data on the patients who were not subject to review. These results are consistent with the hypothesis that PSRO review can decrease length of stay and charges generated per patient. We found no evidence of an organizational or procedural change which would affect only the MM population and which occurred simultaneously with the introduction of review. Increase in number of MM patients occurred in each of the study periods and can provide only a partial explanation for the observed changes.

These changes occurred even though the review procedure rarely resulted in the denial of services to patients. It is our belief that the attending physicians and house officers, who were aware of concurrent review and were forced to justify in writing lengths of stay beyond the 50th percentile of southeastern norms, expedited the process of hospitalization and discharged their patients sooner than they did before review.

The decrease in ALOS and ACH did not result in a lower overall cost to the funding agency. As more bed space became available, more patients were admitted, and the total cost to the funding agency rose. The changes in ALOS did permit the funding agency to provide necessary hospitalization to more of its clients. We can expect reduction in length of stay to reduce the overall cost of the Medicare-Medicaid programs only after the need for hospitalization, as defined by the PSRO review committee and by government regulation, is met.

The literature indicates that the favorable changes that occurred in ALOS and ACH following initiation of PSRO review are not unique to the reporting institution [3]. Our observation—that these changes were not the direct result of the Utilization Review Committee's disallowing admissions or extensions of length of stay—has not been widely discussed. This observation, though perhaps only a local one, may have significant implications for planners in the health service arena.

Length of stay, in ordinary circumstances, is under the exclusive control of the attending physician or the responsible house officer, who must write the discharge order. If, as we hypothesize, the institution of PSRO review *indirectly* brought about a reduction in ALOS, then the review process must have introduced stimuli that modified the behavior of the attending physicians and house officers, accelerating the process of hospitalization. A search for the specific stimuli which produced this change in the behavior of a group of

physicians might provide information leading to improved design of the PSRO review process or of other programs which for societal reasons seek to modify the behavior of groups of health professionals.

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