Factors affecting the availability and use of hemodialysis facilities

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This article describes factors related to the geographic distribution of hemodialysis facilities and the relationship between availability and use. Such facilities tend to be concentrated in the same types of areas as other medical resources, and the number of medical specialists in an area is related to the rate of treatment for renal diseases.

The proportion of treatment stations in an area owned by for-profit organizations is not related to the total treatment rate, but the market share of for-profit facilities is positively related to in-center treatment and negatively related to home treatment.

Introduction

Federal policies have improved access for low-income persons substantially over the past two decades, primarily through programs such as Medicaid and Medicare (Aday, Andersen, and Fleming, 1980; Calkins, Burns, and Delbanco, 1986; Davis, Gold, and Makuc, 1981). The growth of profit-making organizations, however, has raised new questions about access to care. On one hand, they may be more likely to locate in areas non-profit providers have avoided if insurance is provided (Schlesinger, Marmor, and Smithey, 1987). On the other hand, for-profit providers may tend to treat those patients or provide those services that are most profitable under the insurance plan's payment scheme (Gray, 1983; Gray and McNerney, 1986; Townsend, 1983).

As a program that provides near universal entitlement to service and relies heavily on proprietary providers, the end stage renal disease (ESRD) program is an important model for studying these issues. A national program was initiated when Medicare was expanded to cover ESRD treatment by the 1972 amendments to the Social Security Act, Public Law 92-603. Today, over 90 percent of all dialysis patients are Medicare beneficiaries for whom Medicare pays about 80 percent of the cost of outpatient dialysis after an initial 3-month waiting period. A number of States cover the other 20 percent of charges through Medicaid or other programs.

In this article, we address three specific questions related to the broader issue of how public financing and proprietary ownership affect access to health care services:

- Has the ESRD program been successful in achieving an equitable geographic distribution of health care resources?
- What is the geographic pattern of ownership type under conditions of almost universal entitlement?
- Is the presence of for-profit providers in a geographical area related to the use of ESRD services in those locales?

Background

Distribution and use of medical resources

As early as 1925, Pearl (1925) suggested that physicians tend to locate in communities that are doing well economically. Subsequent studies have found that there tend to be more physicians per capita in locations that have higher average incomes or greater buying power, higher educational levels, and are in urban areas (Joroff and Navarro, 1971; Mountin, Pennel, and Nicolay, 1945; Rushing, 1975; Fein and Weber, 1971; Newhouse, 1990). These distribution patterns appear to be similar for medical specialists, psychiatrists, psychologists, social workers, and lawyers (Schwartz et al., 1980; Koran, 1981; Richards and Gottfredson, 1978; Knesper, Wheeler, and Pagnucco, 1984).

An unequal distribution of physicians may influence the use of certain services. There are marked regional variations in hospitalization and surgery rates (Paul-Shaheen, Clark, and Williams, 1987) that appear to be related to insurance coverage, income, and the availability of such resources as hospital beds, board-certified surgeons, and general physicians who perform surgery (Perrott, 1964; Bombardier et al. 1977; Lewis, 1969; Fuchs, 1978). It has been suggested that the effect of induced demand is strongest in areas of low education and for procedures judged by physicians to be less urgent and less necessary (Fuchs, 1978; Wennberg and Gittelsohn, 1982). It is also possible, of course, that areas with lower rates of procedures have more unmet needs.

Ownership and access to medical care

In the mid-1980s, for-profit organizations owned 15 percent of acute care hospitals, more than 50 percent of private psychiatric beds, and 70 percent of nursing homes. Some policymakers, researchers, and medical care providers have expressed concern that for-profit organizations will tend to exclude patients who have complex illnesses that are expensive to treat (Gray, 1983; Gray and McNerney, 1986; Townsend, 1983), because proprietary facilities are thought to place more emphasis on maximizing profits than non-profit or public facilities (Nutter, 1984). Alternatively, facilities may offer only those services that are profitable, avoiding those that might lose money (Schlesinger, Cleary, and Blumenthal, 1989; Schlesinger and Dorwart, 1984).

A related issue is that for-profit facilities may be less likely to locate in areas in which providing care is more expensive and more likely to locate in areas where it is more profitable. Increases in the ratio of proprietary to total hospital beds have been highest in States with the greatest increases in population per capita income and insurance coverage (Kushman and Nuckton, 1977). Mullner and Hadley (1984) found that increases in the market share of proprietary hospital chains were greatest in States that had the greatest increases in per capita income and in insurance coverage. Such patterns might result in less availability of facilities in unprofitable areas as for-profit ownership becomes more common.

On the other hand, for-profit facilities might be motivated to provide care for underserved populations and might be quicker to respond to this opportunity. Research indicates that for-profit facilities are more likely to locate in rapidly growing areas (Mullner and Hadley, 1984; Steinwald and Neuhauser, 1970) that have tended to be underserved.

Ownership and access to renal dialysis

Prior to 1972, there were less than 200 facilities offering outpatient maintenance hemodialysis, but Medicare coverage of ESRD treatment resulted in dramatic changes in the availability of dialysis. By 1983, there were more than 1,300 freestanding ESRD treatment units. The growth in the role of for-profit providers has also been dramatic, increasing to 30 percent in 1980 and to almost 40 percent by 1983 (Gibson and McMullan, 1984). For-profit dialysis facilities were more likely to locate in States in which Medicaid covers copayments for dialysis (Marmor, Schlesinger, and Smithey, 1986) but also in low socioeconomic areas (Lourie and Hamers, 1982).

It has been argued that profit-motivated organizations have financial incentives to dialyze even when dialysis is either not necessary or not the most effective treatment. Dialysis rates are higher in States with a higher proportion of proprietary facilities (Relman and Rennie, 1980) and higher in the United States than in countries without proprietary health care providers.

Critics of proprietary health care also charge that the profit motive may lead to the selection of treatment modes that are the most profitable, but not necessarily the most socially desirable. For example, it has been argued that for-profit facilities were more likely to provide in-center dialysis than home dialysis because there used to be less incentive to provide home dialysis. In fact, at the time the data for this study were collected, Congress had just passed the Omnibus Budget Reconciliation Act of 1981 (Public Law 97-35), which required the Health Care Financing Administration (HCFA) to develop a new payment scheme, known as the composite rate, that took into account the cost of both home and in-facility treatment. The payment changes were requested to "... eliminate some of the economic incentives for physicians to treat dialysis patients in the facilities, rather than at home." (Zimmerman, 1982). Earlier studies have found that sections of the country with fewer for-profit providers have higher rates of home dialysis (Gardner, 1981).

A number of these studies have been limited by the fact that they have not adequately controlled for factors associated with variations in the prevalence of ESRD. For example, race is strongly related to rates of ESRD (Ginson and McMullan, 1984), and much of the variation in interstate (Held, Pauly, and Smits, 1981; Lowrie, 1981; Velez and Charlton, 1981) and international (Prottas, Segal, and Sapolsky, 1983) rates of dialysis is due to variations in the relative number of different racial groups in the population. Another factor explaining some of the international differences in dialysis rates is countries' willingness to devote resources to the treatment of ESRD (Prottas, Segal, and Sapolsky, 1983). Some researchers have found that there is no statistically significant association between for-profit ownership and the rate of home dialysis when average income, population density, crime rate, and average age of the population are controlled (Lowrie and Hampers, 1982). Another recent study that carefully controlled for population characteristics, physician supply, and other environmental factors found little relationship between facility ownership and patient case mix (deLissovoy, 1988).

Hypotheses

The availability of medical personnel and resources tends to be related to how socially desirable an area is to the providers of care. It follows that relative number of dialysis stations should be highest in areas where the relative density of other medical professionals is highest. There are also practical reasons for ESRD facilities to locate in areas where there are a relatively large number of other medical providers.[1]

Financial incentives also may affect both the location of facilities and the availability of care in areas of comparable social desirability. Almost all of the costs of treatment for ESRD are paid by Federal and/or State programs, so possible strategies to maximize profits include minimizing costs through more efficient delivery of care or choosing patients who are less expensive to treat (Nutter, 1984; Steinwald and Neuhauser, 1970). Patients who are more affluent and who are better educated are more likely to be in better health, have fewer complicating conditions, and have more resources to pay for Medicare's 20-percent coinsurance. We predicted that for-profit facilities would be more common in areas with higher proportions of such patients and in areas with higher average income and education.

Proprietary facilities also may respond faster to changing situations because of their more ready access to private capital. Therefore, we hypothesized that the market share of for-profit dialysis facilities is highest in areas with the greatest change in population.

As indicated earlier, financial incentives used to favor in-center dialysis. We predicted that for-profit facilities

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[1]ESRD treatment decisions are typically made by a nephrologist, and it might be useful to assess the independent effect of the number of nephrologists in an area. Accurate data on the number of nephrologists practicing in small areas are difficult to obtain, however, and different medical specialists tend to concentrate in similar areas so we used the relative number of medical specialists as a proxy for the availability of appropriate medical personnel.

would be more responsive to such incentives and that areas with a high proportion of for-profit facilities would have lower rates of home dialysis and higher rates of in-center dialysis.

Relman and Rennie (1980) suggest that for-profit ESRD facilities try to maximize profits by providing a high volume of services. If that is true, areas with a higher proportion of for-profit facilities should have higher treatment rates, in general, then other areas (Gardner, 1981; Held, Pauly, and Smits, 1981; Lowrie, 1981; Velez and Charlton, 1981; Prottas, Segal, and Sapolsky, 1983; Bays, 1979; Lemann, 1981). We therefore hypothesized that total adjusted treatment rates are positively associated with the proportion of for-profit treatment beds in an area.

Methods

We compiled a data set that combined information on the number of patients treated, basic facility characteristics, and information about the sociodemographic characteristics and medical resources in different counties. The county-level data were aggregated by county groups, which are clusters of counties designated by the U.S. Bureau of the Census as being relatively homogeneous in terms of sociodemographic characteristics. There are 408 county groups in the contiguous United States; most of the groups have populations of at least 250,000 people.

Data sources

Data for these analyses were derived from four sources. The Area Resource File of the National Technical Information Service is a county-based data file summarizing secondary data from a wide variety of sources. It contains more than 3,000 data elements from all counties in the United States, with the exception of Alaska.

A file listing the county for each ZIP Code in the United States was created for this study to enable us to link facility data and county data. ESRD facility survey data for the year 1982 was obtained from HCFA. This file contains information on the number of patients treated in each facility in the preceding 6-month period. We also used the June 15, 1982, Medicare-approved ESRD provider certification data. These data include information on certain characteristics of the facility such as type of facility, ownership, and size.

The facility survey data were merged with the certification file, inactive facilities removed, and then ZIP Code files containing county codes were linked to the facility-level file. The facility-level data were aggregated by county and merged with the Area Resource File data. These data were then aggregated by county group.

Population density was defined as the total number of people determined to be in an area by the 1980 census divided by the land area. Average income was defined as the average per capita income in 1977 as determined by the U.S. Bureau of the Census 1977 population estimates and projections. The measure of relative number of medical specialists was based on the total number of non-Federal medical specialists involved in medical care

in 1979. Population change was defined as the increase in the total population between 1970 and 1980. As indicated in the analysis section that follows, this figure was divided by the 1980 population when estimating the regression equations. An index of Medicare payment was created using information on the total payments for Part A and/or Part B in 1980 divided by the total number of persons enrolled in Part A and/or Part B in 1980. This information on the Area Resource File was obtained from the Medicare Payment and Geographic Index data file prepared by HCFA. This was used as a general measure of payment levels and as a proxy for the availability and cost of health care. In order to test for regional patterns of facility location and dialysis use, we created variables representing four geographical regions: the South, the Midwest, West, and Northwest.

Statistical techniques

In our analyses, we wanted to statistically control for variations in the prevalence of renal failure. There are no comprehensive population-based area-specific studies of the incidence or prevalence of ESRD. Most of the data on ESRD patients are incidence rates that are reported only for particular areas or populations and are quite variable. Reported incidence rates for the period before 1980 range from about 40 to 77 per million (Easterling, 1977; Hiatt and Friedman, 1982; Mausner et al., 1978; Rimm et al., 1978). In the 32 Renal Disease Networks (Berg and Ornt, 1984), the incidence varies from 66 to 148 per million with an average of 99.

Lacking data on area-specific prevalence rates, we statistically controlled for characteristics of the population that are related to prevalence. ESRD patients are more likely to be black, male, and older (Easterling, 1977; Hiatt and Friedman, 1982; Mausner et al., 1978; Evans, 1980; Evans, Blagg, and Bryan, 1981; Sugimoto and Rosansky, 1984; Burton and Hirschman, 1979). Because of the variability of the estimated rates, it was not possible to use direct or indirect standardization. Instead, we used regression analysis to adjust for the characteristics in each area. We regressed the dependent variables (e.g., number of stations or dialysis patients per 100,000 population in an area) on variables representing the age, sex, and racial distribution in the county groups (e.g., percent female, percent black, percent between the ages of 25 and 44) and calculated a residual for each county group. This residual represents how that county differs from what we would expect on the basis of the sociodemographic characteristics of the area.

In the adjustment procedure, we divided both the dependent variables (e.g., number of patients in treatment) and the independent variables (e.g., number of women in the area) by the total population to control for population size. Ratio variables give rise to the appropriate coefficients when properly specified, and the ratio method actually has smaller variance than methods that avoid the use of the ratios when population size is the control variable (Firebaugh and Gibbs, 1985).

For each set of hypotheses, we calculated the correlations between the adjusted dependent variable and the hypothesized predictors and computed a multiple

Table 1

Association between independent variables and the adjusted number of dialysis stations

Predictors	Zero-order correlations	Standardized regression coefficients	
		Model without region	Model with region
Population density	.06	**−.24	**−.23
Income	**.20	−.10	−.08
Physician-specialist	**.45	**.66	**.65
Population growth	−.02	*.13	.08
Medicare reimbursement per enrollee	**.18	.03	.04
Midwest	—	—	.03
South	—	—	.09
West	—	—	.07
R^2	—	.27	.27
N = 408			

*Statistically significant at the $p < .05$ level.
**Statistically significant at the $p < .01$ level.

NOTES: R^2 is percent of variance explained. N is the number of cases.

SOURCE: Cleary, P.D., Harvard Medical School; Schlesinger, M., John F. Kennedy School of Government; Blumenthal, D., Massachusetts General Hospital.

linear regression equation.[2] We calculated each regression model with and without the region variables to facilitate the interpretation of region effects.

Results

In general, a comparison of the certification and facility data indicated that with the exception of facilities dialyzing only hospitalized patients, we had information for between 98.4 percent and 100 percent of the different types of facilities. The response rate among facilities providing only inpatient services was lower, probably because they are not involved in providing maintenance hemodialysis and thus are not paid by HCFA.

Table 1 summarizes the associations between the area characteristics and the adjusted number of dialysis stations. These data provide strong support for the hypotheses that the number of stations in an area is related to the number of medical specialists in an area. The relative number of stations is also correlated with income and payment levels, but these associations are not significant when the number of medical specialists in the area is controlled. Regression analyses not presented here indicate that the relative number of specialists is higher in areas with higher per capita income, higher income, and in more densely populated areas.

In the regression model, population density was negatively associated with the relative number of treatment stations, controlling for other variables such as the number of physicians in the area. In more densely populated areas, fewer stations may serve more people

because the average distance to facilities is shorter. It also may be that there are certain efficiencies at higher volumes or that facilities in densely populated areas have longer hours. However, universal coverage may have induced some shift of facilities to more rural areas with comparable numbers of physicians. There do not appear to be any significant regional differences in the number of facilities per capita controlling for the other variables in the model.

The relationships between area characteristics and proportion of beds that are located in for-profit facilities are presented in Table 2. For the most part, proprietary facilities seem to be located in similar types of areas as non-profit facilities. However, population growth was positively related to the proprietary market share. This finding is consistent with the argument that investor-owner facilities are quicker to respond to newly emerging health care needs, as long as those services are covered by insurance (Marmor, Schlesinger, and Smithey, 1986), but this relationship was not significant when variables representing regions were included in the regression equation. Compared with the Northeast, the proportion of stations that are for-profit is higher in the South and lower in the Midwest.

The associations between area characteristics and treatment rates are presented in Tables 3 and 4. Results are presented separately for total treatment rates and the proportion of patients treated at home. The strongest predictor of the relative number of patients on dialysis is the relative number of medical specialists in an area. A second important result is the lack of a statistically significant association between the for-profit market share in an area and the rate of total outpatient dialysis treatment. We conclude that there is no evidence that for-profit facilities induced demand to a greater extent than non-profit facilities. Total dialysis rates were negatively associated with density and income in the regression equation, although the zero-order correlations between these variables and dialysis rates is positive.

Table 2

Association between independent variables and the proportion of for-profit stations

Predictors	Zero-order correlations	Standardized regression coefficients	
		Model without region	Model with region
Population density	−.03	.06	.02
Income	−.03	.01	.12
Physician-specialist	−.07	.01	−.10
Population growth	*.23	**.21	.04
Medicare reimbursement per enrollee	−.11	−.03	.05
Midwest	—	—	**−.18
South	—	—	**.30
West	—	—	.05
R^2	—	.06	.17

*Statistically significant at the $p < .05$ level.
**Statistically significant at the $p < .01$ level.

NOTES: R^2 is percent of variance explained.

SOURCE: Cleary, P.D., Harvard Medical School; Schlesinger, M., John F. Kennedy School of Government; Blumenthal, D., Massachusetts General Hospital.

Table 3

Association between independent variables and total adjusted treatment rates for dialysis patients

Predictors	Zero-order correlations	Standardized regression coefficients	
		Model without region	Model with region
Population density	*.14	**-.21	**-.20
Income	*.23	-.09	*-.12
Physician-specialist	*.56	**.77	**.80
Population growth	-.05	**.16	**.22
Medicare reimbursement per enrollee	*.22	.01	-.01
For-profit market share	.03	.03	.08
Midwest	—	—	.03
South	—	—	*-.13
West	—	—	-.02
R^2	—	.39	.40

*Statistically significant at the $p < .05$ level.
**Statistically significant at the $p < .01$ level.

NOTE: R^2 is percent of variance explained.

SOURCE: Cleary, P.D., Harvard Medical School; Schlesinger, M., John F. Kennedy School of Government; Blumenthal, D., Massachusetts General Hospital.

Table 4

Association between independent variables and the proportion of in-home dialysis patients

Predictors	Zero-order correlations	Standardized regression coefficients	
		Model without region	Model with region
Population density	-.01	-.19	*-.18
Income	*.13	.03	.01
Physician-specialist	**.31	**.52	**.52
Population growth	-.06	.07	.01
Medicare reimbursement per enrollee	-.01	**-.17	**-.18
For-profit market share	**-.22	**-.21	**-.20
Midwest	—	—	*.14
South	—	—	.14
West	—	—	**.17
R^2	—	.22	.24

*Statistically significant at the $p < .05$ level.
**Statistically significant at the $p < .01$ level.

NOTE: R^2 is percent of variance explained.

SOURCE: Cleary, P.D., Harvard Medical School; Schlesinger, M., John F. Kennedy School of Government; Blumenthal, D., Massachusetts General Hospital.

These findings are difficult to interpret, but we think that these unstable results are due to the strong association between the relative number of specialists in an area and income and density.

Table 4 presents the associations between area characteristics and the proportion of ESRD patients treated at home. The variable with the strongest association with the proportion of patients dialyzed at home was the relative number of physicians in the area. Rates were lower in areas where overall health care expenditures are higher. The results in Table 4 do not support the hypothesis that home dialysis is related to the income level in an area. They do support the hypothesis

that the proportion of stations in an area that are for-profit influences the type of dialysis that is performed. In areas in which there is a higher proportion of for-profit facilities, home dialysis rates are lower and in-unit rates are higher. Controlling for all of these factors, there were residual differences in the rates of home treatment, with the rates being lowest in the Northeast.

Discussion

Our first and most general finding is that dialysis facilities tend to be concentrated in the same areas as other medical resources. These results are consistent with location theories that explain the distribution of medical resources on the basis of quality of life and practice issues as opposed to financial incentives (Beckmann, 1968). It also could be that the location of dialysis facilities is driven, in part, by the need to be close to sources of referral and medical expertise for non-renal medical problems. Whatever the reason, these results have important implications for Federal programs designed to increase medical care availability and access. Clearly, there are powerful non-financial forces driving the location of facilities. Any policies that rely only on "market forces" to equitably distribute resources are unlikely to be successful. In general, it appears that for services with near universal entitlement, proprietary facilities are no more likely than non-profits to locate in high-income areas. Newhouse (1990) has articulated how standard location theory can be used to help understand and predict the geographical location of physicians. He suggests that an increase in physician supply should lead to a greater increase in physicians in areas such as small towns. It is not obvious, however, what the future distribution of specialists will be or what the impact of changing distributions of physicians will have on the use of certain procedures, such as hemodialysis.

The results raise important questions about the associations among proprietary market share, population growth, and regional characteristics. The correlation between population growth and for-profit market share may indicate that for-profits may be more flexible and respond more quickly to changing market conditions and incentives. This association is not significant when region is controlled, however, and it may be that other characteristics of areas, such as regulatory environment, are responsible for the higher propensity of for-profit facilities in certain regions. It was not possible to test these alternative hypotheses with the data available, but the findings indicate that future studies of the relationship between growth and the location of proprietary facilities should examine region effects carefully.

Even in the case of a disease for which there is almost complete entitlement, treatment rates are related to the availability of physicians. Without other data, however, it is impossible to assess whether these associations represent induced demand in areas with a high density of facilities, undertreatment in areas with few facilities, or a combination of the two. It is possible that we have not adequately controlled for regional variability in the prevalence of ESRD. We think that it is unlikely though that any residual differences could account for the large differences that remain after the statistical adjustments used in this study.

The data are consistent with analyses of facility-level data (Schlesinger, Cleary, and Blumenthal, 1989), indicating that choices about type of treatment by proprietary facilities are influenced by financial incentives. For example, home dialysis was less likely to occur in areas in which there was a higher proportion of for-profit facilities. These results are compelling because they are based on relatively small units of analysis (versus States), controlled for important contextual variables such as region and population growth, and adjusted for variables related to case mix. Whether these differences in treatment result from different protocols in for-profit facilities or from differences in medical practices in all facilities in communities where there are more for-profit facilities cannot be determined from these data. Also, it is unclear whether these differences are related to better care or worse care.

The residual regional differences in the rates of home dialysis (Table 4) are fascinating and suggest that there may be important factors related to treatment decisions that we have not included in our models. Specifically, nephrologists in certain areas of the country may be more inclined to use home dialysis because of more confidence in the efficacy and appropriateness of that treatment approach. More research is needed to understand the extent to which regional differences in perceived efficacy explain observed differences in treatment rates.

For-profit facilities undoubtedly will play a major role in the provision of health care in the coming decade. As policies are designed to increase insurance coverage for those now uninsured, the incentives for providing health care will interact with other financial and non-financial factors that influence the location and behavior of individuals and organizations. Since these data were collected, the ESRD program has grown substantially, and there have been basic changes in the payment system. The organization and financing of health care in the United States is changing rapidly, and it is important to analyze more carefully the types of incentives that are implicit in the various payment schemes that are currently in place or that are being planned. Only by acknowledging and taking advantage of both the positive and negative potential consequences of financial incentives will policymakers be able to effectively use the "double-edged sword" of payment policy to maximize the quantity and quality of health services available in this country.

Acknowledgments

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