The Effect of Certificate-of-Need Laws on Hospital Beds and Healthcare Expenditures: An Empirical Analysis

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Certificate-of-need programs attempt to curtail the construction of unnecessary healthcare facilities and to limit the acquisition of costly equipment that provides little benefit by compelling hospitals and other healthcare entities to acquire prior approval from a governmental entity.[1-3] Indeed, efforts to control the growth of healthcare facilities and acquisition of expensive equipment have been ongoing for more than 60 years.[4]

The 1946 federal Hill-Burton program provided funds for new hospital construction contingent on the adoption of a state health plan that detailed the process by which proposed projects would be evaluated.[5,6] The Hill-Burton program encouraged local planning to facilitate the recognition and classification of local needs.

State and local Comprehensive Health Planning agencies (so-called A and B agencies) were created by the 1966 amendments to the Public Health Service Act. These agencies were obligated to produce a state plan for healthcare facilities growth, but they were given no statutory power to implement their judgments and were incapable of mandating the submittal of capital budgets. Consequently, their effectiveness was limited. Nevertheless, many Blue Cross plans refused to reimburse for the interest and depreciation expenses associated with unapproved capital projects.

The Medicare program was enacted in 1966 and adopted a cost-based reimbursement method for short-term hospital services. Following the enactment of Medicare, large increases in hospital and healthcare costs created an intense interest among third-party payers, lawmakers, and the public in the size and expense of short-term hospitals.[7]

In 1967, New York became the first state to enact a certificate-of-need program. Shortly thereafter, Rhode Island, Maryland, and California passed certificate-of-need legislation.[8]

Section 1122 of the 1972 amendments to the Public Health Service Act incorporated controls on capital expansion by healthcare facilities through the withholding of Medicare and Medicaid funds for the interest and depreciation expenses associated with unapproved projects. States were allowed to designate either their state health planning agency or Hill-Burton agency to determine the need for new capital expenditures. The National Health Planning and Resources Development Act of 1974 required states to enact certificate-of-need laws to receive funds through the Public Health Service Act.9 Only Louisiana failed to implement a certificate-of-need law, but Louisiana operated a section 1122 program during this period and in 1991 passed a certificate-of-need law. In 1986, Congress repealed the federal mandate to implement certificate of need to receive funds under the

Public Health Service Act.

The sanctions included in the National Health Planning and Resources Development Act of 1974 were never imposed, although 3 states (Utah, Idaho, and New Mexico) repealed their certificate-of-need law in the early 1980s before the federal mandate was rescinded (**Table 1**).[8,10] Eight more states (Arizona, Minnesota, Kansas, Texas, California, South Dakota, Wyoming, and Colorado) dismantled their certificate-of-need program during the late 1980s, and 2 states (North Dakota and Pennsylvania) dismantled their program in the mid-1990s.

Several studies[11-14] of the effect of certificate-of-need laws found that they had little effect on the supply of hospital beds or on the cost of care. However, Salkever and Bice[3,15] found that certificate-of-need laws reduced the number of hospital beds but did not decrease a hospital's investment in other plant assets, and Cromwell[16] found that certificate-of-need laws reduced the number of hospital beds but did not affect other measures of hospital investment. These studies are based on data from before 1986, when the federal mandate to operate certificate-of-need programs was overturned.

In contrast, the present study uses data from 1985, 1990, 1995, and 2000 to examine the effect of certificate-of-need legislation. It will be relevant to ascertain whether these findings change when more recent data become available. Indeed, there is concern that many state certificate-of-need programs have become too lenient, suggesting that the effect of state certificate-of-need laws on hospital bed supply has lessened in recent years.[17,18]

METHODS

Data

Because all but 1 state (Louisiana) operated some form of certificate-of-need process until the early 1980s, it is difficult to isolate and estimate the effect of this legislation using data from before 1986 unless data from before 1974 are used, as this is when certificate-of-need legislation was mandated for all states. It is possible to estimate the effect of certificate-of-need laws using data after 1983 because 11 states repealed their certificate-of-need laws after 1983 and before 1990 (Table 1). In addition, 2 states (Indiana and Wisconsin) repealed and reinstated their certificate-of-need laws in the early 1990s, and 2 states (Pennsylvania and North Dakota) repealed their programs after 1990. Meanwhile, Louisiana implemented its first certificate-of-need program in 1991.

Another 9 states repealed the sections of their certificate-of-need laws covering short-term hospitals, while maintaining controls on other types of facilities, and 7 of these states did so in the 1980s. Consequently, statewide data from the 1980s and 1990s provide a contrast between states that operated certificate-of-need programs and those that did not operate a certificate-of-need program, as well as between states with a certificate-of-need program that covered hospitals and states without such a program. Moreover, because most states that repealed their certificate-of-need laws did so in the 1980s, data from the 1990s provide a contrast between states that had no certificate-of-need law for several years and states with a certificate-of-need program that had been in place for more than a decade.

An array of independent variables are included in our model to explain the supply of short-term hospital beds per 100,000 civilian residents and the level of healthcare expenditures per capita. Three of these relate to certificate-of-need legislation: (1) a dichotomous variable indicating whether a state had a certificate-of-need law in a given year, (2) a dichotomous variable indicating whether a state had a certificate-of-need law that covered short-term acute care hospitals in a given year, and (3) a dichotomous variable indicating whether a state had a stringent certificate-of-need process as designated by the American Health Planning Association.[10]
The supply of physicians is included in our model as an independent variable. It is assumed that states with more physicians will have more short-term hospital beds and higher healthcare expenditures, and physician availability is measured by the number of active nonfederal physicians practicing in each state per 100,000 civilian residents. The mean personal per capita income also is included as an independent variable in our model. States with higher personal incomes are assumed to have a greater demand for healthcare services and higher healthcare expenditures, and for this reason we include personal income as an independent variable in our model.

Similarly, it is assumed that states with higher unemployment rates are likely to have decreased demand for health services, fewer hospital beds, and lower healthcare expenditures. For this reason, we include a state's unemployment rate in our model.

Because it is likely that population density is a proxy for omitted measures of price, we expect to find an inverse relationship between population density and hospital bed supply. It is also possible that there are fewer hospital beds in sparsely populated areas because of the longer distances involved for patients seeking physician care or hospital care, and it is likely that citizens in less densely populated states are more likely to receive healthcare in states that are more densely populated. For these reasons, we include a variable that measures the number of citizens (measured in thousands) per square mile for each state.

A recent publication states: "In general, individuals with lower income, less education, and lower-status occupations and employment have poorer health. Therefore, it would seem that raising educational levels would reduce health-related expenditures for the public sector, as well as for individuals."[19(p1)] We include the proportion of the state's population who graduated from high school, the proportion of residents without health insurance, and the proportion of residents enrolled in a health maintenance organization. We anticipate that each of these variables is inversely related to healthcare expenditures per capita.

We also include a variable measuring the political climate in a state because the political climate may affect the likelihood that a state repeals certificate-of-need legislation and the amount spent on healthcare. We chose the proportion of voters in the state who voted for the Democratic candidate for president in the most recent election to measure the political climate in a state. In addition, we include a variable measuring the number of deaths per 1000 residents to adjust for the health and age of the state's population.

A greater proportion of a state's population working on farms is assumed to be negatively related to the demand

for health services, and a variable measuring the proportion of a state's domestic product that is attributable to farm income is included in the hospital bed supply and healthcare expenditures equations. Indeed, studies[20,21] provide evidence supporting the hypothesis that farm residents have less access to healthcare services and are less likely to receive healthcare services even after adjusting for insurance coverage and income.

Older citizens have a greater demand for healthcare services than younger citizens because of the increased frequency of illness, and citizens older than 64 years are almost always covered by Medicare. Therefore, it is hypothesized herein that the proportion of the population who are older than 64 years is positively related to the number of hospital beds per capita and to the level of healthcare expenditures per capita.

Data on the population of each state and the number of square miles in each state were obtained from the US Census Bureau (US Department of Commerce).22 Data on state unemployment rates were obtained from the US Department of Labor's Current Population Survey.[23] Data on the mean state per capita income were obtained from the US Bureau of Economic Analysis (US Department of Commerce) as published in various issues of the *Survey of Current Business*.[24] Data on the proportion of the state's domestic product that is attributable to farm income were obtained from reports issued by the National Agricultural Statistics Service and the Economic Research Service of the US Department of Agriculture.[25] The number of hospital beds in each state was obtained from the American Hospital Association (AHA) in various issues of AHA *Hospital Statistics*.[26] The number of active nonfederal physicians practicing in each state was obtained from various issues of the American Medical Association's *Physician Characteristics and Distribution in the US*.

Analytic Approach

In this study, we hypothesized that the effect of certificate-of-need laws on healthcare expenditures is realized through its effect on the supply of hospital beds. Hence, we included the supply of hospital beds as an independent variable in an equation explaining healthcare expenditures and measured the effect of certificate-of-need laws on healthcare expenditures by multiplying the coefficient of certificate of need in the hospital bed supply equation by the coefficient of hospital bed supply in the healthcare expenditures equation. We also estimated the direct effect of certificate-of-need laws on healthcare expenditures by including certificate of need in the healthcare expenditures equation.

We estimated our equations using several different certificate-of-need variables. The first variable is set equal to 1 if the state had a certificate-of-need law in a given year, the second variable is set equal to 1 if the state had a certificate-of-need law that covers short-term acute care hospitals, and the third variable is set equal to 1 if the state had a stringent certificate-of-need process as determined by the American Health Planning Association. We used data from 4 periods (1985, 1990, 1995, and 2000) to estimate the number of hospital beds per 100,000 civilian residents in a state. After explaining the hospital bed supply, we used data from the same 4 periods to estimate the logarithm of the cost of per capita healthcare expenditures in a state. Because of normality issues, we estimated the cost equations using logarithms.

In this study, we used generalized estimating equations[27] to estimate a model that includes dummy variables for time effects and error terms that are correlated for the same crosssectional units observed through time. One of the central suppositions of the generalized linear model is the serial independence of the error terms. However, if data from different periods are used, the assumption of serially independent error terms is not credible, and although ordinary least squares estimates in the generalized linear model will produce unbiased estimates, it is likely to result in serious underestimates of the SEs of the estimated coefficients.[28]

One technique of estimating models based on data from repeated observations of the same cross-sectional unit is to use a fixed-effects model.[29] Such a model has a constant slope, with intercepts that vary according to the crosssectional unit (ie, by state in our study). We did not use a fixed-effects model because we have too many cross-sectional units of observations and too few periods, necessitating too many dummy variables for their specification (ie, including 49 dummy variables would deplete the number of *df* available to perform the necessary statistical tests).

An article by Betrand and colleagues[30] found that serial correlation was a serious problem in studies that used multivariate regression analytic techniques to study causal relationships. They found that serial correlation led to overestimates of the statistical significance of the estimated coefficients and to serious underestimates of the SEs of the estimated coefficients in investigations using ordinary least squares estimates.

Betrand and colleagues30 found that using empirically estimated variance-covariance matrices to produce estimates of the coefficients and SEs generally eliminated this problem if the data did not possess any cross-sectional heteroscedasticity. We tested our model for cross-sectional heteroscedasticity (White31 test and Breusch-Pagan32 test were used) and found no evidence of heteroscedasticity. To account for serial correlation resulting from correlated data observations from the same state, we used generalized estimating equations. As expected, we found that the SEs derived using generalized estimating equations were considerably larger than those derived using ordinary least squares. We also tested our model for autocorrelation and found no evidence of autocorrelation using the Durbin-Watson test.[33]

RESULTS

The means of the variables in our model analyses are given in **Table 2**. The mean annual healthcare expenditures per capita in a state in our data set totaled $2672 in nominal US dollars, and a mean of 13% of the population in each state were older than 64 years. In the average state, almost 4 of 5 residents older than 25 years had at least a high school education, and slightly more than 15% of the population were enrolled in a health maintenance organization. The mean number of hospital beds (short-term nonfederal) per 100,000 civilian residents in a state in our data set was 384.

The estimated coefficients and their associated SEs are given in **Table 3** and **Table 4**. We did not report the equation for the certificate-of-need variable with the 5-year lag because its coefficient was similar to the coefficient without the lag component. The coefficients of the certificate-of-need variables are statistically

significant in each of the equations given in Table 3.

The coefficient of the first certificate-of-need variable (equation 1 in Table 3) indicates that states with any type of certificate-of-need programs average 34 fewer hospital short-term hospital beds per 100,000 civilian residents than states without a certificate-of-need program. Because the mean number of hospital beds per 100,000 civilian residents is 384, this implies that certificate-of-need programs reduce the number of hospital beds per 100,000 civilian residents by almost 10%. Similarly, states with certificate-of-need programs that covered short-term acute care hospitals average 41 fewer beds, or slightly more than 10%, and states with stringent certificate-of-need programs average 76 fewer beds, which represents a 20% reduction.

The dependent variable for the 3 equations in Table 4 is the natural logarithm of state healthcare expenditures per capita. The coefficient in Table 4 for the variable measuring the number of hospital beds per 100,000 civilian residents is 0.00045. The results from equation 4 imply that, if a state reduced the number of hospital beds per 100,000 civilian residents by 1, then the mean per capita healthcare expenditures levels would fall by 0.045% ($e^{0.00045} - 1 = 1.00045 - 1 = 0.00045 = 0.045\%$, where e indicates expenditures). This implies that states with certificate-of-need programs that cover short-term hospitals experience healthcare expenditures per capita that are 1.8% ($41 \times 0.045\%$) lower than those in states without such a certificate-of-need program. Similarly, this implies that states with stringent certificate-of-need programs experience healthcare expenditures per capita that are 3.4% ($76 \times 0.045\%$) lower than those in states without stringent certificate-of-need programs.

The coefficients in equations 5 and 6 in Table 4 indicate that certificate of need does not have a direct effect on healthcare expenditures per capita. Indeed, neither the coefficient for the certificate-of-need variable in equation 5 nor the coefficient for the certificate-of-need variable in equation 6 approaches statistical significance.

Because policy interventions in an empirical statistical analysis are not experimental variables, the omission of variables that are related to both the adoption of the policy intervention and the dependent variable is potentially a serious problem.[29] Consequently, we estimated the equations using a 2-stage least squares method, and the coefficients of the relevant variables did not change appreciably.

DISCUSSION

In 1974, Congress mandated that states adopt certificate-of-need laws and required states to establish comprehensive health plans. This mandate was repealed effective January 1, 1987. Today, 36 states operate certificate-of-need programs, and there is still considerable debate about the effect of this legislation on the availability, access, and cost of healthcare. Moreover, bills are introduced each year in a dozen or more state legislatures to expand, modify, and eliminate state certificate-of-need laws.[7]

Proponents of certificate-of-need laws emphasize that a primary cause of rising healthcare costs is the proliferation of healthcare facilities and the diffusion of expensive medical equipment. They maintain that certificate-of-need programs impose much-needed economic discipline on the healthcare industry and, because the fixed cost of an empty hospital bed is estimated to be about two-thirds the cost of an occupied bed, that

hospitals have an incentive to admit more patients when new hospital beds are brought online.

Opponents of certificate-of-need laws often argue that these laws stifle competition and, because of the political power of large healthcare providers, that certificate-ofneed agencies are often coerced into approving unworthy projects. They also contend that certificate-of-need agencies have few incentives to limit their approval of questionable applications because they do not benefit directly from limiting costs and they are not at risk for cost increases. Indeed, much of the cost of providing new services in an area will be borne by taxpayers in other states because Medicare and Medicaid are major payers. Therefore, supporters of new projects may argue that the citizens of the region will reap all of the benefits of a new facility or service, while bearing little of the cost.

CONCLUSIONS

Between 1985 and 2000, there were numerous changes in our healthcare system that affected the number of hospital beds in a state, and we included variables in our model of hospital bed supply (eg, age, unemployment rate, income per capita, health insurance, physician availability, percentage graduated from high school, health maintenance organization penetration) that may be expected to influence hospital bed supply. Nevertheless, it is impossible to rule out factors such as the growth of highly integrated health systems in specific states that may have led to a reduction in hospital bed supply relative to states without such developments. Yet, our inclusion of the proportion of persons enrolled in a health maintenance organization to some extent reflects changes in the growth of managed care across states and its effect on hospital bed supply.

Certificate-of-need programs vary across states in their coverage, application procedures, and stringency of review. Measurement error in a predictor variable in a regression model does not affect the regression coefficient. Nonetheless, it augments the SE of the coefficient, diminishing accuracy in tests of statistical significance.[29]

This study uses data from 1985, 1990, 1995, and 2000 to ascertain the effect of certificate-of-need laws on hospital bed supply and on healthcare expenditures. We were unable to use more recent data because data on state healthcare expenditures are unavailable for any years after 2000. State healthcare expenditures estimates for years after 2000 will be available in the near future, and it would be relevant to compare the findings in this study with findings using more recent data. It also would be useful if future studies compared the costs and benefits of certificate-of-need programs, as there are no studies to date on the effect of these programs that include estimates of the cost of operating the program, although there have been numerous complaints about the burden imposed by these laws on providers who apply for a certificate of need.