The Effects of Certificate of Need Regulation on Hospital Costs

Patrick A. Rivers, Myron D. Fottler, and Jemima A. Frimpong

This study examines the impact of Certificate of Need Regulation (CNR) on hospital costs (HC). Secondary data from multiple sources were used for the analysis. A panel representing 2,168 short-term general, nonfederal US hospitals operating during the period 1999–2003 was analyzed. Results of our analysis indicate that the existence of a CNR program was not related to HC; however, the stringency of the CNR program was *positively* and significantly related to HC. Implications from these results include the inability of CNR to contain HC as assumed or expected, and the possibility that CNR may actually increase HC, while reducing competition. Keywords: *Certificate of Need Regulation (CNR), hospital costs (HC), HC per adjusted admissions, hospital competition.*

The Certificate of Need Regulation (CNR) emerged in the early 1960s as a practice to contain health costs (HC) in American hospitals. The overarching rationale was to regulate capital expenditures of health care providers by requiring providers to obtain specific certification showing the need for services and expenditures. As a result of the CNR, prior approval of health care investments over certain dollar limits became mandatory, though the threshold varies from state to state. In an increasingly global competitive world economy, the necessity of containing HC cannot be overemphasized. However, assumptions and practices on how HC are contained merit a critical examination. Through such an examination, health policy makers and administrators in the health care industry are likely to become more informed and adaptive to the ever-changing economic environment of health care.

The CNR reflects one response to the rising cost of medical care and the existence of excess capacity within the US health care system, which are some of the major concerns of health care policy makers. As a result of these concerns, state governments have been compelled to become actively engaged in regulating health care expenditures. Indeed, the CNR has been embraced as an alternative instrument to controlling the increase in hospital capital expenditures and the state Medicaid budgets.[1]

From a historic perspective, the first CNR law was enacted by New York State in 1964. New York was then followed by Rhode Island and Maryland in 1968 and California and Connecticut in 1969. In 1972, the US Congress modified the Social Security Act (SSA) by enacting a Public Law (Public Law No. 92–603) to resonate with the CNR. The SSA reinforced the orientation of various

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state CNR proposals by prohibiting the use of monies allocated for Medicare, Medicaid, and maternal and child health programs to make "unnecessary capital expenditures" by the health care facilities or health maintenance organizations (HMOs).[2] The CNR laws require that state regulatory agencies approve both the entry of new hospitals and "large" capital expenditures by existing hospitals. By 1979, almost all states had enacted these laws. There is some empirical evidence that hospitals began some capital projects in anticipation of CNR.[3] Once enacted, CNR laws plausibly would have greater effects after they had been in place for a number of years. By 1999, most CNR state laws had been in effect for at least 13 years.

As of 2002, 36 states were active participants of the CNR program or had passed some form of CNR legislation. Although the laws governing the administration of CNR differ from state to state, they generally cover hospitals, nursing homes, ambulatory facilities, and laboratories.[4] As a norm, the state CNR laws require agencies that regulate the health care providers within states to approve the investments over a certain dollar amount made toward the construction of new facilities and additional beds, investments in new services and equipment, and expenditures towards restoration and equipment to sustain existing services.[5]

However, the current normative implementation of the CNR in various states has been criticized by some researchers. For example, Campbell and Fournier[6] maintain that "a clear, economic, and legal standard to distinguish between an action to deny an applicant in order to prevent investments that would raise costs by unnecessary duplication, and actions motivated by the anticompetitive effect of such denial" is absent from most state CNR policies. In addition, the CNR programs necessitate that a legally authorized government agency offer written substantiation that a change for service or project is needed.

The "need," often based on the requirements of the public for an institution or for a service over a preset period of time, may be difficult to quantify. Furthermore, the review process that certifies "need" also varies from state to state. For example, some states require two while other states require three reviews each by different bodies of the review board. There is also an appeal process for institutions that want to appeal the decisions of the review board. The structure of CNR legislation adopted by a state also depends on the economic situation of the state and the relations between political bodies such as legislators, government regulators, planners, providers, and consumers.[7] Each of these entities undoubtedly holds a distinct purpose and objective in the CNR process.

This article presents the results of an empirical study on the effectiveness of CNR as a hospital cost containment practice in the US hospital industry. The study examines prior research on CNR and HC, investigates CNR and HC in light of more recent data, and addresses the implications of the current study findings on public policy and future research.

Literature Review

Research Streams on CNR

Since the introduction of CNR as a mechanism for cost containment in health care, there have been numerous studies in the health care domain concerning the impact

of CNR efforts. Most studies published in the 1980s and 1990s have analyzed data from the 1970s and 1980s. This literature has examined the relationship within three streams:

1. Between CNR and quality of health care;[8]
2. Between CNR and access;[9] and
3. Between CNR and health care system costs.[10]

Although we have seen some progress in understanding the nature of CNR in the field of health care and its impact on health care—related outcomes from the above studies, the results have been quite mixed.[11] For example, results from the first research stream (CNR and quality) suggest that no clear conclusion concerning the impact of CNR on hospital quality is possible since data are old and results mixed. Results from the second stream (CNR and access) suffer from the same limitations. However, while the impact of CNR on quality and access are important topics, the present research focuses on the third research stream (*i.e.*, the impact of CNR on HC) where current studies suggest inconsistent results.

Research on CNR and HC

Empirical studies have shown different and mixed impacts of CNR on HC. Data gathered from the early 1980s suggest that CNR programs did little to contain cost.[12] Although most of the past studies on CNR focused on hospital expenditures, CNR has been used by many states to plan and regulate facilities despite the apparent inability of CNR programs to lower costs.[13] Burda[14] states that CNR programs have not been instrumental in controlling the cost of health care and have negatively affected the health care industry by reducing competition. Examination of CNR's failure to control cost has been based largely on the performance of programs during the early years of their enactments.[15]

Some authors claim that the performance of many CNR programs has improved over time.[16] Donahue *et al.*[17] acknowledged the importance of early evaluation of the performance of CNR programs but concluded that the CNR programs generally have little impact on overall cost inflation of hospitals. These authors pointed out that some successes have been experienced in states that have cost control as the primary function of CNR programs. Sloan[18] came to a similar conclusion when he found that CNR laws reduced cost per patient. However, his finding did not conclude that CNR laws have considerable impact.

Lanning, Morrisey, and Ohsfeldt[19] found contrary results associated with the presence of CNR. According to these authors, the presence of a CNR *increased* hospital spending by 20.6 percent, personal services by 13.6 percent, and other health care expenditures by 9 percent. In other cases, the *absence* of a CNR program is reported to have a negative effect on HC. For example, using time series data to assess the effects of eliminating CNR, Conover and Sloan[20] found that there is a 5 percent long-term *decrease* in acute care spending per capita as a result of eliminating mature CNR programs. In addition, these authors found no significant change in total per capita spending. However, they also found that after the elimination of CNR, there was no increase in the acquisition of facilities or costs, and there was a 2 percent reduction in bed supply. Finally, Younis, Rivers, and Fottler[21]

also found a *positive* relationship between the existence of CNR and HC.

While most studies have failed to clearly delineate the usefulness of CNR regulations in containing hospital and other health care costs, the case for deregulation seems strong to some researchers.[22] Some researchers believe that deregulation is necessitated by the anti-competitive CNR impact of protecting existing providers from competition.[23] Although assessment of CNR programs does not show a significant impact on hospital expenditures, policymakers in many states are not inclined to abolish CNR laws. Their prime concern is that eliminating the CNR program would result in increased health care capital expenditures and operating expenses despite data to the contrary. The motivating factor is that for a CNR program to be effective, it has to put restrictions on both existing hospitals and those looking to enter the industry.

The review of the literature reflects an ambiguity regarding the impact of CNR on HC. Previous research suffers from a lack of recent data, failure to differentiate the various impacts of CNR (*i.e.*, on HC versus other impacts), inadequacies of the measurement of CNR, insufficient research on CNR impact on HC, failure to control for the effects of managed care and other environmental or market variables, and the lack of national data in most of the earlier studies conducted.

While the question of CNR effectiveness remains an area of public policy debate and an area that warrants the attention of health service researchers, it has been at least a decade since research in this area has been done. The purpose of the present study is to present a focused examination of the effectiveness of CNR as a hospital cost containment practice in the US hospital industry.

In addressing the limitations of previous research on CNR and HC, this study takes a different, more sophisticated approach to looking at the relationship between CNR and HC. National data (1999–2003) encompassing all states in the United States were used to assess the impact of CNR on HC. The impact of both existence and stringency of CNR in the states where it exists was included in the analysis. The study also advances our knowledge base of CNR and extends the literature by controlling for a number of environmental, market, and institutional variables, which have not been controlled in previous research. The study hypothesis examines the relationship of both the existence of CNR and the stringency of the regulation on HC:

Hypothesis: The existence of a Certificate-of-Need Regulation and the stringency of CNR will both negatively impact HC, after controlling for environmental, market, and institutional characteristics.

Methodology

Sources, Definitions, and Measures of Variables

This study integrates data from different but related sources and datasets to test the study hypothesis. The datasets used were drawn from the databases of the American Hospital Association Annual Survey (AHA),[24] American Health Planning Association (AHP),[25] Area Resource File (ARF),[26] Centers for Medicare & Medicaid Services (CMS),[27] CMS Case-Mix Index (CMI), and InterStudy Data (ISD).[28] The AHA dataset contains data on an annual survey of nonfederal short-term general hospitals in the

United States. The analysis included data on surveys conducted in 1999–2003. The AHA, AHP, ARF, CMS, and CMI datasets provided measures for capital investment, financial factors, and operational characteristics while the ISD dataset provided HMO penetration rate. The measures were used to obtain operational and market characteristics, and only hospitals located in metropolitan statistical areas (MSAs) in 1999–2003 were included in the analysis.

While defining a hospital's market can be problematic,[29] for this study, a hospital's market is defined by the MSA for urban hospitals, and by county for non-MSA hospitals since rural hospitals may be in communities too small to be included in an MSA. MSA is defined by the US Bureau of Census[30] to include central cities and their associated suburbs. The use of only those hospitals operating in MSAs is valuable in that the definitions of hospital markets and HMO markets are reasonably clear, and enhance the validity of hospital and HMO penetration measures.

The impact of CNR on HC was investigated with the hospital as the unit of analysis. Data 1999–2003 determined if current findings will refute or substantiate findings from earlier studies that used data from the 1980s. In addition to using more recent hospital data, this study takes into consideration the stabilization of the hospital industry in the implementation of CNR in the United States. Those states that enacted CNR have not seen significant changes in these laws between the early 1990s and 2000. The period selected for this study is also particularly advantageous since there were significant changes in both the number of HMOs and enrollment in HMOs than what would have been captured in studies using 1980s data. Finally, by 1999, the effects of the Medicare's Prospective Payment System and the Balanced Budget Act of 1997 should have also stabilized, thereby minimizing extraneous sources of variation in the data.

CNR is defined as the primary independent construct with two variables:

1. The existence of CNR law in the state where the hospital is located; and
2. The stringency score for the CNR program of each state used.

The stringency score is measured by the number of CNR-regulated services multiplied by a weight based on reviewability thresholds. For the two CNR variables, (1) CNR laws are defined as 1 if hospital is located in a state that has a CNR law, and 0 otherwise; and (2) for CNR stringency (1 if a state has the most stringent CNR thresholds, and 0 otherwise).

The states having the most stringent CNR are Maine, Connecticut, West Virginia, Georgia, Alaska, Vermont, South Carolina, and Missouri. If CNR programs are effective in containing cost, then it is expected that the regression coefficients for each of the two CNR independent predictor variables will be negative and significant (see the analytical approach in next section).

The study defines the dependent construct with one variable, HC per adjusted admission. Previously, measures of HC have been cost per day or cost per case. In some cases, both of these indicators have been used.[31] In the present study, costs-per-adjusted admission was used to measure HC. Since the expense data on the AHA Annual Survey of Hospitals included both the inpatient and outpatient expenses, the admission was adjusted

to summarize the inpatient and outpatient use into a single utilization measure. The AHA calculated adjusted admissions attributed to outpatient services by multiplying admissions by the ratio of outpatient revenue to inpatient revenue.

The HC measure was calculated in this study as operating expense or costs divided by adjusted admissions. This choice of variable was conceptually consistent with the goals of hospitals in the environment of increasing dominance of fixed payment reimbursement. Fixed payment reimbursement caused hospitals to have as their objective the minimization of the cost per episode of care. Operating expense or cost was calculated as the total facility expense minus non-operating expenses including depreciation, interest, and other non-operating losses.[32]

All variables used in the study are defined and listed in Figure 1. For all constructs Figure 1 lists the variables, measures, means, and standard deviations of the variables and data sources.

The specific market environmental, market, and control variables were identified through a review of previously cited literature regarding CNR regulation and HC,[33] as well as the impact of these variables on HC.[34] The control variables included the models' per capita income and percentage of non-White in the market as proxies for socio-economic status. To examine the effect of market competition on HC, the Herfindahl-Hirschman index (HHI), defined as the sum of squares of the market shares of all facilities in the market, is used. Hospital market share is measured by the hospital's acute-care patient days divided by total acute-care patient days for the MSA in which the hospital was located for urban hospitals, and total acute-care patient days in the county for rural facilities.[35] This study also measured the level of managed care penetration in each market defined as the percent of the population enrolled in HMOs. Market variables also include per capita income and percentage of non-Whites in the market area.

The institutional control and operating variables include percentages of Medicare and Medicaid discharges from the hospital as well as patient acuity [derived from CMS data on Medicaid and Medicare discharges], bed size, system affiliation, staffing intensity, ownership status, occupancy rate, staffing index, teaching status, and Medicare wage index (*i.e.*, cost of hospital labor).

Empirical Specification and Analytic Approach

The analytic approach addresses several important issues absent from any earlier single study. First, from the theoretical framing of the CNR program, HC are assumed to differ only in the values of the measured attributes included as explanatory variables and control variables. However, there exists the possibility that hospitals have unmeasured attributes that may affect HC. It is often believed that these hospital-specific variables are correlated with the variables of interest, and thus their exclusion leads to omitted variables bias problems.[36] Second, there might be year-specific effects.[37] Third, while market variables are assumed as strictly exogenous, that is, uncorrelated with the error term in all time periods, hospital-level variables are not strictly exogenous.[38]

Fourth, there is the possibility of "feedback effects" which are most easily thought of as a type of endogeneity across time periods. For example, a change in HC in period [t]

Figure 1. Variables, Measurement, Descriptive Statistics, and Data Source: 1999–2003

Variable	Measure	Mean	Std. Deviation	Source
Dependent Variable				
Hospital Costs	Operating expense or costs divided by adjusted admissions	6,187.515	2554.44	AHA
Independent Variables				
Certificate of Need Regulation (CNR)	1, existence of CNR law; 0 otherwise	0.660	0.474	AHP
CNR Stringency	1, if a state has most stringent CNR thresholds; 0 otherwise	0.085	0.278	AHP
Market Variables				
HMO Penetration	% HMO enrollment as % of total MSA population	0.309	0.157	ARF
HMO Competition MSA	Market shares based on distribution of enrollees' market (*i.e.*, 1- value of HMO Herfindahl Index)	0.681	0.206	Interstudy
	Squared sum of (acute-care patient days/total acute-care patient days in the market)	0.819	0.185	ARF/CM
Per Capita Income	Log of per capita income in the market	27,775.020	7352.318	ARF
% Non-White	% Nonwhite population in the market	0.314	0.178	ARF
Operating Variables				
For Profit	1, for profit; 0, otherwise	0.192	0.394	AHA
Bed Size	Number of staffed beds	229.886	189.659	AHA
Teaching Status	1, for teaching; 0 otherwise	0.105	0.306	AHA
Occupancy Rate	Inpatient days/(staffed beds* 365)	0.571	0.171	AHA
Staffing Intensity	Health care workers full-time equivalents (FTEs) per 1,000 adjusted patient days	13.691	5.567	AHA
Wage Index	Cost of health care labor (i.e., ratio of adjusted average hourly wage to mean of adjusted average hourly wage)	1.013	0.154	CM
System Affiliation	1, system affiliated; 0 freestanding	0.723	0.448	AHA
% Medicare Discharges	Medicare discharges/total discharges	0.412	0.129	
% Medicaid Discharges	Medicaid discharges/total discharges	0.139	0.101	CMS
Case-Mix Index	Medicare case-mix index	1.394	0.253	CM

Notes: AHP = American Health Planning Association; ARF = Area Resource File; AHA = American Hospital Association; CMS = Centers for Medicare & Medicaid Services; CM = CMS Case-Mix Index; ISD = InterStudy Data

may feed back to changes in bed size in period [t+1]. Such feedback effects violate the typical assumption of strict exogeneity. In this study, feedback effects are allowed by making the weaker assumption that hospital-level regressors are predetermined: the error term is uncorrelated with current and past values of the predetermined regressors but potentially correlated with future values of regressors.

To address the foregoing problems, a fixed effects model is employed to remove the influence of such hospital heterogeneity and year-fixed effects. Although one of the commonly applied methods for fixed-effects models is the within-group transformation in which the ordinary least squares (OLS) estimator is applied to data transformed by taking deviations from time-series means for each cross-sectional unit, the within-group transformation yields inconsistent parameter estimates if the model does not include strictly exogenous variables.[39]

Thus, the current study applies first-difference transformation with the instrument variable (IV) estimation. After applying the first-difference transformation to eliminate the fixed effects, the dependent variable is regressed on the first differences of the regressors. As consistent estimates may be obtained by using past values of the strictly exogenous regressors as instruments, a two-year lagged value of the endogenous variable and one-year lagged values of the predetermined regressors are used as the instruments.

More specifically, the regression model is given below:

$$yit = \alpha + \beta 1X1\ it + \beta 2X2\ it + \beta 3X3\ it + \beta 4X4\ it + \lambda i + \eta t + uit;\ i=1,2,\ldots,N;\ t=1,2,\ldots,T,$$

where i is used to index the hospital and t is used to index the year (N = 2,168 and T = 5 in our case). yit equals log of hospital i's costs per adjusted admission at year t, α is constant, X1 it equals CNR, X2 it equals CNR stringency, X3 it equals environmental/market variables, X4 it equals operating variables, λi is unobservable hospital-specific effect which is constant across time, ηt is an time-specific effect which varies across time, and uit equals unexplained residual variation. α, β1, β2, β3, and β4 are coefficients needed to be estimated, and they are estimated by applying the IV estimation to the following first-differenced equation:

$$\Delta yit = \beta 1\Delta X1\ it + \beta 2\Delta X2\ it + \beta 3\ \Delta X3\ it + \beta 4\ \Delta X4\ it + \Delta \eta t + \Delta uit;\ i=1,2,\ldots,N;\ t=1,2,\ldots,T,$$

where Δ denotes the difference operator.

Results

Preliminary Tests

First, the study checked correlations among the study variables. While most had low correlations, some correlations coefficients were higher than others. However, dropping one or more of the independent variables in an effort to reduce multicollinearity could lead to omitted variable bias.[40] Since the study variables are properly chosen based on theory and previous literature, all the variables were included in the subsequent analyses.

Also important is the question of serial correlation. Serial correlation was tested without strictly exogenous regressors. First, the simple OLS regression of the dependent variable on the independent variables

was run; and the OLS residual value was obtained. Second, the residual was regressed on the lagged residual and all of the independent variables. Finally, a heteroskedasticity-robust version of the test was used to check the significance of the coefficient for the lagged residual. Since no significant results were obtained, there is no evidence that the data have serial correlation problems.

Descriptive Findings

Figure 1 displays the mean values and standard deviations for all variables included in the analysis of the 2,168 (36 percent of total number of hospitals) nonfederal short-term care general hospitals in the sample. Nineteen percent were for-profit organizations, the average number of staffed beds were 229, the occupancy rate was 57 percent, and 10 percent were teaching hospitals. HMO penetration in the market averaged 30.9 percent in 1999–2003 and on average; the hospitals were located in more competitive markets. In 1999–2003, 41 percent of hospital discharges showed Medicare as payer and 13.9 percent showed Medicaid as payer. The mean of costs per adjusted admission was $6,187.52.

Regression Results

A regression model was used to determine the impact of CNR on costs per adjusted admission in hospitals. The model contained all the hospitals in MSAs in the sample. The existence of CNR laws and CNR stringency were used as independent variables.

The dependent variable used in the regression is the natural logarithm (LOG) of HC per adjusted admission. The LOG is used to provide normal distributions of the dependent variable in order to meet the normality assumption of regression.[41] We analyzed the data to test the hypothesis of the relationship between CNR construct variables and HC performance variables (as indicated above). The results of the analysis of CNR on health system performance (*i.e.*, HC per adjusted admission) are discussed below. The estimates of the coefficients and standard errors from OLS results of the model regressions are presented in Figure 2.

From the analysis, the adjusted R^2 for the model is 0.48. CNR stringency is significantly and *positively* associated with costs per adjusted admission at the .05 level. There was no significant relationship between CNR laws and HC. The estimated coefficient for the CNR law variable is 0.009. The positive signs indicate that all else being equal, HC per adjusted admission *increase* if the hospital is located in a state that has CNR law. Our findings concur with a number of studies conducted with data from 1970s and 1980s, which concluded that the CNR did not decrease HC in the 1970s.[42] Our findings are also in agreement with two other studies which showed that CNR is associated with only a modest increases in HC in the 1980s.[43] Even though previous results separately examined the 1970s and 1980s, these results for 1999–2003 data are consistent with those earlier studies.

The results also showed that there are several other variables that have a significant impact on HC. Higher costs were found to be associated with hospitals with major teaching functions, larger size, higher occupancy rates, higher staff intensity, higher percentage wage intensity, higher percentage of Medicare and Medicaid discharges, higher case-mix, and location in high income

Figure 2. OLS Regressions with Robust Standard Errors—Dependent Variable: Log of Hospital Costs

Variables	Coef.	Std. Err.	t
Intercept	5.808	0.284	20.450 **
Certificate of Need Regulation (CNR)	0.009	0.013	0.750
CNR stringency	0.049	0.021	2.370 *
HMO penetration	0.050	0.042	1.190
HMO competition MSA	-0.038	0.032	-1.160
Hirschman-Herfindahl Index	-0.082	0.038	-2.140 *
Log [per capita income]	0.141	0.030	4.750**
% Non-Whites	0.123	0.039	3.130 **
For profit	-0.050	0.015	-3.390 **
Bed size	0.000	0.000	7.220 **
Teaching status	0.221	0.021	10.410 **
Occupancy rate	0.101	0.040	2.530 *
Staffing intensity	0.005	0.001	4.510 **
Wage index	0.457	0.049	9.330**
System affiliation	-0.021	0.012	-1.720
% Medicare discharges	0.276	0.053	5.170 **
% Medicaid discharges	0.343	0.060	5.730 **
Case-Mix Index	0.040	0.029	15.390 **

Adjusted R-square = 0.48
F-value = 40.70
* Significant at 0.05 level
**Significant at 0.01 level

areas and/or areas with a higher percentage of non-Whites. HC were lower for hospitals located in more competitive hospital markets as defined by the market share variable and HMO penetration.

Discussion

The purpose of this study was to investigate the impact of CNR on health care organizational performance, as measured by HC. The main findings of this study can be summed up as follows: Based on the hypothesis investigated:

1. Contrary to expectation, the existence of CNR law has *no* statistically significant impact on HC per adjusted admissions for all hospitals; and
2. Contrary to expectation, CNR stringency has a *positive* statistically significant relationship with HC per adjusted admissions for all hospitals.

Previous health services research on the impact of CNR on HC has tended to either use data that pre-dates the implementation of the prospective payment system (PPS) in 1984 or predates the rise of

managed care during the 1990s. This has made the generalizability of these previous results to the current health care environment questionable. The present study went beyond previous research in a number of ways. The CNR effects on HC were examined after establishing more sophisticated controls for possible intervening environmental, market, and institutional variables. In the current study, cost per adjusted admission was used as a measure for HC. HC were calculated in this study as operating expense or costs divided by adjusted admission.

Our results, as well as those of several previous studies, indicate that CNR programs do not only fail to contain HC, but may actually *increase* costs as well. Our results, together with those of previous research, heighten the debate whether CNR will ever be an effective HC containment approach, and counter arguments that CNR programs could be more effective after they have been in place for a period of time.

Numerous studies, as referenced in this research, have made evident the ineffectiveness of the CNR program in containing HC. Studies conducted in the 1980s showed that CNR programs were not successful in controlling hospital expenditures.[44] The findings of our study are consistent with several studies conducted during the 1980s as well as some studies published in the 1990s.[45]

Our findings, together with results from previous studies, raise the question of the impact of the abolishment of CNR on HC. To determine the impact of the abolishment of CNR programs, Mendelson and Arnold[46] reported that there was no increase in cost in 12 states that abolished CNR programs. Considering this finding, it is important to note that each state has different regulations and operates in different markets that are unique to the particular state. A similar statistical analysis of all 50 states by Conover and Sloan[47] reported that removing CNR did not have any overall effect on per capita health care spending.

Examining the impact of CNR, we controlled for all things being equal and the estimated coefficient showed a *positive* sign, which illustrates that HC per adjusted admission *increase* if the hospital is located in a state that has a CNR law. Our findings are substantiated by previous studies. Lanning, Morrisey, and Ohsfeldt[48] also measured the effects of CNR on hospital expenditures and also found it to be positive and significant. The most significant increase was for hospital expenditure where CNR appeared to increase per capita hospital expenditure by 20.6 percent. They also found that CNR raised hospital prices and they attributed this finding to the restraining of competition by CNR laws. Similar to our findings, Sloan and Steinwald[49] found no evidence of CNR impact on for-profit hospitals. After CNR repeal, for-profit hospitals did not significantly increase their costs or market presence.

Limitations

There are a number of limitations inherent in this study. Similar to studies that defined hospital and HMO markets in the research process,[50] this study by definition excluded some hospitals. Hospitals that operate outside of an MSA were not included in this study. Organizational strategy is another limiting factor; by using a geographic definition of the market, this study tends to

overestimate the competitiveness of markets if segmentation is part of the market strategy. That is, hospitals and HMOs may be located in the same MSA, yet due to market segmentation, they may appear not to compete with others in that MSA since they cater to different populations (*e.g.*, young families versus older adults, white collar versus blue collar).

There are some issues that may be of concern but were not addressed in the design of this study. HMO enrollment data do not delineate which portions of the enrollees are located within the MSA. Also, the study data do not capture how the HMOs reimburse. The data do include the total number of enrollees and the service area (usually by county) of the HMO, requiring that the enrollment for HMOs with service areas overlapping MSA and non-MSA counties be estimated.

Second, like all cross sectional studies, this study demonstrates only association and leaves open the question of causality. Third, by defining a market at the MSA level, only a fraction of hospitals were included in the analysis. Hospitals located outside of defined MSAs would not be captured by the measure. This biases the sample toward urban areas and larger size hospitals.[51] Fourth, of the hospitals studied, the mean case-mix index is 1.34. This figure contrasts poorly with the nation as a whole with a mean of 1.00. This difference could also bias the results of this study. Not withstanding the foregoing limitations, this study provides further insight into CNR and spurs further research that will seek to address these shortcomings.

From the current study and the findings of several earlier studies, it appears that CNR may stifle competition and *increase* HC. These findings when combined suggest CNR laws constrain competition more than the lowering of hospital expenditures. Similar to Conover and Sloan,[52] these study results refute the argument that the ending of CNR laws will increase HC or costs of other health care services. The goals for cost containment, in addition to increasing access and quality sought by most CNR laws do not achieve that end result, and may be counterproductive. A recent study by Short, Aloia, and Ho[53] examined how Certificate of Need (CON) influences cardiac mortality rates and reported that states that dropped CON had relatively lower rates for Coronary artery bypass graft (CABG) surgery, with no association between CNR and higher quality of care.

State goals for enhancing consumer access and quality could be better achieved through other programs such as provider or insurer report cards.[54]

The results indicate that CNR stringency has a positive statistical relationship to urban HC within the period 1999–2003. Since the purpose of CNR legislation is to contain or reduce such HC, we conclude that CNR policies did not achieve their stated objectives during the study period. As a consequence of the inability of CNR laws to contain HC, many states in the United States are attempting to refine their CNR to better address the nature and causes of HC inflation. Future research should evaluate these initiatives in order to determine which approaches are most effective in achieving state objectives, with particular attention to rural hospitals that experience a higher percentage of Medicare and Medicaid discharges, higher case-mix, and higher percentage of non-Whites.

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