Financial Performance Monitoring of the Technical Efficiency of Critical Access Hospitals: A Data Envelopment Analysis and Logistic Regression Modeling Approach

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EXECUTIVE SUMMARY

From 1980 to 1999, rural designated hospitals closed at a disproportionally high rate. In response to this emergent threat to healthcare access in rural settings, the Balanced Budget Act of 1997 made provisions for the creation of a new rural hospital—the critical access hospital (CAH). The conversion to CAH and the associated cost-based reimbursement scheme significantly slowed the closure rate of rural hospitals. This work investigates which methods can ensure the long-term viability of small hospitals.

This article uses a two-step design to focus on a hypothesized relationship between technical efficiency of CAHs and a recently developed set of financial monitors for these entities. The goal is to identify the financial performance measures associated with efficiency. The first step uses data envelopment analysis (DEA) to differentiate efficient from inefficient facilities within a data set of 183 CAHs. Determining DEA efficiency is an a priori categorization of hospitals in the data set as efficient or inefficient. In the second step, DEA efficiency is the categorical dependent variable (efficient = 0, inefficient = 1) in the subsequent binary logistic regression (LR) model. A set of six financial monitors selected from the array of 20 measures were the LR independent variables. We use a binary LR to test the null hypothesis that recently developed CAH financial indicators had no predictive value for categorizing a CAH as efficient or inefficient, (i.e., there is no relationship between DEA efficiency and fiscal performance).

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INTRODUCTION

Background

In the dynamics of the at-large US health system, rural health facilities are generally viewed as victims of adverse trends within the total system and of challenges arising from characteristics typical of rural environments (Wood 2008). The confluence of these realities often creates the perception that rural entities are victims of their circumstances (Trinh 1999). As a "victim," the typical rural health organization is presumed to be beset by forces driving the inevitable and unavoidable specter of hospital closure or conversion (Cordes 1989; Drain, Godkin, and Valentine 2001).

The public policy response to these rural health challenges is expressed in the Federal Balanced Budget Act of 1997 (BBA) through the creation of a rural care entity—the critical access hospital (CAH). Since 1998, 1,200 rural facilities have converted to CAH status, a tactic that has reduced the closure-conversion rate of rural hospitals and has stabilized access to care. In turn, a lessening of the closure threat fosters a concern for the performance of CAHs in quality of care (Moscovice et al. 2004) and fiscal performance (Pink et al. 2006; Pink et al. 2004). The provision of cost-based reimbursement does not insulate CAHs from the historical closure threat or relieve these facilities of managerial accountability for outcomes (Fogel and Watt 2007).

Frontier Analysis Methodology

Performance remains a critical yet largely unaddressed concern for CAHs because the enabling legislation was concerned primarily with ensuring the survival of rural hospitals. However, the rural policy dialogue and research emphasis has begun to shift from survival toward managing performance. Furthermore, this step away from the rural-hospital-as-victim metaphor that has characterized prior research on rural health entities is occurring under the operations research (OR) umbrella of technical efficiency.

The research intent is to determine how well CAHs manage resources (inputs) to produce needed health services (outputs). Although data envelopment analysis (DEA) and stochastic frontier analysis (SFA) are both well-established OR approaches to assessing the efficiency of health service facilities (Worthington 1999; Hollingsworth 2008; Hollingsworth 2003), CAHs have received limited research attention regarding efficiency (Rosko and Mutter 2010).

DEA is a deterministic, nonparametric OR technique that calculates the economic efficiency of a given organization relative to the performance of other organizations in the same industry. DEA converts the technical efficiency ratio—determined as the ratio of the weighted sum of outputs to the weighted sum of inputs—into a linear programming function that is subject to specific constraints. In contrast, SFA is a stochastic, econometric approach for production frontier modeling that accounts for random noise (error) affecting the production process. SFA specifies a production function and an error term composed of two parts with different statistical distributions—one representing randomness and the other inefficiency. The error term encompasses

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uncontrollable factors directly concerning the production function and other econometric errors (Aigner, Lovell, and Schmidt 1977; Meeusen and Van den Broeck 1977).

Although SFA has been widely used in the healthcare environment (Dor 1994), it has notable weaknesses, such as the method's susceptibility to collinearity through misspecification of the actual production function and the requirement for monotonicity of relationships. A recent study of Dutch dairy farm environmental efficiency evaluated the results of estimates produced by SFA with those produced by DEA. This research revealed that, while the efficiency rankings are similar, the efficiency scores do vary. Furthermore, while DEA was able to produce estimates in all cases, SFA could not due to monotonicity and theoretical violations (Reinhard, Lovell, and Thijssen 2000). Fulton, Lasdon, and McDaniel (2007) demonstrated that given well-specified models, DEA efficiency estimates had lower variance and bias in forecasting costs in a large hospital system. Here SFA and DEA efficiency rankings were similar; however, DEA was able to produce estimates in all cases, while SFA could not due to requirements for monotonicity and other theoretical violations. For these reasons, we proceed with DEA.

Overview

This study provides a further step toward assessing the efficiency and performance of CAHs. Specifically, we apply an OR procedure (DEA) and a multivariate statistical technique (logistic regression) to develop a two-step design focused on a hypothesized relationship between technical efficiency of CAHs and a recently developed set of financial performance monitors for these rural hospitals. This study's results have the potential to make a useful, quantitatively based contribution to the emerging rural policy concern for performance. The ability to identify fiscal components of technical efficiency fosters an administrative awareness of factors relevant to performance improvement—an essential research, public policy, and administrative issue for CAHs and rural health delivery.

DESIGN STRUCTURE AND METHODS

Data Source

The study's data source is the annual Medicare cost report (CR), which is a detailed summary of the statistical and financial performance of each CAH. The CR is a valuable reservoir of details regarding key dimensions of facility performance for each 12-month period. The CR data source is publicly available from the Centers for Medicare & Medicaid Services of the Department of Health and Human Services in the form of a relational database, the Healthcare Cost Reporting Information System (HCRIS). The HCRIS database for settled 2006 CRs is the data source for this study because it has the largest number of settled, full-period reports.

Subjects and Subject Selection

The study's subjects are rural hospitals, here defined as a CAH in accordance with criteria delineated in the Balanced Budget Act and operationalized in each state's Medicare Rural Flexibility

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Program. For designation, a rural facility must (1) be located in a rural area, (2) be in a state with a Medicare Rural Flexibility Program, (3) provide 24-hour emergency services, (4) have an average length of stay of 96 hours or less, (5) be more than 35 miles from another hospital, (6) or be designated by the state as a necessary provider, and (7) operate no more than 25 beds for acute inpatient care. Using a group of CAHs meeting these and additional subject selection criteria enhances the sample's internal validity because of the structural and operational similarities among entities in the final data set. To be selected, a hospital must (1) have operated as a CAH for two or more years and (2) have a 12-month settled Medicare CR available in the 2006 HCRIS database.

Step One: Data Envelopment Analysis Method

Determining technical efficiency is an a priori categorizing act, which differentiates efficient from inefficient facilities within the specified HCRIS data set of CAHs. To establish an efficiency score for each critical access hospital, DEA optimizes the combination of input and output variables to identify an efficient frontier—a benchmark from which the performance of all other units in the set are compared. The group of facilities on the efficient frontier is designated efficient. Those facilities lying above the convex piecewise linear frontier (efficient frontier curve depicting the best achievable outputs for a given set of inputs) are designated inefficient (enveloped). DEA is a nonstochastic method in that it assumes that all deviations from the productivity frontier are the result of inefficiency, not a combination of efficiency and statistical noise or error. The resultant administrative challenge is to determine the management control action needed to move an inefficient facility closer to the efficient frontier.

We selected DEA as the first step in our methodology because it represents an analytical sophistication beyond attempting to juggle an array of financial ratios to determine how well a CAH is performing. Data envelopment analysis gives users the ability to translate multiple inputs and outputs into a single index of efficiency. The DEA efficiency index creates a useful starting point regarding organizational performance, one that enables a follow-up assessment of potential ways to enhance overall organizational performance relative to the facilities in the original DEA sample.

The first research question is: What factors are associated with CAH efficiency as estimated by DEA? Step one defines the dependent variable of technical efficiency for each CAH in the data set. Our analysis used an input-oriented, variable return-to-scale DEA model consistent with the reality that CAHs in the data set may operate at (1) increasing, (2) constant, and (3) decreasing returns to scale. Our DEA model is consistent with the rural administrative challenge of continuously controlling or reducing inputs as the typical means of improving operating efficiency. DEA analysis was accomplished using DEA-Solver Pro version 6 published by SAITECH, Inc. Exhibit 1 depicts the DEA input and output variables used.

The three DEA input variables were extracted from the HCRIS database for

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EXHIBIT 1
DEA Input and Output Variables and Labels

INPUT	LABEL	OUTPUT	LABEL
Total FTEs	FTES	Total Patient Revenue	PT_REV
Total Square Feet	SQ_FEET	Total RHC Visits	RHC_VISITS
Total Expenses	TOT_EXPNS	Total Patient Days	PT_DAYS

2006 for each CAH. They were selected because they typify a cost-reduction managerial orientation, such as the desire to maintain or increase outputs while reducing costs. As such, they are consistent with an input-oriented DEA model. These variables are not included as predictor independent variables in the subsequent logistic regression (LR) analysis of step two, as they provide more of a macro system look. The three DEA output variables were also extracted from the 2006 CRs.

Step Two: Binary Logistic Regression Method

The second research question investigates which financial monitors reasonably forecast DEA-estimated efficiency. The intent is to identify the most relevant monitors. For step two, DEA efficiency is the categorical dependent variable (efficient = 0, inefficient = 1) in the subsequent binary LR model. A set of six financial monitors from an array of 20 measures serve as the LR independent variables. These financial monitors are derived from the CR of each hospital in the data set and are the independent/predictor variables in the two-group regression model. A binary LR application is used to test the null hypothesis that the selected financial indicators for CAHs have no predictive value for categorizing a hospital as efficient or inefficient; that is, there is no relationship between DEA efficiency and fiscal performance.

Therefore, step two determines whether selected predictor/independent variables can accurately categorize hospitals as efficient or inefficient as defined by the a priori DEA differentiation. Binary LR was selected because the dependent variable is dichotomous (efficient = 0; inefficient = 1) and because the assumptions undergirding LR impose no requirements about the distribution of the predictor variables (e.g., normally distributed, linearly related, equal variances). LR is sensitive to high correlations among the predictor variables (multicollinearity), a potential condition that will be assessed and remedied by the preliminary data screening step. Because LR is sensitive to outliers, the data screening step eliminates outliers from the data set. The data screening and logistic analysis is accomplished using PASW Statistics GradPack version 17.0.

Exhibit 2 depicts the set of 20 financial monitors developed by the Technical Advisory Group (TAG) of the University of North Carolina (Pink et al. 2004; Pink et al. 2006).

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EXHIBIT 2
CAH Financial Performance Indicators by Indicator Category

Number	Variable/Category
	Profitability Indicators
1.	Total Margin
2.	Cash Flow Margin
3.	Return on Equity
	Liquidity Indicators
4.	Current Ratio
5.	Days Cash on Hand
6.	Net Days Revenue in Accounts Receivable
	Capital Structure
7.	Equity Financing
8.	Debt Service Coverage
9.	Long-term Debt to Capitalization
	Revenue Indicators
10.	Outpatient Revenues to Total Revenues
11.	Patient Deductions
12.	Medicare Inpatient Payer Mix
13.	Medicare Outpatient Payer Mix
14.	Medicare Outpatient Cost-to-Charge
15.	Medicare Revenue per Medicare Day
	Cost Indicators
16.	Salaries to Total Expenses
17.	Average Age of Plant
18.	FTEs per Adjusted Occupied Bed
	Utilization Indicators
19.	Average Daily Census–Swing-SNF Beds
20.	Average Daily Census–Acute Beds

Six independent/predictor variables were selected from fiscal monitors in Exhibit 2 on the assumption that they are reflective of managerial action. In this sense, they can be considered proxy variables that are indicative of outcomes of managerial activity designed to enhance organizational efficiency through stewardship of resources. The predictor variables and their fiscal performance dimensions used in the LR are as follows:

1. Profitability: *Return on Equity*
2. Liquidity: *Net Days Revenue in Accounts Receivable*
3. Capital Structure: *Debt Service Coverage*

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4. Revenue: *Medicare Outpatient Cost-to-Charge Ratio*
5. Cost: *FTEs per Adjusted Occupied Bed*
6. Utilization: *Average Daily Census–Acute Beds*

It is important to note that the variables selected for the LR model were not used in the DEA model, even though the DEA variables and predictor variables have their origin in the CR for each hospital in the data set. This distinction ensures that the results were not confounded by the presence of the same measure serving as a variable in both stages of the methodology.

RESULTS AND ANALYSIS

Step One: Data Envelopment Analysis Results

Exhibit 3 is a descriptive summary of three input and three output DEA variables extracted from the 2006 HCRIS database for CAHs meeting the selection criteria. During the subject selection, a total of 191 CAHs met the two criteria of generating gross revenue equal to or greater than $10 million and operating a rural health clinic (RHC). From this initial sample of 191 facilities, 8 CAHs were eliminated from the analysis because an input and/or output variable contained a missing or extreme value. Therefore, 183 CAHs were retained in the final data set for the DEA analysis, which is a 4.1 percent reduction in sample size because of data outliers.

The initial DEA analysis resulted in 18 facilities being identified as technically efficient and 165 inefficient. The average DEA efficiency score was 0.705 with a standard deviation of 0.163. DEA scores range from 1 to 0.329 for the CAHs in the final sample, in which only a small percentage of the CAHs (9.8%, or 18 facilities) compose the efficient frontier. Of the 165 inefficient hospitals, 128 displayed increasing returns to scale, 41 showed constant returns to scale, and 14 exhibited decreasing returns to scale.

Step Two: Binary Logistic Regression Results

This section provides a review of LR findings and an additional multiple regression (MR) analysis that was

EXHIBIT 3

Descriptive Summary of DEA Input and Output Variables for CAHs in the Final Data Set (N = 183)

DEA Input and Output Variables

Statistic	(I)FTEs	(I)TOT_EXPENS*	(I)SQ_FEET	(O)RHC_VISITS	(O)PT_DAYS	(O)PT_REV*
Mean	192.13	18.27	61,370	11,255	3525.77	31.16
SD	87.45	9.54	32,080	9,379	1706.27	18.58
Median	174.50	14.93	51,844	9,047	3,400	25.93
Minimum	59	5.84	3,544	225	83	10.19
Maximum	572	51.40	165,160	59,964	13,689	142.44

*Expressed as $1,000,000

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EXHIBIT 4
Descriptive Summary of Logistic Predictor Variables Derived from HCRIS Relational Database Tables

Monitor	Mean	SD	Median
SAL_2_TOT*	45.1	0.055	45.2
ROE	10.89	40.64	8.52
FTE_AJOB	8.31	4.66	7.47
AR_DAYS	61.55	25.81	57.93
AVG_CENSUS	6.97	4.46	6.17
COST_2_CHRG*	0.45	0.13	0.44

*Expressed as a percentage (%)

conducted as a confirmatory step. Exhibit 4 is a descriptive summary of values for the LR independent variables based on data extracted from HCRIS and calculated in accordance with TAG procedures for determining fiscal performance monitors.

The chi-square goodness-of-fit assessment of the LR model is summarized in Exhibit 5, where COST_2_CHARGE was entered in step one, FTE_AJOB was entered in step two, and AVG_CENSUS was entered in step three. Each step resulted in significant ($p < 0.001$) chi-square values, which indicates that the three variables have predictive capability of a CAH's DEA efficiency status.

Exhibit 6 provides the Cox and Snell R-square value (0.203) and a Nagelkerke R-square value (0.428) as estimates model fit similar to the coefficient of determination. In general, it is accepted that the Cox and Snell estimate tends to underestimate the coefficient of determination while the Nagelkerke index is a more accurate measure. It is possible to argue that the three independent variables account for a portion of variance, yet not a pronounced amount. This outcome suggests the need for further research on variables more predictive of DEA efficiency.

The classification table in Exhibit 7 compares the predicted values for the dependent variable determined as a result of the LR model with the actual or observed values from the data set.

The model accurately predicted efficient (0) facilities at a rate of 33.3 percent and inefficient (1) CAHs at a rate of 98.2 percent. Exhibit 7 shows that the model has an overall accuracy rate of 91.8 percent. From an overall perspective, the variables in the model are predictive of a CAH's DEA efficiency status. Exhibit 7 is a weak indicator of DEA efficiency status because the model is weakly predictive of CAHs that are efficient but strongly predictive of CAHs that are inefficient.

Exhibit 8 shows the variables in the model and the coefficients for the three financial performance variables retained in the model and their respective significances. The significance of LR variable coefficients (B) is tested with the Wald statistic.

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EXHIBIT 5
Goodness-of-Fit Indices for Variables Entered into Model

Improvement				Model			
Step	Chi Sq	df	Sig	Chi Sq	df	Sig	Correct
1	25.951	1	.000	**25.951**	1	.000	90.2%
2	7.664	1	.000	**33.615**	2	.000	91.8%
3	7.890	1	.000	**41.505**	3	.000	91.8%

EXHIBIT 6
Logistic Regression Model Summary

Step	-2 Log Likelihood	Cox and Snell R^2	Nagelkerke R^2
1	91.706	0.132	0.279
2	84.042	0.168	0.354
3	76.151	0.203	0.428

EXHIBIT 7
Classification Table for DEA Efficiency Status

Efficiency*	Observed	Predicted	Percent Correct
0	18	6	33.3%
1	165	162	91.8%

*DEA efficient = 0; DEA inefficient = 1

Given that only 18 of 183 facilities were identified as efficient, we conducted a stepwise MR to confirm the LR findings. Using DEA efficiency as a continuous dependent variable and the six fiscal monitors as the independent variables, the same three financial monitors (FTE_AJOB; COST_2_CHARGE; and AVG_CENSUS) were significantly associated with a facility's DEA score when evaluated against a = 0.05; $R^2 = 0.217$, $R^2_{adj} = 0.204$, $F(1, 179) = 12.97$, $p < 0.001$. The model accounted for 20.4 percent of the variance in DEA efficiency or technical efficiency. This outcome is consistent with the logistic regression results, thereby confirming that DEA can be used to differentiate efficient from inefficient CAHs in a data set. The respective models allow for a rejection of the null hypothesis by concluding that three of the six established fiscal monitors have some capacity to predict the DEA efficiency status of the 183 CAHs in the data set.

DISCUSSION AND RECOMMENDATIONS

Hypothesis Decision

The DEA application using input and output variables extracted from the HCRIS did differentiate CAHs in the

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EXHIBIT 8
Variables in the Equation

Variables	B	S.E.	Wald	Df	Sig	Exp(B)
FTE_AJOB	0.434	0.150	8.339	1	0.004	1.543
AVG_CENSUS	0.170	0.071	5.799	1	0.016	1.186
COST_2_CHARGE	0.135	0.036	14.103	1	0.000	1.144
Constant	-6.996	1.793	15.220	1	0.000	0.001

data set as efficient (N = 18) and inefficient (N = 165). A central finding is that very few (9.8%) CAHs in the data set were determined to be perfectly efficient (i.e., on the production frontier). Also, the identification of three fiscal monitors retained in the subsequent LR model provided statistically significant results in support of the alternative hypothesis. The LR analysis led to a rejection of the null hypothesis by showing that established fiscal monitors were able to correctly predict the DEA efficiency status of a percentage of CAHs in the data set.

Three TAG monitors retained in the LR model were representative of three areas of financial performance, those being (1) FTE_AJOB: *Cost of Operations*; (2) AVG_CENSUS: *Utilization*; and (3) COST_2_CHRG: *Revenue Production*. These findings were confirmed by the MR in which the same three variables were significantly associated with the continuous dependent variable—DEA efficiency. The results of this study have begun the argument that DEA efficiency is associated with financial monitors, tapping the cost of operations, inpatient volume, and revenue production of the CAHs in the data set. Meanwhile, DEA efficiency has value as a freestanding result, especially because a limited number of CAHs in the data set are technically efficient.

The LR and MR results argue that technical efficiency can be enhanced by reducing the allocation of FTEs, increasing inpatient volume, and reducing total operating expenses. The compelling feature of these results is that each recommended tactic is a reasonable, feasible administrative action. Also, each recommended step can be taken independent of external factors presumed to hinder rural hospital performance. Each financial monitor assesses the extent to which an organization exerts management control over elements that are readily subject to control. There are no victims in the data set. Instead, 165 CAHs have opportunities to implement precise operating improvements.

Efficiency Considered

When taken as a stand-alone finding, DEA efficiency is a useful starting point. This study is consistent in reporting that a small percentage of CAHs are technically efficient, which demonstrates that there are abundant opportunities for performance improvement throughout the population of CAHs in the country (Harrison, Ogniewski, and Hoelscher 2009). An additional analysis of this study's results assesses the average

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amount of excess for input variables and the average shortage for output variables for the inefficient CAHs when compared to efficient hospitals in the data set. Such a summary provides a measure of overall inefficiency for the 165 facilities. This slack analysis enables an administrator to envision the extent to which inputs can be reduced and outputs increased in order to move the facility closer to the efficiency frontier. In this data set, the slack analysis indicates that on average the number of FTEs should be reduced by 11.94, with a total cost reduction of $40,000 and a square foot reduction of 10,113.

On the input side, RHC visits can be increased by 2,754 visits, coupled with an increase in patient days of 530 plus a $640,000 increase in total patient revenue. The need to reduce FTEs and square footage suggests that inefficient facilities operated on a larger footprint prior to their conversion to CAH status—a change that was not accompanied by a reduction in staff and a reallocation of square footage. Additionally, RHC operations present an opportunity to increase market share in an amount equivalent to the productivity of one mid-level practitioner or half the productivity of a full-time physician. The need to increase patient days is associated with the need for the RHC component to be a more active admitter to the inpatient program.

This summary of slack adjustments based on DEA analysis alone is an example of ways in which such results are readily converted into administrative activity to improve efficiency. Independent of the input and output variable selected for the DEA analysis, the slack analysis offers specific detail on improvement tactics.

Model Limitations and Future Research

This study suffers the limitations inherent in an exploratory foray into the performance of CAHs. The TAG fiscal monitors are purported to identify six dimensions of fiscal performance. The assumption that the 20 variables are representative of these six dimensions has not been tested. Because these 20 variables are increasingly being accepted as measures of CAH fiscal health, exploratory factor analysis should be conducted to identify specific factors represented by these 20 monitors. It is quite possible that the number of monitors and factors indicative of fiscal performance could be reduced and thereby lead to a simplified interpretation. Future DEA studies with CAHs should continue a focus on DEA differentiation and the operating results associated with technical efficiency.

Additionally, our model specification for the DEA is limited by its minimal use of variables, but we used a macro rather than micro approach largely due to the unavailability of data. Also, our sample selection process was too limiting, especially for an exploratory study. The working assumption was that nongovernmental critical access hospitals that operate rural health clinics and generate $10 million or more in revenue represent flagship CAHs. This group is a model for other CAHs, especially those not performing well. Future research should focus primarily on CAH performance differences between governmental and nongovernmental facilities.

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Last, the population base served by a given CAH is an important variable in that it serves as a limiting factor in market share calculations. Future studies need to differentiate facilities in a sample on the basis of sole county providers versus CAHs with competition within a given county. This study showed only that the primary population was not a factor in the efficiency or inefficiency designation of a CAH facility in the data set.

CONCLUDING REMARKS

Although this study is focused on a small data set of CAHs located in equally small rural communities, the results support the conclusion that statistically significant financial performance differences among these entities means that performance improvement is a real possibility and a reasonable mandate. More important, performance improvement is possible independent of the presumed limitations of rural environments. These performance improvement opportunities are within the purview of management control of operations; that is, they are not hindered by the obstacles routinely identified in the hospital-as-victim rubric.

Technical efficiency advances will always be hindered by an undue administrative reverence for the presumed power of environmental factors. This study confirms the view that a manager of an inefficient CAH in this data set has an opportunity and the obligation to improve efficiency by reducing personnel resources, reducing operating expenses, and managing physical plant utilization. This more recent inventory of environmental forces adversely affecting rural entities does not alter the fact that it is possible for a CAH system to continuously pursue efficiency as a natural feature of governance and administrative activity. The results of this study confirm the validity of such a view. That is, once a given facility abandons the hospital-as-victim metaphor, it can begin to act as a complex adaptive organization and move toward efficiency within the limits of legitimate boundaries or the statistical ceiling imposed by its population base. In keeping with this argument, future research on the performance of CAHs should focus on ways to continuously improve performance within the natural or statistical limits of each facility's location.

This study has established a foundation for linking DEA efficiency to specific fiscal performance improvement opportunities for CAHs. This outcome is as true for stand-alone DEA efficiency results as it is for efforts to link DEA efficiency to established CAH financial monitors. Because a limited number of CAHs in the data set were determined to be efficient, it follows that there are significant opportunities for performance improvement among the CAHs in this data set and in the larger population of CAHs. The future research challenge is to identify and quantify those variables, both fiscal and quality, that further define or expand the meaning of efficiency.

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PRACTITIONER APPLICATION

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The authors of this study have chosen a timely topic. As the national debt continues to climb, many Americans are questioning the value of government programs that subsidize rural healthcare providers.

By definition, critical access hospitals service geographical areas with declining population densities, making efficient operations a challenge. These hospitals cannot

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benefit from the economies of scale enjoyed by their metropolitan counterparts. The findings of this research validate what many economists would predict: The government's use of cost-based reimbursement methodology was designed to keep these essential providers operational, not to make them efficient.

As a CAH administrator for seven years, I learned to avoid developing new service lines that required high patient volumes. We developed new service lines based on the anticipated percentage of Medicare patients that would use the service. Service lines with high Medicare utilization work because these programs allowed the hospital to move additional administrative and general costs into areas of the cost report that are reimbursed by the methodology.

The findings of this study affirm my personal experience in CAH hospitals. Reducing full-time equivalents will make an operation more efficient. However, the licensing bodies like CMS and The Joint Commission require minimal staffing levels. Therefore, most CAH hospitals have very few or no positions they can eliminate, making it almost impossible for a CAH hospital to move toward efficient operations by simply cutting staff.

The study also suggests that reducing the total size of the building is a way of making the hospital more efficient. In cases where a hospital is maintaining a physical space that adds no revenue to the organization, I agree with the authors' recommendation. However, in practice this solution is not practical for most facilities. Most CAH hospitals do not have adequate space to house necessary supplies, medical equipment, and employee offices. Eliminating space that is needed for these reasons will create an undue hardship.

I agree with the researcher's recommendation that CAH hospitals should work to increase rural health clinic visits. This suggestion is achievable. Increasing RHC visits will definitely increase net revenue, especially if the RHC has excess service capacity.

I was surprised that this study showed that the primary size of the population supporting the hospital was not a factor in the efficiency or inefficiency designation of a CAH facility. This finding defies traditional logic. The number of potential patients in a hospital's service area will limit the number of people that use its services.

More research is needed to flesh out other relevant factors associated with efficient CAH operations. Future studies might examine variables like driving distance to the nearest full-service hospital. Another variable worth considering is the complexity level of services offered at the critical access hospital. Some CAH facilities offer very low-complexity services while others offer high-complexity services. Low-complexity hospitals will be bypassed by patients needing higher levels of care.

I suspect that many of the hospitals identified as efficient by this research provide high-complexity services and are in geographically isolated areas, making travel to a larger facility impractical. My hypotheses are, however, based on anecdotal evidence. The data collected in this project may be able to confirm this.

This research project is a great start is an area that sees very little research. As federal dollars become scarce, hospital administrators and policymakers will benefit from more research like this if CAH hospitals are to ever become self sustaining.

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