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Changes in Efficiency of U.S. Dialysis Centers Amid Regulatory and Payment Reform

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BACKGROUND AND OBJECTIVES

- In January 2011, the Centers for Medicare & Medicaid Services (CMS) implemented a major payment reform for the treatment of patients with End-Stage Renal Disease (ESRD) on dialysis.[1]
- Driven by rapid spending growth in this population-- especially use of injectable drugs including erythropoietin stimulating agents (ESAs) – the dialysis program payment reforms included prospective bundled payments and pay-for-performance incentives in an effort to curb costs while maintaining quality of care and improving efficiency of care delivered.
- Both the General Accountability Office (GAO) and U.S. Congress have requested an evaluation of the effects of the ESRD Prospective Payment System (PPS) but effects on dialysis center efficiency have not been examined to date.
- We hypothesized that this new payment system would lead to increased efficiency in the periods immediately following implementation, as facilities adapted to stricter payment controls and potential penalties for inferior quality of care.

Objectives

- To evaluate the impact of a new PPS on the efficiency of U.S. dialysis facilities after implementation of major payment reforms on January 1, 2011.
- To identify which sectors (based on dialysis organization characteristics and geographic factors) demonstrated changes in efficiency after PPS implementation.

METHODS

Study Setting

- 4173 Medicare-certified free-standing dialysis facilities in the U.S. that offered in-center hemodialysis from 2010 through 2012 (comprising ~85% of all such US facilities.)

Data Sources

- Treatment data and cost and labor inputs of dialysis treatments were obtained from 2010-2012 Medicare Renal Cost Reports[2] and Dialysis Facility Reports.[3] Sociodemographic data on characteristics of residents in the neighborhoods where dialysis facilities were located were obtained from the 2010 US Census.

Definitions

- *Efficiency* in dialysis is best viewed from the perspective of technical efficiency (i.e., improvement in some inputs or outputs without worsening any other inputs or outputs), vs. productive efficiency (producing maximum outputs from a fixed set of inputs) as dialysis facilities are confronted with a relatively fixed patient base for which they produce a fixed number of outputs. Efficiencies are realized through either a) reducing inputs and/or b) improving the quality of outputs. In such an input-oriented model, the minimum inputs that a facility should require to produce its outputs is estimated from the best-practice frontier, as defined through appropriate benchmarking for technical efficiency.[4]
- Changes in *productivity* are the result of the combination of changes in the relative technical efficiency of a unit and changes in the best practices frontier. As the best practices frontier changes, e.g. – through technological innovation, there is a change in the minimum input requirements to produce a given level of outputs.[5] A technically-efficient unit may fall behind if the industry-leading innovations are not adopted. Hence, with no (absolute) change in technical efficiency, there is a decline in relative productivity.

Analysis Technique

- This was a longitudinal, facility-level retrospective study using data envelopment analysis (DEA) to model the technical efficiency of free-standing dialysis centers for the years 2010-2012. DEA uses cross sectional data and a linear programming technique that converts multiple inputs (e.g., costs, staffing levels) that a dialysis facility uses to produce an output (e.g., dialysis treatments) to a relative efficiency score between 0 and 1, where scores are proportional to the efficiency frontier (score of 1.0.) Following previous work in this field[6,7] we used an input-oriented variable-returns-to-scale DEA model.
- The DEA-based Malmquist Productivity Index was used to compare DEA-based efficiency scores across years. The Malmquist index can decompose the overall productivity measure into two components: one measuring change in technical efficiency (catching-up effect); and the other measuring change in the Best Practices Frontier (technology/innovation).

RESULTS

Dialysis Facility Characteristics

- The 2010 Renal Cost Reports database included 4,870 free-standing hemodialysis facilities, of which 588 were excluded due to missing data or cost outliers. Of the 4,282 remaining facilities 4,173 had data from all three years 2010-2012.
- The dialysis market in 2010-2012 was dominated by the two largest chains, which owned 77.7% of all free-standing facilities by 2012. Local market concentration was also high (low competition), as measured by a mean Hirschman-Herfindahl Index of 0.677 in 2012. 93.5% of all free-standing facilities were for-profit, 93.3% were chain-affiliated, and 75.7% were located in urban areas. Nearly half of all facilities were located in the South census region (**Table 1**).

Data Envelopment Analysis

- The distributions of efficiency scores from the DEA model changed significantly between 2010 and 2011-12; whereas 26.9% of facilities were on the efficiency frontier (maximum relative efficiency, score = 1.0) in 2010, this dropped to between 11-12% in 2011-12 (**Figure 1**). About 36% of facilities were functioning efficiently (efficiency scores ≥.90) in 2010, dropping to 21-22% in 2011-12. The overall distribution of scores in 2011 and 2012 was more concentrated near the mean efficiency score (0.78 in both years) with fewer outlier facilities in the tails of the distributions.

Figure 1: Relative Efficiency Score Distributions 2010 to 2012

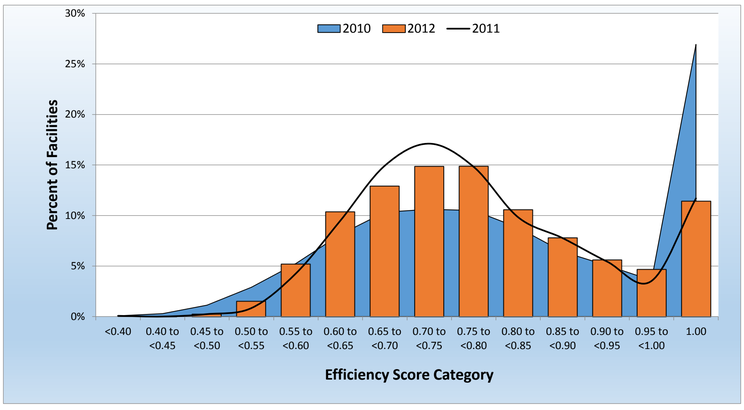


Table 1: Characteristics of Sample Freestanding Dialysis Facilities

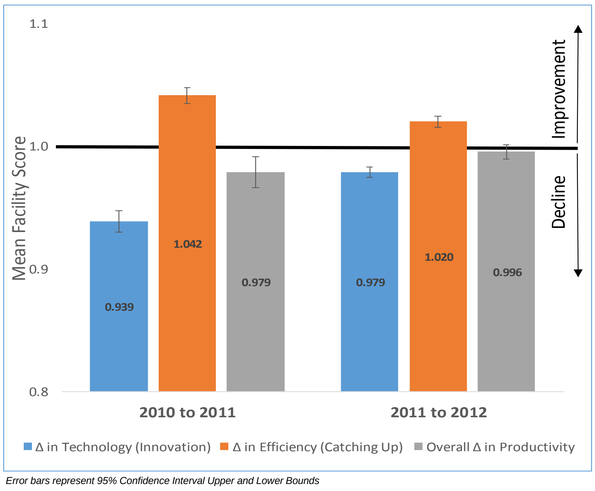
Variable	Number (n=4173)	Mean (%)
Annual 4-Hour Hemodialysis Equivalent Sessions		12,238
Market Competition (2012)		
Hirschman-Herfindahl Index		0.677
% For Profits in Market		93.3%
Facility Characteristics (2012)		
Not affiliated-Independent	279	6.7%
Affiliated with Small Chain	232	5.6%
Affiliated with Mid-Sized Chain	418	10.0%
Affiliated with Large Chain	3,244	77.7%
For Profit	3,900	93.5%
Non-Profit	273	6.5%
Northeast Region	527	12.6%
Midwest Region	889	21.3%
South Region	1,988	47.6%
West Region	769	18.4%
Rural	406	9.7%
Suburban	610	14.6%
Urban	3,157	75.7%
Average Annual Costs*		
Admin & General Costs		$623,579
Drug Costs		$589,613
Medical Supply Costs		$288,073
Capital Costs		$218,008
Machine Costs		$103,439
Operations & Maintenance		$91,125
Other Costs		$67,391
Nursing FTEs		4.7
Dialysis Technician FTEs		6.5

*Adjusted to 2010 dollars

Productivity Changes after 2010

- The average Malmquist productivity score declined by -2.1% from 2010 to 2011 (95% CI: -3.4% to -0.8%) and was basically unchanged from 2011 to 2012 (mean productivity index score: 0.996, 95% CI 0.990-1.001). While the average facility saw some relative technical efficiency gains, the technology/innovation portion of the index declined each year 2011 and 2012, more than offsetting the average facility gain in technical efficiency (**Figure 2**).
- Some productivity gains were seen in 2011 in independent facilities and in facilities that were members of medium-sized or non-profit chains, and in the Northeast region (**Table 2**). For 2012, only the Western region showed a statistically-significant marginal productivity improvement (mean index score 1.016, 95% CI 1.004-1.027).

Figure 2: Average Malmquist Productivity Index Component Scores 2011-2012



Error bars represent 95% Confidence Interval Upper and Lower Bounds

Table 2: Malmquist Productivity Index Scores by Market Segment

Market Segment	2010 to 2011 Mean (SD)	2011 to 2012 Mean (SD)
All Facilities	0.979 (0.426)	0.996 (0.191)
Independent (Unaffiliated)	1.070 (0.516)	1.014 (0.399)
Small Dialysis Organization	0.996 (0.279)	0.988 (0.211)
Medium Dialysis Organization	1.025 (0.249)	0.939 (0.249)
Large Dialysis Organization	0.960 (0.450)	1.002 (0.147)
Non-Profit	1.011 (0.222)	0.874 (0.151)
For Profit	0.977 (0.437)	1.004 (0.191)
Rural	0.926 (0.201)	0.994 (0.348)
Suburban	0.956 (0.231)	0.995 (0.161)
Urban	0.990 (0.474)	0.996 (0.166)
Midwest Region	0.927 (0.201)	0.992 (0.160)
Northeast Region	1.108 (1.023)	0.974 (0.165)
South Region	0.960 (0.241)	0.995 (0.218)
West Region	1.000 (0.240)	1.016 (0.162)

DISCUSSION

- The US dialysis industry's response to the 2011 Medicare payment reforms was mixed. While there was a substantial "catching up" effect in some industry segments that had significantly lagged the efficiency frontier in 2010, the overall efficiency frontier regressed in 2011-12, as observed by the decline in the technology component of the overall Malmquist Index.
- Some facilities may have anticipated PPS reforms by implementing efficiency measures prior to 2011. The relatively high number of facilities at the efficiency frontier in 2010, and general broader dispersion of efficiency scores below the frontier, suggest that 2010 may have been a period when the level of preparation for the payment reforms varied across the industry.
- The exigencies of the payment reforms, once implemented, may have proven less draconian than expected, which could have resulted in some relaxing of innovation and/or efficiency on the part of the most efficient providers, while other industry segments began to catch up to the leaders through both a "lowering of the bar" as well as improving their own relative efficiency.
- Limitations include the absence of input measures to adjust for variability in patient case mix (i.e. – input requirements) across facilities, and the possibility of selection bias due to the fact that some facilities were excluded because of missing data.

CONCLUSIONS

- Contrary to our hypothesis, the US dialysis industry did not appear to realize any short-term gains in productivity in response to the 2011 Medicare payment reforms, as compared to the period just prior to reform. Pre-emptive measures to improve efficiency might have been implemented by some firms prior to 2011.
- Future work in this field should incorporate quality of care dimensions and case-mix adjustment in the measurement of efficiency and productivity over a longer timeframe.

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