JOURNAL OF

# HEALTH CARE FINANCE

## *Quantifying Aspects of Government Programs*

VOL. 40, NO. 1 FALL 2043
JAMES J. UNLAND, EDITOR

# Editorial Board

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Wolters Kluwer
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# *From the Editor— About This Issue*

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**—James J. Unland, MBA**

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# The Patient Protection and Affordable Care Act's Provisions Regarding Medical Loss Ratios and Quality: Evidence from Texas

***Troy Quast***

**Objectives**. The Patient Protection and Affordable Care Act (PPACA) includes a provision that penalizes insurance companies if their Medical Loss Ratio (MLR) falls below a specified threshold. The MLR is roughly measured as the ratio of health care expenses to premiums paid by enrollees. I investigate whether there is a relationship between MLRs and the quality of care provided by insurance companies.

**Methods**. I employ a ten-year sample of market-level financial data and quality variables for Texas insurers, as well as relevant control variables, in regression analyses that utilize insurer and market fixed effects.

**Results**. Of the 15 quality measures, only one has a statistically significant relationship with the MLR. For this measure, the relationship is negative.

**Conclusions**. Although the MLR provision may provide incentives for insurance companies to lower premiums, this sample does not suggest that there is likely to be a beneficial effect on quality.

**Key words:** *Affordable Care Act, medical loss ratio, HEDIS.*

One of the provisions of the 2010 Patient Protection and Affordable Care Act (PPACA) sets minimum thresholds for an insurer's Medical Loss Ratio (MLR), which is approximately measured as the health expenses paid by the insurer divided by the premiums paid by enrollees. PPACA requires insurers to rebate to enrollees the amount of premiums in excess of certain MLR thresholds, when the thresholds depend on the number of enrollees. Initial estimates for 2011 suggest that these rebates will total roughly $1.3 billion.[1]

However, it is not clear whether insurers with higher MLRs deliver higher quality of care. MLRs and quality may be positively related if an insurer has a higher MLR because it spends a relatively greater amount for health care per enrollee. On the other hand, an insurer may have a relatively high MLR because it is forced to charge lower premiums due to the perception by consumers that it provides a low-quality product.

While physicians obviously have a direct effect on the quality of care provided to enrollees, insurance companies can also have an important influence. Insurance companies may directly affect quality through their ability to influence physician practices, observe the care being received by their enrollees, track enrollee satisfaction, and institute large-scale quality-improvement efforts.[2]

In addition to these direct channels, the financial performance of insurance

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companies may have an indirect effect on quality through impacts on physician behavior. One mechanism that may have an effect quality is through incentive-withhold pools. These pools are incorporated into physician contracts and provide that the insurer withholds part of the physician compensation until the end of the year. The insurance company only releases these funds to the physician if certain goals have been met. These goals may include provisions regarding whether the care provided by a physician has been deemed cost-effective.[3] Incentive pool disbursements may also be based on whether an insurer "holds down costs."[4] These pools could have an indirect effect on physician practice patterns. For instance, during periods of poor financial performance by the insurance company, physicians may be less likely to perform procedures due to expected reduced compensation for the procedure from the incentive pools.

There has been scant empirical research into the relationship between quality and MLRs. The closest existing paper employs a cross-section of insurance companies using data from 1996 and finds that quality is positively associated with the medical expense ratio, which is similar to the MLR and is calculated as total medical expenses divided by total revenue.[5] However, given the significant changes in the insurance industry in the subsequent 15 years, it is unclear whether those results are still valid. Further, the cross-sectional nature of the analysis implies that there may be significant unmeasured variables for which the estimation does not control.

As such, the quality consequences of the MLR provision of PPACA are ambiguous. This paper investigates a period prior to the enactment of PPACA to potentially gain insight as to what those effects may be.

## Methods

### Sample

The sample used in the analysis is all basic service commercial insurance companies in Texas with at least 5,000 enrollees. The data cover 2000 through 2010 and encompass 24 companies in 28 geographic markets. The unit of observation is insurer-market-year.

## HEDIS Rates

Quality is measured by Health Plan Employer Data and Information Set (HEDIS) rates. These rates are reported by the National Committee for Quality Assurance (NCQA) and have been widely used in academic research.[6,7,8,9] The rates are process measures that reflect whether enrollees receive recommended screenings and treatments.

Figure 1 describes the HEDIS rates used here, which cover child health, women's health, behavioral health, and chronic conditions. Insurance companies in Texas with 5,000 or more enrollees are required to report these rates to the Texas Department of State Health Services (DSHS) and the Texas Office of Public Insurance Counsel (OPIC).[10] The measures employed in the analysis are those that were reported for the entire sample period. The measures include screenings, such as well-child visits, cancer screenings, and cholesterol screenings. The rates of appropriate treatments are also specified for conditions such as childhood immunizations, antidepressants, and asthma medications. Given the differences across measures, the

**Figure 1. Descriptions of HEDIS Measures**

| Measure | Description |
|---|---|
| **Child health** | |
| Prenatal care | Percent of deliveries that received a prenatal visit in the first trimester or within 42 days of enrollment. |
| Well-child visits (0–15 mths) | Percent of children who received 6 or more well child visits in the first 15 months after birth. |
| Well-child visits (3–6 yrs) | Percent of children aged 3–6 years who received one or more well-child visits during the past year. |
| Childhood immunizations | Percent of children who received all of the recommended doses of the combination 2 vaccinations by two years of age. |
| **Women's health** | |
| Breast cancer screening | Percent of females aged 40–69 who received a mammogram to screen for breast cancer during the past two years. |
| Cervical cancer screening | Percent of females aged 21–64 who received one or more Pap tests to screen for cervical cancer during the previous three years. |
| Postpartum care | Percent of mothers that received a postpartum visit between 21 days and 56 days after delivery. |
| **Behavioral health** | |
| Anti-depressants (acute phase) | Percent of individuals 18 years and older who, after being diagnosed with a new episode of major depression, were treated with an antidepressant medication, and who remained on an antidepressant medication the entire 12-week acute phase treatment. |
| Anti-depressants (continuation phase) | Percent of individuals 18 years and older who, after being diagnosed with a new episode of major depression, were treated with an antidepressant medication, and who remained on an antidepressant medication for at least 180 days. |
| Mental health hospitalization follow-up (7-day) | Percent of individuals 6 years and older who, after being hospitalized for treatment of a selected mental health disorder, had an outpatient visit with a mental health practitioner, an intensive outpatient encounter, or partial hospitalization within 7 days of discharge. |
| Mental health hospitalization follow-up (30-day) | Percent of individuals 6 years and older who, after being hospitalized for treatment of a selected mental health disorder, had an outpatient visit with a mental health practitioner, an intensive outpatient encounter, or partial hospitalization within 30 days of discharge. |
| **Chronic conditions** | |
| Appropriate asthma medications | Percent of individuals aged 5–50 years with persistent asthma who were prescribed medications acceptable as primary therapy for long-term control of asthma. |
| Cholesterol mngt: LDL-C screening | Percent of individuals aged 18–75 years who, after being discharged from a hospital for an acute cardiovascular event, had an LDL-C screening in each of the last two years. |
| Diabetes care | Average percent of males and females aged 21–64 with Type 1 or Type 2 diabetes who received care across six types of care. |
| High blood pressure mngt | Percent of individuals aged 18–85 years diagnosed with hypertension, whose blood pressure adequately controlled during the year. |

relevant population varies depending on the specified care.

Figure 2 details the values of the HEDIS measures used in the analysis. For instance, on average 77.3 percent of eligible enrollees received the recommended prenatal care. There is significant variation across the mean rates, ranging from 38.6 for continuation phase antidepressants treatment to nearly 80 for cholesterol treatment, that is, LDL-C screening. For most measures, there is also considerable variability across the units of observation. For instance, the prenatal rate varies from a minimum of 17.5 to a maximum of 100.0, while the diabetes care rate ranges from 28.9 to 75.7. This variation is conducive to the fixed effects estimation strategy employed below.

The number of observations varies due to missing observations for some insurers in some market-years. There are three potential reasons for a HEDIS rate to be unreported: The insurer did not have a large enough sample to report a valid rate, the insurer failed to submit the rate, or the rates were not certified by a licensed auditor.

A potential advantage of this analysis is the use of HEDIS rates measured at the market level. It has been shown that rates disaggregated to this level more accurately

**Figure 2. Descriptive Statistics of Health Plan Employer Data**

| HEDIS Measure | No. of Observations | Mean (SD) |
|---|---|---|
| Child health | | |
| Prenatal care | 248 | 77.3 (15.3) |
| Well-child visits (0-15 months) | 244 | 52.4 (15.8) |
| Well-child visits (3-6 years) | 251 | 51.9 (11.3) |
| Childhood immunizations | 220 | 52.2 (22.4) |
| Women's health | | |
| Breast cancer screening | 290 | 66.8 (6.6) |
| Cervical cancer screening | 259 | 74.4 (8.1) |
| Postpartum care | 238 | 64.7 (21.0) |
| Behavioral health | | |
| Antidepressants (acute phase) | 265 | 55.4 (8.3) |
| Antidepressants (continuation phase) | 265 | 38.6 (7.7) |
| Mental health follow-up (7 days) | 206 | 48.0 (13.4) |
| Mental health follow-up (30 days) | 206 | 67.0 (13.5) |
| Chronic conditions | | |
| Appropriate asthma medications | 306 | 76.8 (16.7) |
| Cholesterol management: LDL-C screening | 205 | 79.4 (8.9) |
| Diabetes care | 232 | 57.7 (9.2) |
| High blood pressure management | 175 | 56.3 (10.8) |

*Note:* Rates are measured as percents.

reflect local factors that may affect quality of care.[11]

**Additional Covariates**

Figure 3 describes the explanatory variables used in the regressions. The MLR is calculated as the ratio of health care expenses divided by premiums and is based on data from the Texas Department of Insurance.[12] This calculation differs slightly from the revised MLR definition employed in PPACA, in which expenses for activities that improve health quality are added to the numerator, while federal and state taxes and licensing and regulatory fees are subtracted from the denominator.[13] The sample average of 0.86 is interesting in light of the MLR thresholds in PPACA, which is 0.80 for coverage sold to small employers (defined as 1–50 employees) and 0.85 for larger employers.

Figure 3 also includes descriptive statistics of control variables thought to also influence the quality of care provided to enrollees. The number of enrollee months in a year is included to control for the potential differential effects that the size of the insurer may have on quality. The percentages of enrollees in group coverage and Medicare are included to capture the effects that these types of plans may have on quality.

Additional control variables are included to reflect the training and number of physicians, as well as the proportion of enrollees in specific populations. As discussed below, the specific variables included in a given regression vary according to the population to which that HEDIS rate applies.

To reflect the qualifications of the providers, the percentages of physicians who are board certified are included. Also, the number of physicians is included to control for any potential issues regarding the availability of physicians to provide the specified care. The proportion of individuals in the specified population is also included. The rationale for its inclusion is to account for the potential that the insurance company may be more or less likely to provide a type of care depending on how prevalent that group is in its enrollee pool.

Finally, two binary variables are also included to control for the way the HEDIS rate was calculated. The first reflects how the HEDIS rate was calculated. Specifically, the administrative method is based on an examination of the records for all of the enrollees in the eligible population, while the hybrid method uses sampling to estimate the HEDIS rate. Given that the methodology has been found to influence the HEDIS rate,[14] a dummy variable is used to reflect the method employed by that insurer in that market/year.

The other binary variable takes a value of one if the HEDIS rate was based on the population of HMO members only and a value of zero if it was based on the combined membership of the insurer's HMO and Point of Service (POS) products. POS plans differ from HMO plans primarily in that they partially cover care given by non-network providers.

As a plausibility adjustment, the sample excludes observations in which the MLR is more than three standard deviations from the mean. Depending on the HEDIS measure, this leads to the elimination of anywhere from 8 to 12 observations.

**Empirical Model**

Ordinary least squares (OLS) regression via the REGRESS command in Intercooled Stata 11.0 (version 10.0, StataCorp LP, College Station, TX) is used to estimate the

**Figure 3. Descriptive Statistics of Model Covariates Used to Predict Quality of Care**

| Variable | Mean (SD) | Data Source |
|---|---|---|
| Medical loss ratio | 0.86 (0.10) | TX Department of Insurance |
| Enrollee months (millions) | 0.61 (0.62) | TX Department of State Health Services |
| % group coverage enrollees | 0.83 (0.25) | TX Department of State Health Services |
| % Medicare enrollees | 0.05 (0.16) | TX Department of State Health Services |
| % physicians who are board-certified | | |
| OB-GYNs | 0.76 (0.09) | TX Department of State Health Services |
| Pediatricians | 0.75 (0.14) | TX Department of State Health Services |
| Primary care doctors | 0.75 (0.09) | TX Department of State Health Services |
| Female enrollees aged 18–39 | | |
| % of all enrollees | 0.19 (0.02) | TX Department of State Health Services |
| # primary care doctors per enrollee | 0.27 (0.71) | TX Department of State Health Services |
| # OB-GYNs per enrollee | 0.07 (0.19) | TX Department of State Health Services |
| Female enrollees aged 18–64 | | |
| % of all enrollees | 0.38 (0.03) | TX Department of State Health Services |
| # primary care doctors per enrollee | 0.13 (0.34) | TX Department of State Health Services |
| # OB-GYNs per enrollee | 0.03 (0.08) | TX Department of State Health Services |
| Female enrollees aged 50–69 | | |
| % of all enrollees | 0.10 (0.02) | TX Department of State Health Services |
| # primary care doctors per enrollee | 0.55 (1.5) | TX Department of State Health Services |
| # OB-GYNs per enrollee | 0.13 (0.33) | TX Department of State Health Services |
| Enrollees in 1st year of life | | |
| % of all enrollees | 0.01 (0.002) | TX Department of State Health Services |
| # primary care doctors per enrollee | 3.8 (8.5) | TX Department of State Health Services |
| # pediatricians per enrollee | 0.86 (2.51) | TX Department of State Health Services |
| Enrollees aged 1–4 | | |
| % of all enrollees | 0.06 (0.01) | TX Department of State Health Services |
| # primary care doctors per enrollee | 0.95 (2.1) | TX Department of State Health Services |
| # pediatricians per enrollee | 0.21 (0.60) | TX Department of State Health Services |
| Enrollees aged 5–54 | | |
| % of all enrollees | 0.93 (0.01) | TX Department of State Health Services |
| # primary care doctors per enrollee | 0.03 (0.04) | TX Department of State Health Services |
| Enrollees aged 5–99 | | |
| % of all enrollees | 0.93 (0.01) | TX Department of State Health Services |
| # primary care doctors per enrollee | 0.03 (0.04) | TX Department of State Health Services |
| Enrollees aged 18–74 | | |
| % of all enrollees | 0.72 (0.03) | TX Department of State Health Services |
| # primary care doctors per enrollee | 0.05 (0.10) | TX Department of State Health Services |
| Enrollees aged 18–99 | | |
| % of all enrollees | 0.72 (0.03) | TX Department of State Health Services |
| # primary care doctors per enrollee | 0.04 (0.07) | TX Department of State Health Services |
| % administrative rate | 0.87 (0.34) | TX Department of State Health Services |
| % HMO membership rate | 0.59 (0.36) | TX Department of State Health Services |

model. An important feature of the specification is the inclusion of market and insurer fixed effects. The market fixed effects control for any feature of the geographic market that could affect quality but does not vary over the sample period. For instance, the market fixed effects could control for the potential differences in the quality measures across urban and rural areas.

Further, the insurer fixed effects control for any feature of the insurance company that may affect the HEDIS rates but does not vary over time. An example of such an effect could be that an insurer has a relatively strong pediatric practice that allows it to excel in the well-child measures. Also, the insurer fixed effects will control for any characteristics of their enrollees that do not vary over the sample period. The combination of market and insurer fixed effects largely mitigates a concern that has been previously raised that differences in HEDIS rates are largely due to differences in enrollee characteristics.[15]

Regressions are estimated for each of the 15 HEDIS rates. The applicable control variables are included in each. For example, for the women's health measures, the number of OB/GYN providers per enrollee is included as an explanatory variable.

The full resulting estimating equation is:

$$(1)\quad \begin{aligned} Hedis_{i,j,t} = {} & b_0 + b_1 MLR_{i,j,t} + \\ & b_2' EnrolVars_{i,j,t} + \\ & b_3' PhysVars_{i,j,t} + \\ & b_4' HedisCalcVars_{i,j,t} + \\ & h_i + m_j + e_{i,j,t} \end{aligned}$$

in which *i* indexes the insurance company, *j* indexes the market, and *t* indexes the year. The *h* and *m* terms represent the insurer and market fixed effects, respectively, while the *e* term is the random error. The standard errors are estimated using a robust estimator.

**Results**

Figure 4 presents the regression results. Each cell in the table refers to a different regression. The rows correspond to the HEDIS rate used as the dependent variable, while the columns differ in the inclusion of fixed effects and control variables. The number in each cell is the coefficient estimate of the MLR variable. For instance, the 18.0 value in the upper left corner of the table is the point estimate of the increase in the prenatal HEDIS rate given a 1-unit increase in the MLR in the regression in which fixed effects and control variables are not included.

What may be most striking about Figure 4 is the lack of statistical significance of many of the coefficients. The lack of statistical significance is especially profound for the chronic conditions measures, in which only one of the 20 coefficients is significant. The coefficients in the child health and women's health measures also generally lack statistical significance. Although there is some significance in the estimates in column I for these measures, column V shows that there is none when the full model is estimated.

However, there is a notable exception to this pattern in the behavioral health section. The coefficients in the regressions for follow-up within seven days of mental health hospitalization are all statistically significant. Further, the coefficients in the 30-day version of this measure are all marginally insignificant, with p-values less than 0.10.

The estimates indicate a somewhat surprising relationship. Increases in the MLR are associated with decreases in this HEDIS measure. In the full model, a one-standard deviation in the MLR is associated with an approximately 2.4 point decrease in the

**Figure 4. Regression Results of Ordinary Least Squares Model to Predict Quality of Care**

| HEDIS Measure | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Child health | | | | | |
| Prenatal care (n=248) | 18.0* | −3.9 | 10.1 | −5.7 | −10.4 |
| Well-child visits (0–15 months) (n=244) | 25.7* | −7.3 | 18.8 | −7.4 | 4.0 |
| Well-child visits (3–6 years) (n=251) | −9.8 | −15.7 | −5.3 | −15.9 | −5.4 |
| Childhood immunizations (n=220) | 51.0** | 11.0 | 34.1** | 7.7 | −10.8 |
| Women's health | | | | | |
| Breast cancer screening (n=290) | 5.9 | 0.8 | 1.3 | −0.7 | −5.1 |
| Cervical cancer screening (n=259) | −1.9 | 2.0 | −2.3 | 1.9 | 1.5 |
| Postpartum care (n=238) | 41.0** | 10.7 | 27.3* | 4.2 | −1.8 |
| Behavioral health | | | | | |
| Antidepressants (acute phase) (n=265) | −7.3 | −7.0 | −7.7 | −3.0 | −0.8 |
| Antidepressants (cont. phase) (n=265) | −5.6 | −5.3 | −6.3 | −3.9 | −0.9 |
| Mental hlth follow-up (7 days) (n=206) | −44.6** | −35.4** | −30.9** | −23.1* | −23.9* |
| Mental hlth follow-up (30 days) (n=206) | −29.2* | −26.0 | −20.1 | −21.6 | −25.4 |
| Chronic conditions | | | | | |
| Appropriate asthma medications (n=306) | −14.8 | −9.9 | −10.2 | −10.9 | −2.6 |
| Cholesterol mngt: screening (n=205) | −7.0 | −6.2 | −11.7 | −1.2 | 5.3 |
| Diabetes care (n=232) | 6.1 | −4.7 | 3.0 | −2.6 | −6.0 |
| High blood pressure mngt (n=175) | −7.1 | −12.8* | −10.1 | −6.7 | −1.1 |
| Insurer dummies | | X | | X | X |
| Market dummies | | | X | X | X |
| Control variables | | | | | X |

*Note:* Displayed values are the coefficients on the MLR variable in regressions of the specified HEDIS measure. Additional covariates include the number of enrollee months, percent of enrollees in group and Medicare coverage, percent of board-certified physicians, percent of enrollees in relevant population, number of primary and specialist physicians per enrollee, and whether the measure was calculated administratively and based on HMO enrollees only.
*P<.10; **P<.05; ***P<.01.

HEDIS rate. This change represents an approximately 5 percent decrease as measured at the sample average.

## Discussion

An important feature of the PPACA is a provision that mandates that insurers' MLRs not fall below certain thresholds. However, little is known as to whether there is an association between an insurer's MLR and the quality of care that it provides. The above findings indicate that for the vast majority of the included quality measures, there is no relationship.

The results in this analysis are arguably counterintuitive. Upon first glance, one

may expect that higher MLRs reflect higher investment in quality by insurance companies and, thus, would be associated with higher quality measure scores. However, the statistical insignificance of the vast majority of the regression coefficients suggests that there is no link between MLRs and quality. Further, the mental health hospitalization follow-up regressions indicate a negative relationship between quality and MLR, which is inconsistent with earlier findings.[7]

Unfortunately, the simple regression approach employed here cannot shed light into the channels between MLRs and quality. However, one potential implication of these results is that although the provision may accomplish the goal of reducing consumer health care expenditures by lowering premiums, the MLR provision in the PPACA may not necessarily lead to higher quality care.

**Limitations**

There are a number of important limitations to this analysis. First, the data employed are specific to Texas. Texas is a large state with a diverse population, therefore, the data may not be representative of national conditions. Also, as described earlier, the HEDIS measures are process-based measures. There are other important dimensions in the quality of care received by enrollees. The above results may not apply to these other types of quality measures. Finally, the analysis was limited to measures that were present for all years in the *Guide to Texas HMO Quality* reports. Other HEDIS measures that cover important types of care may have relationships with MLRs that may differ from the above results.

There are also internal data issues that may impact the findings. First, the rates are only reported by insurers with 5,000 or more enrollees. Thus, the findings here may not apply to smaller insurers. Second, as noted above, there are missing observations for some insurers in some market/years. There is no obvious reason to expect it; however, these missing observations may bias the results.

Arguably most important, the regressions only indicate associations and do not necessarily reflect causality. Given the simple reduced form estimation, it is not possible to determine whether changes in an insurance company's MLR cause changes in the quality of care provided. Nevertheless, the associations can be informative to policymakers in suggesting the potential effects of the MLR provision in PPACA.

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# Impact of Changes in Medicare Payments on the Financial Condition of Nonprofit Hospitals

***Dhiman Das***

This article examines the implications of revenue changes on the financial condition of nonprofit hospitals. I examine these implications empirically by studying the effect of changes in Medicare payments in the Balanced Budget Act of 1997. Using data from the Healthcare Cost Report Information System maintained by the Centers for Medicare & Medicaid Services between 1996 and 2004, I show that even though revenue fell significantly, resulting in a decline in profitability, hospitals did not significantly change their capital structure and use of capital. An important implication of this is a higher cost of borrowing for these hospitals, which can affect future capital accumulation and viability. Nonprofit hospitals are a very important part of the healthcare delivery system in the United States. Medicare patients constitute the single largest segment of their revenue sources. Understanding the consequences of the changes in Medicare reimbursement on hospital finances is useful in framing future revisions of Medicare payments.

**Key words:** *Medicare reimbursements, nonprofit hospitals, Balanced Budget Act.*

## Introduction

In this article, I study how changes in revenue from Medicare affect the financial condition of nonprofit hospitals. The US Congress introduced the Balanced Budget Act (BBA) in 1997 to control the growing budget deficit. The main instrument of the reduction in public expenditures was a cut in expenditures under the Medicare program, mainly through a planned reduction in reimbursement to hospitals from 1998 to 2002. The BBA[1] presents an interesting case through which to explore the effect of changes in Medicare reimbursements on nonprofit hospitals.

Earlier studies on the effect of Medicare payment changes concentrated on the reduction in cost or the changes in profitability of the affected hospitals. Cost and profitability, though relevant in understanding the behavior of a financial entity, may not address all aspects of the financial condition of hospitals, most of which are nonprofits.[2] Friedman and Shortell[3] observed that the association between hospital costs and the number of their competitors highlights that competition among the nonprofit hospitals is primarily based on "amenities and quality rather than price."[4] Quality of care is an important objective that nonprofit hospitals tend to optimize[5] and often it translates to higher cost. Hadley, Zuckerman, and Feder[6] found that though hospitals with higher historic costs may react to a revenue reduction by reducing costs, they may not continue that

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*J Health Care Finance* 2013; 40(1):11–39

in the long run. In addition, though profit is an important element of any financial entity, because of the nondistributional constraints,[7] profit may not represent all aspects of the financial organization of nonprofit hospitals. In a study[8] on factor analysis of financial and operational ratios of nonprofit hospitals during the late 1990s and early 2000s, I found that capital structure is responsible in explaining a higher proportion of variation in performance measures for nonprofit hospitals than profitability. This finding requires that a study on the impact of revenue changes on nonprofit hospitals look at its effect on a broader range of financial characteristics.

I used hospital financial data from the Centers for Medicare & Medicaid Services (CMS) over the period 1996 to 2004. I considered a panel data regression model to identify the within-hospital effects of the policy change. I found that even after a significant decline in revenue, which resulted in a significant decline in profitability, the hospitals did not alter their use of debt or new capital investments. The result has an important implication for the future viability of nonprofit hospitals. Declining revenue and profitability are likely to affect the extent to which these hospitals can support debt. Since this study observes that these hospitals do not change their use of debt and the main use of debt capital and capital expenditures, such changes will likely affect the cost of capital adversely and make future access to capital difficult. Evidence of the higher cost of capital can be seen in the decline in the rating of municipal bonds issued by hospitals, which is the single most important instrument of raising capital in the post BBA period both for new[9] and outstanding issues.[10] Difficulty in access to capital will affect the nonprofit hospitals' viability by lowering their capacity to make necessary capital investments and remain competitive.

Hospitals are an important part of the healthcare delivery system in United States. In 2000, Hospital in-patient (IP) and outpatient (OP) services accounted for 60 percent of total Medicare expenditures. Other post-acute care provided by hospital-based units accounted for another 15 percent.[11] As for the hospitals, Medicare and other public programs constitute a very important source of their revenue. In 1997, Medicare, Medicaid, and other public programs constituted approximately 65 percent of the payer mix, with Medicare being the single largest payer, accounting for about 33 percent of gross patient revenue.[12] This makes the financial condition of these hospitals very sensitive to revenue changes from public payers.

Medicare outlays have increased dramatically since its inception. In the coming decades, it is expected to rise even more due to a rapid increase in the number of beneficiaries with the aging of the "baby boom" generation.[13] To keep such a program operational, it is likely that there would be similar steps to control spending growth in the future. This study highlights the need to recognize the effect of these changes on hospitals while planning future Medicare cuts.

## Medicare Payments to Hospitals and the Balanced Budget Act

To understand the nature of revenue reduction introduced in the BBA, it is necessary to know how Medicare reimburses hospitals. When the BBA was introduced, hospital in-patient (IP) services were reimbursed under a Prospective Payment System (PPS).[14] The amount of reimbursement was based on the diagnosis and treatment

category of an admission called the Diagnosis Related Group (DRG). CMS assigns each DRG a weight based on the resources required to treat an average patient in that DRG. For each case, the weight is multiplied by a dollar amount (also called the conversion factor) reflecting the average national DRG payment to obtain the amount due to the hospital for that particular case. CMS updates the conversion factor annually based on the inflation rate of a market basket (MB) of comparable inputs used in the production of the hospital services.

Additionally, hospitals receive geographic and hospital-specific adjustments to account for the variation found in operating cost differences. The main geographic adjustment to the DRG rate is in the form of the area wage index to reflect the difference in labor costs. The payment system adjusts nonlabor costs based on a cost-of-living index. Hospital-specific payments include payments for teaching hospitals that receive additional adjustments to support their teaching and research programs (Direct Medical Education (DME)), as well as the indirect cost of education (Indirect Medical Education, (IME)). Hospitals treating a higher proportion of indigent patients, called disproportionate share hospitals (DSH), receive additional payments to offset revenue losses due to the high costs of treating those patients. Hospitals also receive other adjustments for unusually expensive cases or lengthy admissions, called outliers. In addition, hospitals receive additional payments to cover bad debts in case the beneficiaries fail to pay off coinsurance and deductibles.

Until the introduction of the BBA, the hospital out-patient (OP) services and services rendered at other post-acute care sites, like skilled nursing facilities (SNFs), home health agencies (HHAs), long-term care units (LTCs), and inpatient rehabilitation facilities (IRFs), attached to the hospitals were paid on a reasonable-cost basis based on the charges reported by the hospitals to Medicare.

Congress introduced the BBA to rationalize payments to hospitals and to reduce future burdens on the Medicare Trust Fund. CMS (previously the Health Care Financing Administration) introduced the hospital IP PPS in early 1980s and PPS for IP capital costs in early 1990s. The differences in payment systems across different hospital departments resulted in significant growth in the use of OP and other post-acute care sites. CMS was still paying them on a cost basis, and that contributed to Medicare cost growth for hospital reimbursement. Spending on post-acute care rose from 3 percent of Medicare Part A spending in the mid-1980s to 26 percent of Part A spending by the mid-1990s as hospitals adjusted to the new payment incentives and reorganized the delivery system from in-patient to more out-patient and post-acute care settings.[15] Guterman[16] points out that although the annual rate of growth in Medicare payments per enrollee during the period 1990–96 was 5.2 percent for IP services, it was 9.9 percent for OP, 23.2 percent for SNF, and 27.9 percent for HHA. Between 1990 and 1996, the number of OP visits increased by 46 percent, the number of hospital-based SNFs rose by 82 percent, and the number of hospital-based HHAs rose by 68 percent.

Hospital IP spending grew at a slower rate than other departments in the pre-BBA period, yet it accounted for the largest share of Medicare expenditure and projected expenditure increases.[17] Some authors[18] also point out that the initial PPS overlooked

the fact that the hospitals were overpaid for those services because of unbundling to other departments. Newhouse and Wilensky[19] observed that the payment system gave incentives to the teaching hospitals to increase their revenue by employing more full-time residents. The DSH program paid additional amounts per patient for hospitals treating a higher share of Medicaid and SSI patients, even though there was no significant evidence in support of the fact that these patients were more expensive to treat. Later it was justified as a "safety net" for uncompensated care, even though there was no provision in the payment to account for uncompensated care.[20]

Policymakers became more concerned about some of these anomalies in payments in 1997, when the Trustees of the Medicare's Hospital Insurance (HI) Trust Fund, which finances Medicare Part A payments, projected that the fund would be insolvent by 2001.[21] Since its inception in the 1960s, Medicare has a history of "insolvency led cuts."[22] Measures like the introduction of the hospital IP Prospective Payment System (PPS) in 1983 were successful in bringing down annual Medicare spending growth without any adverse effect on the quality of services (for example, in access to care, mortality, etc.) provided by hospitals.[23] This provided the basis for the introduction of a wide range of payment changes in the form of the BBA to reduce the growth of Medicare expenditures.

## Main Changes in Reimbursement to Hospitals Under the BBA

BBA planned to control the growth of Medicare expenditures by rationalizing payments in already existing PPSs and by introducing PPS payments in departments where there were none (Table 1). In the following, I discuss some of the important changes affecting hospitals.[24]

The main change[25] with a direct effect on hospital revenue in the BBA was the reduction in payment for IP services. Instead of its usual updating of the "conversion factor" by the changes in prices of the market basket of inputs, BBA kept the payment for 1998 at the 1997 level. Yearly updates were set at less than the market basket by 1.9 percent for 1999, by 1.8 percent for 2000, and by 1.1 percent for years thereafter. In addition, it was felt that the initial Capital Prospective Payment System (CPPS) that started in fiscal year 1992 failed to account properly for the cost of capital and possibly overpaid the hospitals. The BBA reduced IP capital payments by 15.7 percent in 1998 and another 2.1 percent for 1999 to 2002. The BBA also reduced outpatient payments by eliminating overpayments[26] for ambulatory surgery, radiology, and diagnostic services.

Two other important changes within the PPS system were the reductions in payments for teaching hospitals and disproportionate share hospitals. The BBA reduced IME adjustments by 29 percent (from 1.89 during 1988–97 to 1.37 by 2002[27]) and limited DME for residents to the number of full-time equivalents (FTEs) at 1996. The BBA also reduced an additional amount for DSH payments by increments of one percent starting from 1998. To account for uncompensated care, the BBA introduced new reporting standards to better address the problem.

The BBA also introduced a reduction in payments due to bad debts. The amount of bad debt allowed was reduced by 25 percent for 1998, 40 percent for 1999, and 45 percent for subsequent years. The BBA

**Table 1. Changes in BBA and BBRA**

| BBA | | BBRA | |
|---|---|---|---|
| **Provisions relating to Part A** | | | |
| **IPD updates** | | | |
| 0.0% | in 1998 | Increase payments by | |
| MB-1.9% | in 1999 | 4% | in 2001 |
| MB-1.8% | in 2000 | 4% | in 2002 |
| MB-1.1% | in 2001 | Sole community hospitals receive full market basket update for 2001 | |
| MB-1.1% | in 2002 | | |
| **Capital payments** | | | |
| Reduced inpatient capital payment rates by | | No change | |
| 15.7% | in 1998 | | |
| 2.1% | in subsequent years | | |
| **DSH payments** | | | |
| Additional payment amount reduced in by | | Reduction changed to | |
| 1% | in 1998 | 3% | in 2001 |
| 2% | in 1999 | 4% | in 2002 |
| 3% | in 2000 | 4% | in 2001 |
| 5% | in 2002 | | |
| **Elimination of IME and DSH payments attributable to outlier payments** | | No Change | |
| **PPS exempt services** | | | |
| Proposed PPS for | | Enhanced payments for | |
| Inpatient rehabilitation services | | Long Term Care and Psychiatric care | |
| Long term care hospitals | | Refinement for Inpatient rehabilitation services | |
| **Skilled Nursing facilities** | | | |
| PPS introduced in 1999 | | | |
| Interim payment system till PPS is in effect | | Increase in payments during transition to PPS | |
| **Transfer Provisions** | | No Change | |
| Reduced payment to ten high-volume DRGs for short stay patient transferred to post-acute care | | | |
| **Others** | | | |
| Reduction in payment for enrollee bad debt | | No Change | |
| 25% | in 1998 | | |
| 40% | in 1999 | | |
| 45% | in subsequent years | | |

*Continued ...*

**Table 1. Changes in BBA and BBRA *(Continued)***

| BBA | BBRA |
|---|---|
| **Provisions relating to Part B** | |
| **OP services** | |
| Elimination of formula driven overpayment | No Change |
| PPS introduced in 1999 | Additional transition fund |
| New OPPS updated at | |
| MB-1% for 2000-2002 | |
| Volume expenditure caps | Two year delay in implementation |
| **Others** | |
| Reduction in payment for durable medical equipment and other equipment | Temporary increase in payments |
| **Both Part A and B** | |
| **Home Health service** | |
| PPS introduced in 2000 | Delayed to 2001 |
| Interim payment system till PPS is in effect | |
| **Graduate Medical Education** | |
| **IME adjustment factor lowered from 7.7%** | Increased IME adjustment factor |
| to 7% in 1998 | to 6.5% in 2000 |
| to 6.5% in 1999 | 6.25% in 2001 |
| to 6% in 2000 | 5.50% for subsequent years |
| to 5.5% for 2001 to 2004 | |
| **DME** | |
| Limitation on number of residents as basis of DME payments to 1996 level | Use of national average payment methodology based on 1997 per resident amount |

*Source:* The Balanced Budget Act of 1997 (Pub. L. No. 105-33); The Balanced Budget Refinement Act of 1999 (Pub. L. No. 106-113).

also removed IME and DSH adjustments for outlier payments, which resulted in further reductions in reimbursements for teaching hospitals.

The most important structural change in the nature of Medicare payments came with the introduction of PPS in all remaining hospital activities. The BBA introduced (or proposed steps toward the introduction of) PPS in almost all remaining departments. The three important PPS changes proposed in the BBA included PPS for OP services, SNFs, and HHAs. The BBA created the new PPS using a set of relative weights, a conversion factor, and an adjustment for geographic differences in input prices using the IP PPS wage index and outlier payments as in IP services. The relative weights and conversion factors are to be reviewed annually by the CMS. All the new PPSs covered both operating and capital costs. In all cases, the BBA introduced a new payment system

to address the higher cost growth for the interim period. The two other PPSs involving LTCs and IRFs became effective only after the initial BBA period (1998–2002).

**Impact of the BBA on the Hospitals**

According to Guterman,[28] the reduced payments over the five-year period represented a 9.1 percent reduction in total Medicare program spending and a decrease in the annual growth rate from 8.8 percent before to 5.6 percent after the BBA. Evaluation of the policy changes by MedPac[29] showed that the BBA was successful in balancing the federal budget and reducing Medicare's growth rate. It was reported in an HCIA-Sachs study[30] that the projected reduction in Medicare payments would postpone the insolvency of the Trust Fund until 2025.

A number of studies,[31] however, projected that these changes would result in a decline in the financial condition of the affected hospitals. A report by the Lewin Group[32] projected that the BBA would reduce total Medicare payments to hospitals by $76.7 billion (10.7 percent) between 1998 and 2002. Hospital associations also raised concerns about other provisions of the BBA, such as new payment changes for teaching hospitals and additional payments received by disproportionate share hospitals, which could pose additional challenges for these types of hospitals.

The Balanced Budget Refinement Act (BBRA) of 1999 introduced some changes in the initial BBA to address concerns about excessive reduction in payments, which reduced the burden of the revenue cuts or postponed implementation of some of the programs. According to the Lewin Group report,[33] the BBRA was projected to restore approximately $5.4 billion of BBA reductions between 2000 and 2002. This represented 9.7 percent of the $55.4 billion payment reduction that would have occurred for that period. The net reductions due to BBA amounted to approximately $71.3 billion, or 10.1 percent, between 1998 and 2002. The report also projected that the BBA changes would result in negative Medicare margins for a large proportion of hospitals. Further, the report projected the Medicare margins to be higher after BBRA but still negative. The report found that the nonprofit hospitals in general, teaching hospitals, and disproportionate share hospitals, were likely to bear a higher burden of the Medicare cuts.

The most important change, introduced in the BBA, affecting hospitals was the reduced payment updates for hospital IP services between 1998 and 2002, which was supposed to affect all types of hospitals. It also introduced new prospective payment systems for all other post-acute care services, making virtually all Medicare payments to hospitals prospective rather than based on reported costs. By paying at a national average rate under PPS, the high-cost hospitals are encouraged to reduce their expenses, while the low-cost hospitals, which retain the difference between their actual costs and reimbursements for their services, are encouraged to spend more on patient care. The OP PPS affected all hospitals, though the other PPSs affected only hospitals that had those facilities.

Studies on the effect of the initial introduction of IP PPS on the financial condition of hospitals[34] found that the introduction of PPS in IP departments resulted in different types of behavior among hospitals based on the extent of their financial pressure[35] as a result of the new payment policy. PPS resulted in slower growth of costs, but

hospitals with higher levels of financial pressure did most of the cost containment. Hospitals with higher fiscal pressure increased efficiency by reducing average lengths of stay and increased Medicare discharge more compared to the ones with lesser pressure. On the other hand, despite the higher level of reduction in their expenses, these hospitals saw a higher reduction in their profitability.[36] By the fifth year of the introduction of the IP PPS, the majority (57 percent) of the hospitals were earning negative profit in their IP department as initial cost containment dissipated in later years resulting in lower margin on average.[37]

Hadley, Zuckerman, and Feder[38] found that the variation in costs among hospitals could be explained by inefficient use of resources, identified by higher length of stay and excess capacity, and identified by low occupancy rates. However, even controlling for length of stay and occupancy rate, they found variations in financial pressure due to factors that the PPS already adjusts. For example, they found that hospitals' location, teaching activities, etc., determined the extent of their financial pressure at the beginning of the IP PPS.

Hadley, Zuckerman, and Feder[39] pointed out the possible limitations of approaches to increasing efficiency using revenue cuts. They argued that expenditure increases in later years of IP PPS could indicate that either the hospitals had already reached an optimal level of efficiency or were reluctant to introduce further cost reduction. Later studies by Younis, Rice, and Barkoulas,[40] observing profitability in the post-PPS period, also found profitability to vary with some of these factors, for example, the geographic region, teaching status, size, etc. However, they argued that the variation also might be due to factors other than the PPS. For instance, they argued that part of the explanation for the geographic variation was the variation in HMO penetration and differences in the regulatory environment, apart from differences in wage and capital costs.

Even though some of these studies found that IP PPS had an effect on profitability and changes in cost and expenditures, a study by Sloan, Morrisey, and Valvona[41] found no significant change in investments due to the IP PPS changes during the initial years. The most important reason for that was that even though Medicare paid IP operational costs on a prospective basis, it still paid capital costs on a cost basis. Wedig *et al.*,[42] showed that the cost-based reimbursement for capital costs without any particular reimbursement when income generated from operations is used for capital expenditures (as in the case of for-profits), created a bias for debt financing among nonprofit hospitals. Further, such payments also reduced the cost of borrowing by reducing the risk associated with debt financing as they both decrease the risk of bankruptcy and increase income in case there is a bankruptcy.

A study by Acemoglu and Finkelstein[43] on capital use by nonprofit hospitals during that period found that partial PPS due to PPS in noncapital costs and cost-based payments for capital costs affected the relative cost of capital and promoted further capital investment by hospitals. As an evidence of substitution, they found that the changes in Medicare payment policies led to decrease in average length of stay as a result of the substitution of high-tech capital equipment for a more labor-intensive hospital stay. They also found evidence of the adoption of a number of new medical technologies and changes in the skill composition of employees.

In 1991, Medicare introduced the Capital Prospective Payment System (CPPS) under which Medicare reimbursed capital expenditures based on national average costs adjusted for hospital-specific and area-specific adjustments. Given the importance of the Medicare payments, it is expected that CPPS may have resulted in a decline in capital expenditure or the use of debt. Barniv, Danvers, and Healy[44] argue that separating cost and payments introduced a higher level of risk in new capital expenditure as well as reduced the possible number of new investment options that hospitals can carry out. In addition, they pointed out that the annual variability of the update factor leads to higher risk-adjusted cost of capital. Barniv, Danvers, and Healy[45] and Lynch[46] found that capital expenditure and long-term debt went down significantly as a result of the change in payment policies.

The BBA is different from earlier changes and it came into effect under different circumstances. First, the BBA introduced more than one PPS. The BBA also included a significant reduction in preexisting PPS, which was further affected by specific reductions in payments to teaching and disproportionate share hospitals and changes due to bad debts and reductions in capital payments. Bazzoli *et al.*,[47] pointed out that the BBA was introduced at a time when hospitals faced significant cost pressure, particularly due to labor costs. In addition, some of the factors that facilitated cost cutting after IP PPS, such as declines in admission[48] or the use of labor and its cost,[49] did not fall during this period as they did after IP PPS in the early 1980s.

Policy changes in the BBA can affect financial and performance measures in different ways. Through its effect on revenue, it can directly affect the hospitals' profitability. To address changes in revenue stream, hospitals may make changes in their use of resources. They may also try to improve their market share by making new investments. BBA thus provides an opportunity to observe the manner in which nonprofits alter their financial organization as a result of changes in revenue and the extent to which such revenue changes affect their use of capital.

Because of the already-existing CPPS, the BBA was not expected to introduce any differential in the relative cost of labor and capital as was observed by Acemoglu and Finkelstein[50] since the capital is now paid on a prospective payment basis. However, there is the direct effect of the reduction in capital PPS reimbursement, which can potentially affect all hospitals, and not necessarily only hospitals with higher capital costs. The reduction in IP payments and the uncertainty of the revenue stream as a result of PPS in other departments may introduce higher levels of variability in operating income and reduce the hospitals' ability to access capital or the amount of debt that they can support, as suggested by Barniv, Danvers, and Healy[51] and Lynch.[52]

Bazzoli *et al*.,[53] compared the effects of the BBA on operations of nonprofit hospitals between the years 1996 and 1999 and found that, despite the cost cutting by the high-cost hospitals, these hospitals had a decline in margins following BBA. The decline in margins, however, was not restricted to only the high-cost hospitals as observed in the initial years of IP PPS.

**Empirical Strategy**

Most of the earlier studies[54] exploring the effect of the changes in Medicare revenue policy on the financial conditions of

hospitals concentrated on either the change in costs and efficiency of resource use—as it was the desired objective—or on the change in profitability as an overall measure of the financial performance. In case the study focused on the effect of changes in capital payments,[55] they looked at change in the use of debt and new investments.

In this study, instead of focusing only on profitability, I concentrate on all the financial characteristics, which may explain the variation in the financial and operational performance of these hospitals. I identify the important financial characteristics using the results of a factor analysis of financial and operational ratios of nonprofit hospitals during the period 1996 to 2004.[56] The factor analysis identifies five factors representing five aspects of operational and financial performance of nonprofit hospitals consistently over a nine-year period around the time the BBA became effective. The first factor showing high correlation with ratios related to capital structure explains close to two-fifths of the variation (common variance) in performance measures. The second factor showing high correlation with ratios related to profitability explains close to one-fifth of the variation in performance measures. The remaining three factors, identified by ratios related to revenue, liquidity, and operational efficiency respectively, explains approximately a third of the variation.

I consider ratios, which are highly correlated with these factors in the factor analysis, as a proxy for these factors. For the two most important factors, capital structure and profitability, I choose two ratios each, while for the remaining three factors, I choose one ratio each. As a proxy for capital structure, I consider equity financing,[57] which is the ratio of fund balance[58] to total debt, and the ratio of total liabilities to total assets. I consider return on asset, which is a ratio of net income to total assets, and total margin, which is a ratio of net income to total revenue as a proxy for profitability. As a proxy for revenue, I consider the ratio of total revenue to total assets. As a proxy for liquidity, I consider current ratio, which is the ratio of current assets to current liabilities. Finally, I consider hospital occupancy rate, which is the ratio of average daily census to number of beds, as a proxy for operational efficiency.

I further look into the main use of debt capital for these firms—capital investments, because of the importance of capital structure observed in the factor analysis. Hospitals need to make continuous investments to keep up with technological innovations and the changing nature and volume of their services. An important part of the efficiency gains during the initial implementation of PPS in IP departments came from the introduction of labor-saving technology, which reduced average length of stay and increased occupancy rates. Such investments are also necessary to maintain and improve the hospitals' market share. Improved market share also affects their ability to attract patients and physicians and thereby improve revenue and the quality of their services. Besides, improved market share also helps them to obtain better rates from private payers and suppliers of inputs. In this study, I look at changes in capital labor ratio and as a consequence of those changes, changes in length of stay as they reflect substitution of capital-intensive methods for labor-intensive methods. Further, I also consider logarithms of capital and labor expenditures separately to identify the source of changes in capital labor ratio if any.

**Identification Strategy**

Because of the extent of the changes, I hypothesize that revenue cuts under the BBA will affect the different aspects of financial and operational ratios outlined above. Other factors may also affect their financial and operational performance because of the nature of the operations of hospitals.

The most important cause of variation in financial performance among hospitals is that the hospitals evolve under unique market conditions due to a number of factors, such as the hospitals' past revenue sources and socio-economic and demographic condition of the market in which they operate. These, according to Friedman and Shortell,[59] result in hospitals differing in their financial and operational targets.

Most of the earlier studies on the effect of policy changes on a hospital's financial condition, looked at only two periods of data[60] and attempted to address these systematic differences in hospitals' characteristics by controlling for factors like hospital size, teaching status, urban/rural location, census region, etc. In this study, I follow a strategy similar to Acemoglu and Finkelstein[61] by considering a panel data of hospitals over a nine-year period around the time of the implementation of the BBA. I use hospital fixed effects to separate the effect of the variation among hospitals due to time invariant characteristics resulting from their unique circumstances.

The BBA became effective in a period of some important structural changes in the hospital sector with consequences on their revenue and expenditures. First, there were changes in the payments received from the private payers particularly due to the rise and subsequent decline in the influence of health management organizations (HMOs) in the health care market during the period.[62] Another related event with consequences on hospital costs and revenues was the surge in hospital mergers and consolidation throughout the 1990s.[63] Both these events were not coincidental with the introduction of the BBA, and their effect varied with the specific conditions of the market in which the hospitals operated. So it is reasonable to assume that the hospital fixed effects control for these factors.

In addition to hospital-specific factors, there were other changes affecting the entire sector during the period. According to the CMS,[64] the period saw rising input costs for supplies, pharmaceuticals, devices, and equipment, as well as medical liability insurance, with implications on their finances. The single most important source of cost pressure facing the hospitals was the rising wage costs, which tripled between 1997 and 2001 fueled mainly by a nursing shortage. To separate the effect of the above factors from the impact of revenue changes brought about the BBA, I control for year fixed effects.

There were refinements to the BBA and BBRA, which revised some of the payment changes. In addition, the different changes in the BBA did not become effective at the same time but were introduced on different dates between 1998 and 2002. However, the main change in terms of its coverage and prospective reduction in payments became effective from the beginning of 1998. Other changes became effective at different times, and their effect on hospitals' finances varied with their nature of services. In this study, I do not attempt to separate the different channels through which and different phases in which hospitals financial conditions were affected. Rather, in this study I look at the

overall cumulative effect of all the changes that followed since the implementation of new payment methods under the BBA. I use a dummy variable that equals one for all cost reports with a fiscal year begin date after the BBA became effective (January 1, 1998) to identify the effect of the BBA on financial and operational ratios.

The problem of using a post-BBA dummy variable to identify the before and after effect of the BBA, is that it assumes that all hospitals are equally affected by the revenue changes. This, however, is not the case as hospitals differ in the effect of Medicare changes by the difference in their Medicare share of business. Thus, the effect, if any, of a BBA cut will be more severe on hospitals with a higher share. To account for this, instead of the BBA dummy, I consider an interaction term of the BBA dummy with the Medicare share, measured by the proportion of Medicare inpatient beds to total beds. Hospitals, on the other hand, may change their Medicare share of business in the face of changes in reimbursement. To address the possible effect of reimbursement on the Medicare share of business, I consider the pre-BBA value of the Medicare share in the following specification.

$$y_{it} = \alpha_i + \gamma_t + \beta\,(\text{Post BBA} * \text{Medicare Share}_{1997}) + \varepsilon_i \quad (1)$$

where, $y_{it}$ is the performance measure, $\alpha_i$s are hospital fixed effects and $\alpha_t$s are year fixed effects. Post-BBA is a dummy variable taking the value of one for all years after 1998.

Acemoglu and Finkelstein[65] point out that the above identification strategy is valid under the assumption that all hospitals with the same level of Medicare share react similarly to policy change. Particularly when the Medicare share itself is related to the dependent variable, then it will be difficult to separate the change in dependent variables due to the BBA from the effect of the Medicare share. To test the validity of the assumption that there is no systematic difference, following Acemoglu and Finkelstein,[66] I further consider the following specification as a pre-specification test

$$y_{it} = \alpha_i + \gamma_t + \beta\,(\text{Post BBA} * \text{Medicare Share}_{1997}) + (d_{1997} * \text{Medicare Share}_{1997}) + \varepsilon_i \quad (2)$$

where $d_{1997}$ is a dummy variable for the year 1997. If is not significantly different from zero, then it will be difficult to attribute the coefficient of (Post BBA * Medicare Share1997) purely to changes in the BBA.

A final problem with the above specification is that the hospitals may be at different stages relative to their desired financial targets. In that case, regression to mean may affect the identification of the effect of the BBA. To address that issue, I consider an additional set of variables using the base year (1996) value of the dependent variable interacted with year dummies for all years 1996 to 2004 (with the base year interaction term omitted for collinearity) in the following specification

$$y_{it} = \alpha_i + \gamma_t + \beta\,(\text{Post BBA} * \text{Medicare Share}_{1997}) + (d_{1997} * \text{Medicare Share}_{1997}) + \theta_2\,(d_{1997} * y_{i1996}) + \ldots + \theta_9\,(d_{2004} * y_{i1996}) + \varepsilon_i \quad (3)$$

where $y_{i1996}$ is the value of the dependent variable in 1996 for the *i* hospital. To account for potential serial correlation of observations from the same hospital, I adjust for standard errors by clustering them within each hospital.[67]

**Data and Overview of Changes in Financial and Operational Ratios due to the BBA**

The main data source for this study is the Healthcare Cost Report Information System (HCRIS) data files maintained by CMS. All hospitals are required to maintain these cost reports with CMS. These reports are used widely by the participants in the healthcare market as well as in academic research despite some data problems, mainly due to the lack of suitable alternatives.[68] In this study, I focus exclusively on HCRIS (2552-96) data for private, nonprofit, acute-care hospitals over the period 1996 to 2004. The BBA changes became effective over the period January 1998 until end of fiscal year 2002. Thus, the study period considers data on hospitals extending from two years before to two years after the initial BBA. In addition, to make sure that the analysis can pick up the effect of the BBA correctly, only those providers are retained for which data is available for all years. Thus, the study follows 1,653 hospitals over the nine-year period. However, due to cases of possible errors in reporting, I remove extreme values by removing the top and bottom one percent of the variables considered. This results in slightly fewer hospitals per year in the regression analysis.

I obtain most of the variables necessary to construct the ratios used in the regression specification from Worksheet G of the cost reports. The Medicare utilization rates (Medicare days as a proportion of total inpatient days), used as a measure of the Medicare share of business and the occupancy rates, are obtained from the historical impact files provided by CMS. The CMS data does not directly give information for capital expenses. Acemoglu and Finkelstein[69] set up an alternate measure as a proxy for capital expenditures. They argue that, under the assumption that the costs of capital and equipment do not vary systematically across hospitals with different Medicare shares, depreciation expenses could be considered as a good proxy for capital stock. Following their study, I use depreciation expenses as a proxy for capital expenditures and define capital labor ratio as the ratio of depreciation expense to total input expenses net of interest and depreciation expenses.[70]

Figure 1 through Figure 11 show the plots of the financial and operational ratios considered in this study over the years 1996 to 2004. The plots show the mean yearly values for the different ratios considered in this study. The plots also include separate sets of means for different hospital types, such as those with SNF, HHA, or teaching facilities and those classified as disproportionate share hospitals.

Among the ratios related to capital structure (Figure 1, Figure 2), equity financing started falling since 2000 and stabilized at a lower level by 2002. Total liabilities to total assets went up about the same time as equity financing declined. In either case, hospitals with additional facilities like SNFs and HHAs did better on average while hospitals receiving DSH payments and teaching hospitals were worse than the average.

The most dramatic change since 1998 can be seen in the decrease in profitability (Figure 3, Figure 4) compared to the pre-BBA levels. Income both as a proportion of revenue and assets declined until 2002 (the end of the BBA) after which it showed some improvements. However, the rates were still lower than 1998 and significantly lower than

**Figure 1. Trend in Average Equity Financing of Nonprofit Hospitals**

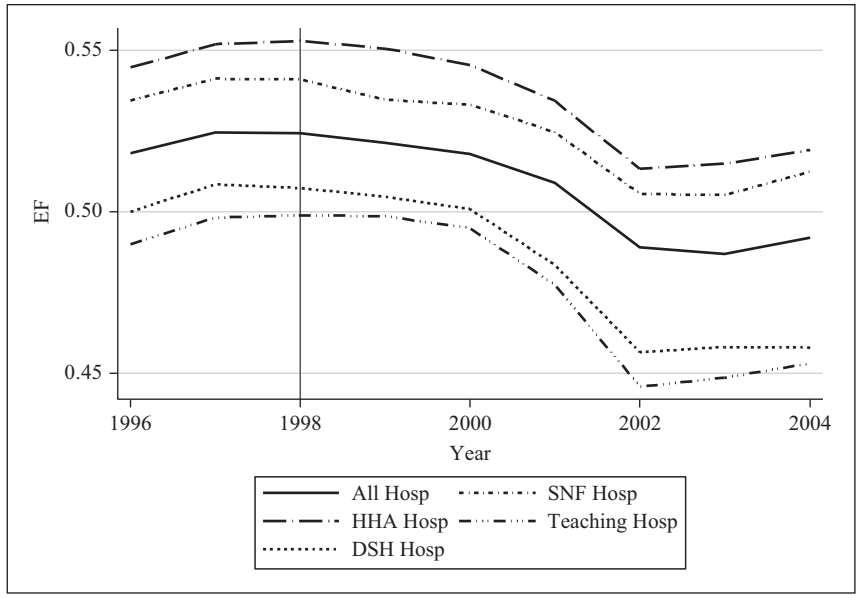



**Figure 2. Trend in Average Total Liabilities to Total Asset of Nonprofit Hospitals**

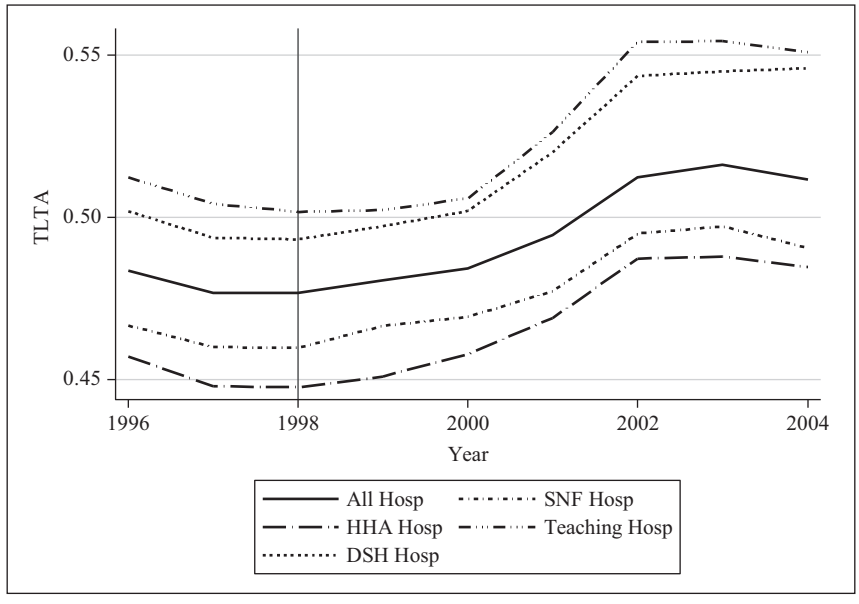


**Figure 3. Trend in Average Return on Asset of Nonprofit Hospitals**

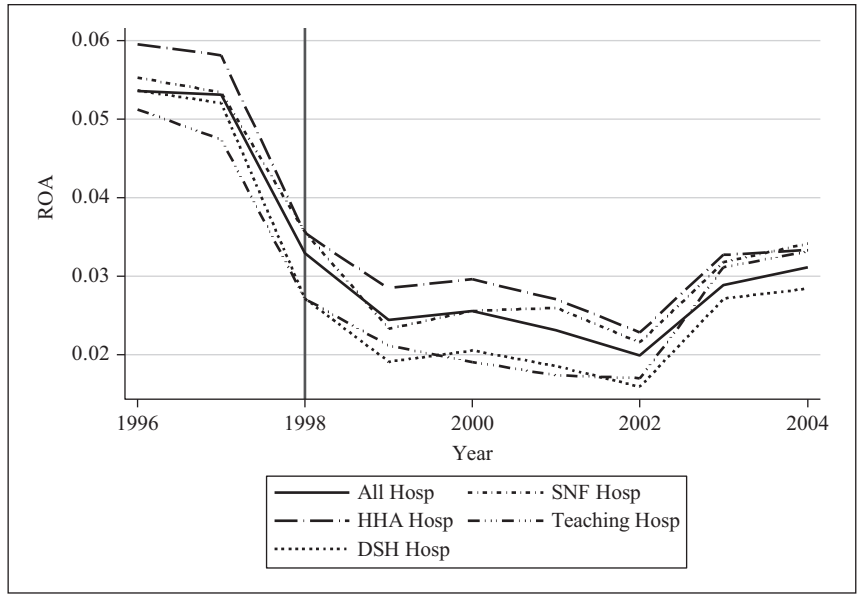
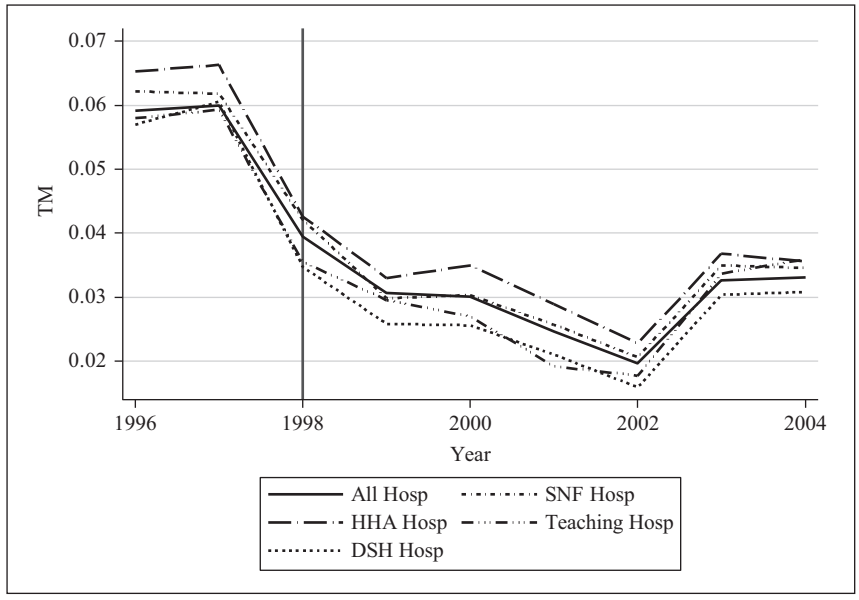



**Figure 4. Trend in Average Total Margin of Nonprofit Hospitals**



the pre-BBA period. Once again, hospitals receiving DSH payments and teaching hospitals were worse on average though the condition of the teaching hospitals has improved faster than others since 2003.

A rather interesting result can be seen in the case of the revenue ratio (Figure 5). Total asset turnover, which is the ratio of total revenue to total assets, shows a steady rise since 1998, which would imply that the average use of the asset increased significantly over the period. One of the important problems that is usually associated with nonprofit hospitals is their excess capacity. The graph here shows a steady increase in the use of assets among all hospital types continuing from before the introduction of the BBA, implying an overall decline in excess capacity. The hospitals receiving DSH payments and teaching hospitals made the maximum number of improvements. A similar trend can also be seen in overall occupancy rate (Figure 7). The occupancy rates show an increase since 2000 compared to the falling rates before 1998. The teaching hospitals and those receiving DSH payments also show similar trends though their levels were higher than the average hospital. The liquidity ratio (Figure 6) shows some fluctuation in 1999 and 2000 but, on average, it remains steady over the period. Hospitals with additional facilities show higher averages compared to teaching hospitals and those receiving DSH payments.

Finally, Figure 8 shows the plot of capital labor ratio over the period. The ratio on average generally is steady until 2001 after which there was a sudden dip between 2001 and 2003. The dip in the capital labor ratio

**Figure 5. Trend in Total Asset Turnover of Nonprofit Hospitals**

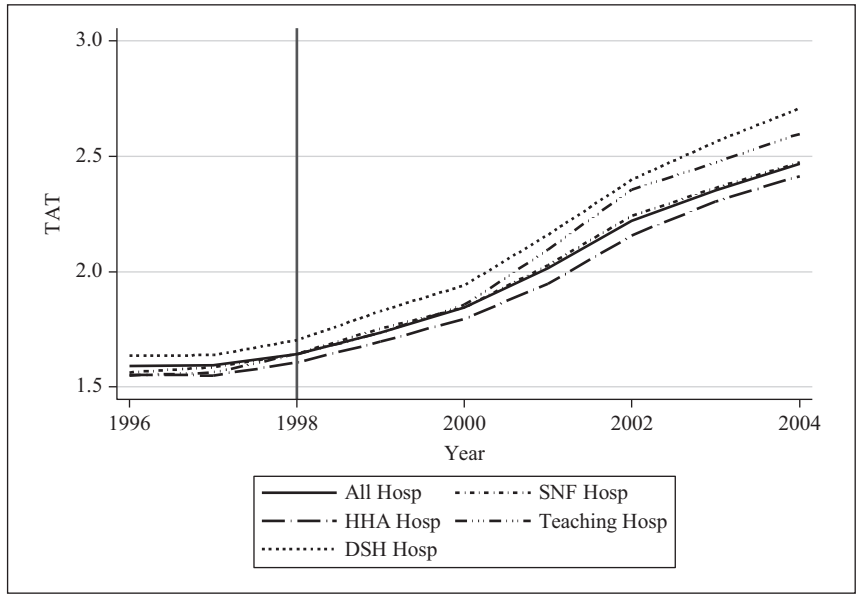


**Figure 6. Trend in Average Current Ratio of Nonprofit Hospitals**

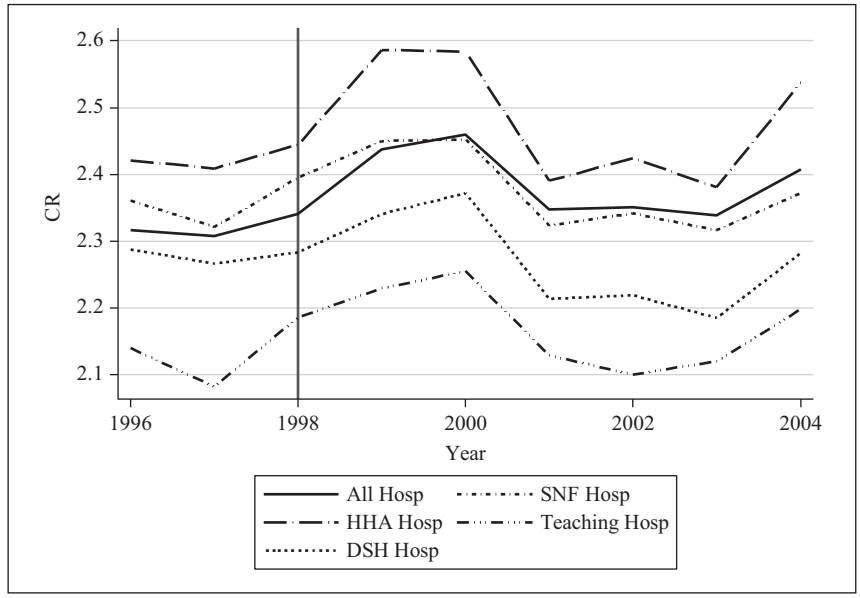



**Figure 7. Trend in Average Occupancy Rate of Nonprofit Hospitals**

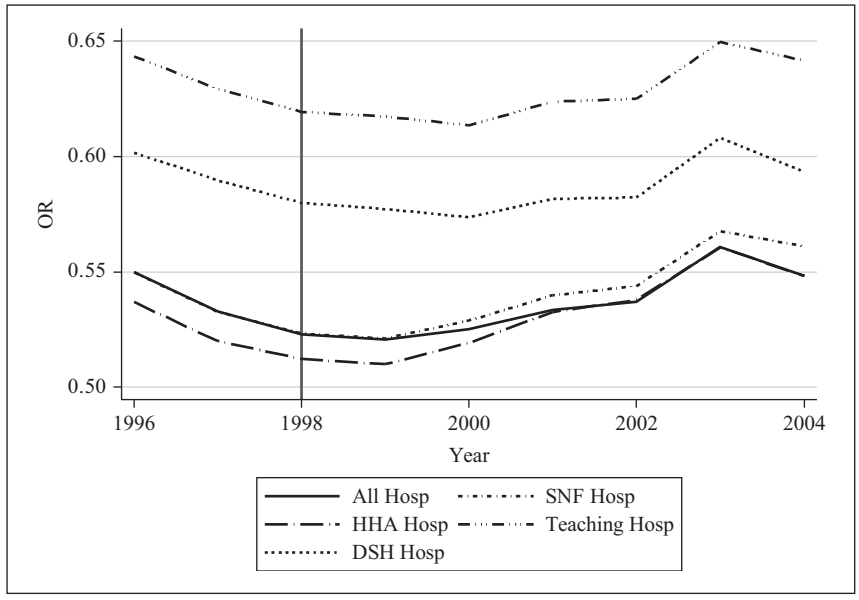


**Figure 8. Trend in Average Capital Labor Ratio of Nonprofit Hospitals**

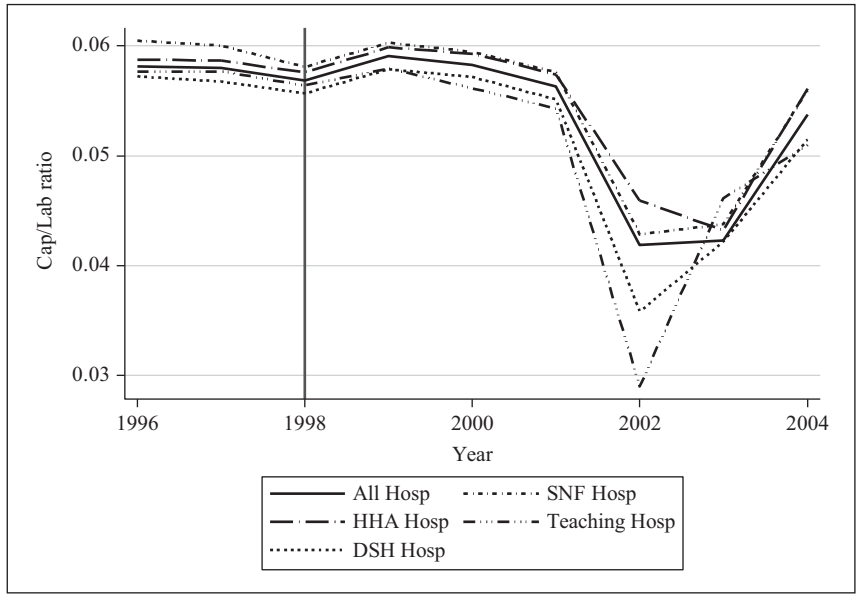



**Figure 9. Trend in Logarithm of Capital Expense of Nonprofit Hospitals**

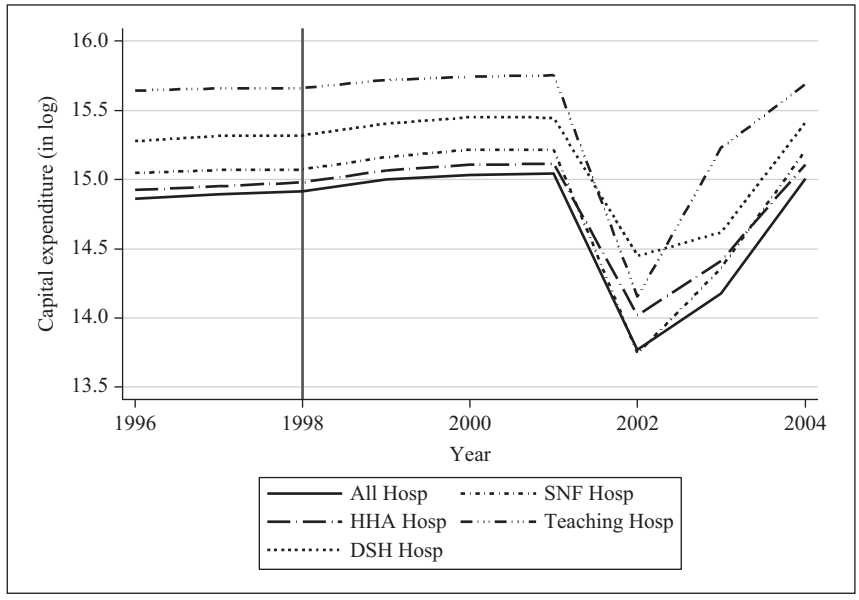


**Figure 10. Trend in Logarithm of Labor Expense of Nonprofit Hospitals**

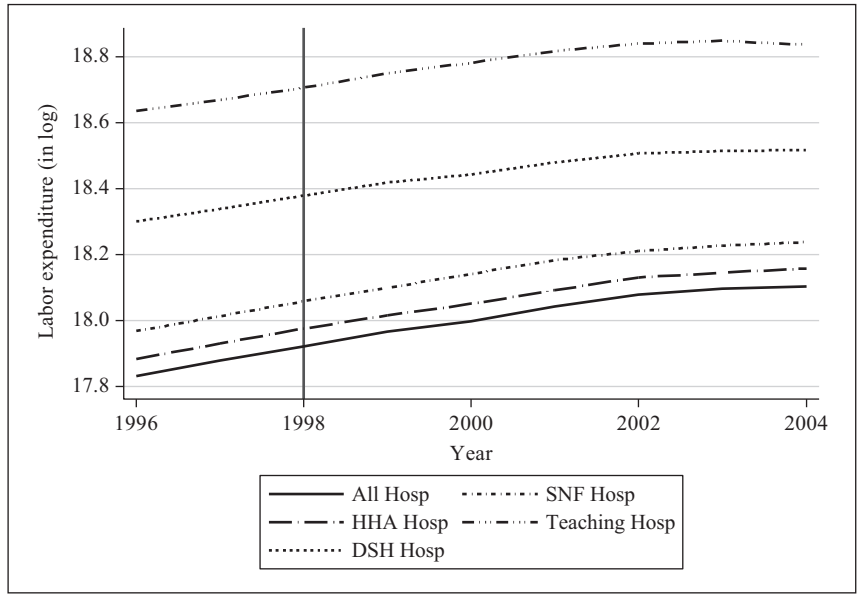
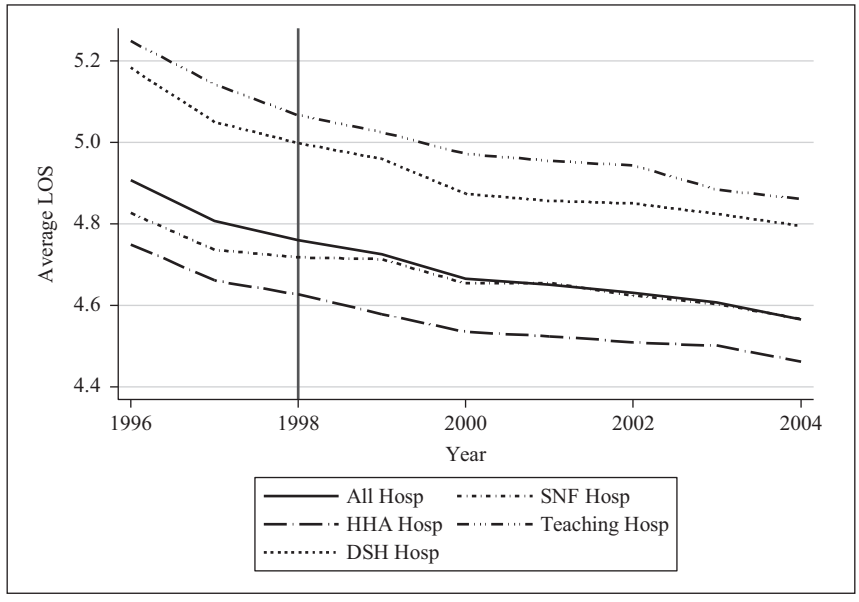



**Figure 11. Trend in Average Length of Stay of Nonprofit Hospitals**



came about mostly from a fall in depreciation expense (Figure 9) as operational expense (Figure 10) shows a steady increase over the period. Average length of stay also fell consistently during the period, indicating a higher use of capital-intensive technology (Figure 11). The teaching hospitals and those receiving DSH payments had a lower than average decline in capital expenditures, but their capital labor ratio declined more for their average labor costs.

Similar changes in the ratios can be seen when pre- and post-BBA values are compared (Table 2). In term of averages before and after the BBA, equity financing shows a significant 3.8 percent decline in the post-BBA period while the ratio of total liabilities to total assets rose by approximately 4.4 percent. As in the plots, profitability measures show a significant 48 percent decline in the post-BBA period compared to the period before the BBA. Total activity ratio rose by approximately 29.5 percent while liquidity rose by approximately 2.9 percent though not apparent from the plots shown earlier. Occupancy rate, which declined initially before rising from 2000, shows no significant change in the means.

As for changes in capital intensity, both capital and labor expenditures increased over the period. However, labor expenditures grew faster than capital on average resulting in a 1.9 percent decline in capital labor ratio. Notwithstanding the slight decline in capital labor ratio, average length of stay declined by approximately 3.4 percent.

However, these changes over time are also likely to be due to specific characteristics and conditions of the hospital or changes other than the BBA that affected

**Table 2. Effect of BBA on Financial and Operational Ratios**

| | Pre BBA | | Post BBA | | Pre-Post Diff | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | in Mean | |
| Equity financing | 0.52 | 0.24 | 0.5 | 0.27 | 0.02 | *** |
| Total liabilities to Total assets | 0.48 | 0.24 | 0.5 | 0.27 | –0.02 | *** |
| Return on assets | 0.05 | 0.07 | 0.03 | 0.08 | 0.02 | *** |
| Total margin | 0.06 | 0.07 | 0.03 | 0.07 | 0.03 | *** |
| Total asset turnover | 1.59 | 0.74 | 2.06 | 1.16 | –0.47 | *** |
| Current Ratio | 2.32 | 1.54 | 2.38 | 1.69 | –0.07 | * |
| Occupancy rate | 0.54 | 0.16 | 0.54 | 0.16 | 0 | |
| Capital-Labor Ratio | 0.06 | 0.02 | 0.06 | 0.02 | 0 | * |
| *log* Capital | 14.86 | 1.24 | 14.99 | 1.27 | –0.13 | *** |
| *log* Labor | 17.84 | 1.01 | 18.04 | 1 | –0.2 | *** |
| Length of Stay | 4.82 | 1.2 | 4.66 | 1.08 | 0.16 | *** |

*** Significant at 99.9% level of confidence

** Significant at 99% level of confidence

* Significant at 95% level of confidence

the hospitals' financial conditions during the period. Besides, a small group of hospitals with very high or very low values may dominate them. In the following, I look at the results of the regression analysis, which isolates the average within hospital changes due to the BBA.

## Results of Regression on Effect of BBA on Hospital Finances

The regression estimates on the effect of the financial and operational measures and capital intensity, etc., are in Table 3 and Table 4. The regression result shows

**Table 3. Regression Results of the Effect of BBA on Financial and Operational Ratios**

| Dependent variable | Equity financing | Total liabilities to Total assets | Return on assets | Total margin | Total asset turnover | Current Ratio | Occupancy rate |
|---|---|---|---|---|---|---|---|
| Post BBAx MedicareShare97 | 0.01 | –0.02 | –0.02* | –0.01* | –0.20*** | 0.22* | –0.02*** |
| | (0.77) | (–1.19) | (–2.29) | (–2.37) | (–3.73) | (2.03) | (–3.52) |
| Year97xMedicare Share97 | –0.02 | 0.02 | 0.02 | 0.03 | –0.06 | 0.03 | 0.04** |
| | (–0.71) | (0.83) | (1.25) | (1.96) | (–0.55) | (0.11) | (2.84) |
| Dependent Variable96xYear97 | –0.08*** | –0.08*** | 0.21*** | –0.33*** | –0.17*** | –0.32*** | –0.07*** |
| | (–4.93) | (–4.14) | (3.90) | (–8.58) | (–5.33) | (–6.27) | (–7.71) |
| Dependent Variable96xYear98 | –0.13*** | –0.13*** | –0.00*** | –0.50*** | –0.15** | –0.38*** | –0.13*** |
| | (–5.73) | (–5.20) | (–41.30) | (–12.73) | (–3.15) | (–8.47) | (–11.15) |
| Dependent Variable96xYear99 | –0.14*** | –0.15*** | –0.00*** | –0.57*** | –0.12** | –0.37*** | –0.14*** |
| | (–5.20) | (–5.72) | (–97.82) | (–14.69) | (–2.63) | (–8.10) | (–11.42) |
| Dependent Variable96xYear00 | –0.16*** | –0.16*** | –0.00*** | –0.65*** | –0.10* | –0.49*** | –0.28*** |
| | (–5.01) | (–5.28) | (–74.36) | (–17.18) | (–2.28) | (–11.25) | (–16.51) |
| Dependent Variable96xYear01 | –0.20*** | –0.21*** | –0.00*** | –0.81*** | –0.07 | –0.55*** | –0.29*** |
| | (–5.76) | (–5.97) | (–69.43) | (–20.64) | (–1.40) | (–13.19) | (–16.68) |
| Dependent Variable96xYear02 | –0.22*** | –0.23*** | –0.00*** | –0.95*** | –0.05 | –0.57*** | –0.31*** |
| | (–6.23) | (–6.55) | (–76.95) | (–22.39) | (–0.89) | (–13.01) | (–18.00) |
| Dependent Variable96xYear03 | –0.25*** | –0.26*** | –0.00*** | –0.77*** | –0.02 | –0.62*** | –0.29*** |
| | (–6.52) | (–6.99) | (–56.64) | (–19.46) | (–0.37) | (–14.14) | (–16.16) |
| Dependent Variable96xYear04 | –0.29*** | –0.31*** | –0.00*** | –0.81*** | 0.01 | –0.63*** | –0.33*** |
| | (–7.28) | (–7.75) | (–77.94) | (–21.63) | (0.11) | (–12.60) | (–17.28) |
| Constant | 0.04*** | 0.96*** | 0.15*** | 0.14*** | 3.53*** | 1.76*** | 0.61*** |
| | (3.71) | (88.91) | (90.75) | (104.30) | (65.37) | (56.75) | (312.36) |
| N | 14352 | 14357 | 14413 | 14374 | 14322 | 14189 | 14543 |

t-values in parenthesis; Coefficients for fixed effects not reported
*** Significant at 99.9%, ** Significant at 99% level, * Significant at 95% level

**Table 4. Regression Results of the Effect of BBA on Capital Use and Length of Stay**

| Dependent variable | Capital-Labor Ratio | *log* Capital | *log* Labor | Average Length of Stay |
|---|---|---|---|---|
| Post BBAxMedicareShare97 | 0.00 | –0.03 | –0.02 | –0.19*** |
| | (1.63) | (–0.67) | (–1.64) | (–3.56) |
| Year97xMedicare Share97 | 0.00 | 0.00 | 0.03 | 0.13 |
| | (0.11) | (0.06) | (1.33) | (1.18) |
| Dependent Variable96xYear97 | –0.26*** | –0.08** | –0.00 | –0.15*** |
| | (–8.14) | (–3.09) | (–1.09) | (–8.11) |
| Dependent Variable96xYear98 | –0.35*** | –0.10*** | –0.01** | –0.22*** |
| | (–11.83) | (–3.82) | (–3.10) | (–10.46) |
| Dependent Variable96xYear99 | –0.42*** | –0.11*** | –0.01** | –0.30*** |
| | (–14.00) | (–4.47) | (–2.62) | (–13.47) |
| Dependent Variable96xYear00 | –0.49*** | –0.13*** | –0.01** | –0.33*** |
| | (–17.79) | (–4.88) | (–2.81) | (–13.43) |
| Dependent Variable96xYear01 | –0.52*** | –0.12*** | –0.02** | –0.36*** |
| | (–18.31) | (–4.76) | (–2.91) | (–13.10) |
| Dependent Variable96xYear02 | –0.39*** | –0.13* | –0.02** | –0.39*** |
| | (–3.34) | (–2.11) | (–3.20) | (–13.22) |
| Dependent Variable96xYear03 | –0.73*** | –0.16** | –0.02*** | –0.42*** |
| | (–6.54) | (–3.26) | (–3.33) | (–12.80) |
| Dependent Variable96xYear04 | –0.57*** | –0.13*** | –0.02** | –0.44*** |
| | (–16.31) | (–5.07) | (–3.18) | (–13.56) |
| Constant | 0.07*** | 15.72*** | 18.28*** | 4.49*** |
| | (237.26) | (1236.03) | (4197.96) | (357.34) |
| N | 10334 | 10550 | 14368 | 14699 |

t-values in parenthesis; Coefficients for fixed effects not reported
*** Significant at 99.9%, ** Significant at 99% level, * Significant at 95% level

that the BBA did not significantly affect measures of capital structure, which explains the majority of the variation in performance of nonprofit hospitals. On the other hand, both measures of profitability—return on assets and total margin—declined significantly.

An interesting result can be seen when we compare the plot over time of the revenue ratio with the result of the regression analysis. Revenue ratio measured by total asset turnover declined significantly after controlling for hospital and year fixed effects even though earlier we saw a steady

overall increase in Figure 5. Thus, although the overall utilization of assets by the hospital sector improved over the period, within hospitals the ratio declined significantly due to the decline in revenue compared to the pre-BBA period.

The related measure of occupancy, which did not show significant change in overall mean, shows a significant decline in the regression results. However, the regression specification also shows that occupancy rate is systematically related to Medicare share, which implies it is difficult to argue that the specification used here is able to identify change in occupancy rate.

The liquidity ratio, which does not show any overall changes in the plot, but a significant increase in the overall averages, also shows a significant positive effect. Thus, hospitals on average may have improved their liquidity to sustain the unchanged level of capital structure observed above.

The change in capital labor ratio is predictable from the results in capital intensity. The main use of debt capital is to finance new investment, and since that was unaffected by the changes in the BBA, use of capital was also unaffected after the BBA. Capital labor ratio showed no significant changes; neither do use of capital and labor. Use of capital is also evident in declining average lengths of stay.

Table 5 and Table 6 summarize the effect of the BBA changes. If we assume that total asset did not change significantly within hospitals, the BBA resulted in a 7 percent decrease in revenue for an average hospital. This resulted in a 17 percent decrease in return on assets and a 12 percent decrease in total margin. Capital structure remained unchanged as liquidity increased by 5 percent. Finally average length of stay (LOS), which is usually linked to the use of capital-intensive technologies, declined by 2.2 percent.

Finally, I look at the effect of the BBA on particular types of hospitals, which were specifically affected by the BBA changes. Table 7 and Table 8 show the marginal effects of the policy change on an average hospital, controlling for mean reversion and systematic pre-BBA differences. As in

**Table 5. Marginal Effect of BBA on Financial and Operational Ratios**

| Dependent variable | Coefficient (i) | Medicare Share for 1997 (ii) | Change for average hospital (iii) = (i) x (ii) | Pre-BBA average (iv) | Percent Change due to BBA (v) = (iii) / (iv) | |
|---|---|---|---|---|---|---|
| Equity financing | 0.011 | 0.554 | 0.006 | 0.524 | 1.12% | |
| Total liabilities to Total assets | –0.016 | 0.554 | –0.009 | 0.477 | –1.88% | |
| Return on assets | –0.015 | 0.554 | –0.009 | 0.051 | –16.78% | * |
| Total margin | –0.012 | 0.553 | –0.007 | 0.057 | –11.98% | * |
| Total asset turnover | –0.200 | 0.553 | –0.110 | 1.587 | –6.96% | *** |
| Current Ratio | 0.218 | 0.554 | 0.121 | 2.317 | 5.21% | * |
| Occupancy rate | –0.024 | 0.548 | –0.013 | 0.537 | –2.45% | |

*** Significant at 99.9%, ** Significant at 99% level, * Significant at 95% level

**Table 6. Marginal Effect of BBA on Capital Use and Length of Stay**

| Dependent variable | Coefficient (i) | Medicare Share for 1997 (ii) | Change for average hospital (iii) = (i) x (ii) | Pre-BBA average (iv) | Percent Change due to BBA (v) = (iii) / (iv) | |
|---|---|---|---|---|---|---|
| Capital-Labor Ratio | 0.002 | 0.555 | 0.001 | 0.058 | 2.17% | |
| *log* Capital | –0.031 | 0.550 | –0.017 | 14.86 | –0.12% | |
| *log* Labor | –0.023 | 0.554 | –0.013 | 17.84 | –0.07% | |
| Length of Stay | –0.189 | 0.549 | –0.104 | 4.825 | –2.15% | *** |

*** Significant at 99.9%, ** Significant at 99% level, * Significant at 95% level

**Table 7. Marginal Effect of BBA on Financial and Operational Ratios for Different Hospital Types (Only Significant Effects Reported)**

| Dependent variable | Hospital Type | Coefficient (i) | Medicare Share for 1997 (ii) | Change for average hospital (iii) = (i) x (ii) | Pre-BBA average (iv) | Percent Change due to BBA (v) = (iii) / (iv) |
|---|---|---|---|---|---|---|
| Total liabilities to Total assets | DSH | –0.05 | 0.507 | –0.023 | 0.492 | –4.74% |
| Return on assets | SNF | –0.02 | 0.558 | –0.010 | 0.052 | –19.32% |
| Return on assets | DSH | –0.02 | 0.506 | –0.012 | 0.052 | –23.35% |
| Total margin | Teaching | –0.02 | 0.511 | –0.010 | 0.057 | –17.93% |
| Total margin | DSH | –0.02 | 0.506 | –0.009 | 0.058 | –14.83% |
| Total asset turnover | SNF | –0.26 | 0.559 | –0.143 | 1.574 | –9.06% |
| Total asset turnover | HHA | –0.25 | 0.557 | –0.141 | 1.551 | –9.12% |
| Total asset turnover | DSH | –0.21 | 0.506 | –0.108 | 1.62 | –6.65% |
| Current Ratio | Teaching | 0.41 | 0.51 | 0.211 | 2.098 | 10.06% |
| Occupancy rate | SNF | –0.04 | 0.558 | –0.021 | 0.537 | –3.84% |
| Occupancy rate | HHA | –0.03 | 0.549 | –0.014 | 0.524 | –2.62% |

*** Significant at 99.9%, ** Significant at 99% level, * Significant at 95% level

the case of all hospitals, none of the capital structure ratios was affected by the BBA, with the exception of total liabilities to total assets in case of disproportionate share hospitals, which showed a 4.7 percent decline after controlling for mean reversion.

Among profitability ratios, return of asset went down by 19 percent for SNFs and 23 percent for disproportionate share hospitals while total margin went down by 17.8 percent for teaching hospitals and 14.9 percent for disproportionate share hospitals

**Table 8. Marginal Effect of BBA on Capital Use and Length of Stay for Different Hospital Types (Only Significant Effects Reported)**

| Dependent variable | Hospital Type | Coefficient (i) | Medicare Share for 1997 (ii) | Change for average hospital (iii) = (i) x (ii) | Pre-BBA average (iv) | Percent Change due to BBA (v) = (iii) / (iv) |
|---|---|---|---|---|---|---|
| Capital-Labor Ratio | Teaching | 0.01 | 0.512 | 0.003 | 0.057 | 5.39% |
| Capital-Labor Ratio | DSH | 0.01 | 0.508 | 0.004 | 0.057 | 6.24% |
| Length of Stay | SNF | –0.19 | 0.559 | –0.108 | 4.762 | –2.27% |
| Length of Stay | HHA | –0.22 | 0.549 | –0.118 | 4.682 | –2.52% |
| Length of Stay | Teaching | –0.17 | 0.501 | –0.085 | 5.16 | –1.65% |

*** Significant at 99.9%, ** Significant at 99% level, * Significant at 95% level

respectively. Total asset turnover went down significantly in the case of both SNF and HHA hospitals by 9.1 percent while in the case of disproportionate share hospitals it went down by 6.7 percent

Among other significant effects, liquidity went up by 10 percent for teaching hospitals, probably because of higher funding following the BBRA. As in the case of all hospitals, occupancy rates show decline in case of some hospitals, but it is difficult to attribute the changes to the BBA for the significant effect of difference in pre-BBA Medicare share on the dependent variable. Unlike the average hospital, teaching and disproportionate share hospitals show a significant increase of 5.3 percent and 6.2 percent respectively for capital labor ratio. SNF, HHA, and teaching hospitals show significant decrease in average length of stay of 2.3 percent, 2.5 percent, and 1.0 percent respectively.

## Conclusions and Implications

In this article, I study the effect of the BBA revenue changes on the financial condition of nonprofit hospitals. I use a broad array of financial and operational characteristics to explore the effect of the revenue changes, beyond summary measures like profitability. Controlling for hospital specific and other time varying factors, I find that the BBA resulted in approximately a 7 percent decline in revenue for an average nonprofit hospital. The revenue reduction significantly affected the total margin of these hospitals, which went down by 12 percent. This decline in profitability occurred despite an improvement in operational efficiency, which can be seen in a significant reduction in average length of stay. These results corroborate the earlier observation by Bazzoli *et al.*,[71] on profitability and efficiency, which looked at the first year of post-BBA data.

The changes in revenue did not significantly alter the hospitals' use of capital or their capital structure. This finding corroborates earlier observations regarding the use of capital after policy changes. A study by Sloan, Morrisey, and Valvona[72] observed that Medicare payment policies did not significantly affect new capital investment by hospitals in the 1980s when the IP PPS was first introduced. Even before the introduction

of the BBA, CMS set PPS updates lower than the market basket updates to control growth in Medicare expenditures in most of the years.[73] Cutler[74] found that in the 1990s, although these reductions in payment translated to some cost cutting by hospitals, there was no evidence of the hospitals' reducing acquisition of capital-intensive technologies. In this study I additionally find that the same is true for the use of debt, which is an important element in financing these capital investments.[75]

The study also finds that hospitals, which had new PPS under the BBA, like those with SNF and HHA facilities, fared better than average (except that one measure of profitability fell for SNFs). On the other hand, hospitals with additional facilities covered under the preexisting IP PPS, such as those with teaching facilities, did worse than average, even though their finances improved after additional payments in the BBRA. Disproportionate share hospitals were the worst affected because of the step towards the dismantling of the DSH payments.

A decline in profitability has important implications on the financial condition of nonprofit hospitals as well as their operations, specifically on their ability to access additional debt for new investment. A firm's ability to raise capital externally is strongly related to its financial conditions, particularly the variation in its operating revenue.[76] Given the evidence that hospitals on average did not change their use of debt capital, it may have affected their cost of borrowing. Difficulty in capital access, due to higher cost of capital, may affect the future viability of these hospitals. In addition, increases in capital expenditures may result in additional burdens on future Medicare outlays. Acknowledging the importance of the use of debt capital in these hospitals is critical for future policy changes.

## REFERENCES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# Antipsychotic Polypharmacy Prescribing Patterns and Costs in the Florida Adult and Child Medicaid Populations

***Edmund R. Becker, Robert J. Constantine, Marie A. McPherson, and Mary Elizabeth Jones***

The rapid growth in the use of antipsychotic medications and their related costs have resulted in states developing programs to measure, monitor, and insure their beneficial relevance to public program populations. One such program developed in the state of Florida has adopted an evidence-based approach to identify prescribers with unusual psychotherapeutic prescription patterns and track their utilization and costs among Florida Medicaid patients. This study reports on the prescriber prescription and cost patterns for adults and children using three measures of unusual antipsychotic prescribing patterns: (1) two antipsychotics for 60 days (2AP60), (2) three antipsychotics for 60 days (3AP60), and (2) two antipsychotics for 90 or more days (2AP90). We find that over the four-year study period there were substantial increases in several aspects of the Florida Medicaid behavioral drug program. Overall, for adults and children, patient participation increased by 29 percent, the number of prescriptions grew by 30 percent, and the number of prescribers that wrote at least one prescription grew 48.5 percent, while Medicaid costs for behavioral drugs increased by 32 percent. But the results are highly skewed. We find that a relatively small number of prescribers account for a disproportionately large share of prescriptions and costs of the unusual antipsychotic prescriptions. In general, the top 350 Medicaid prescribers accounted for more than 70 percent of the unusual antipsychotic prescriptions, and we find that this disparity in unusual prescribing patterns appears to be substantially more pronounced in adults than in children prescribers. For just the top 13 adult and children prescribers, their practice patterns accounted for 11 percent to 21 percent of the unusual prescribing activity and, overall, these 13 top prescribers accounted for 13 percent of the total spent on antipsychotics by the Florida Medicaid program and 9.3 percent of the total expenditure by the state for all drugs. Our findings suggest that a strategy to monitor and ensure patient safety and prescribing patterns that targets a relatively small number of Medicaid providers could have a substantial benefit and prove to be cost effective.

**Acknowledgments:** This research was supported by Contract No. MED112 from the State of Florida Agency for Health Care Administration (Constantine, PI).

**Key words:** *Medicaid prescribing practices, antipsychotic polypharmacy, prescribing costs, costs of antipsychotic medications.*

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*J Health Care Finance* 2013; 40(1):40–67


## Introduction

The development of the second generation of antipsychotics or the atypical antipsychotics (AAPs) had initially been hailed as a significant advance in the ability of prescribers to successfully treat many advanced psychiatric conditions like schizophrenia, severe depression, psychotic agitation, bipolar disorder, and other indications with antipsychotic drugs. Although not without serious side effects, the benefits of using AAP had been touted as having broader efficacy

across a spectrum of conditions, higher responder rates, fewer extrapyramidal side-effects, efficiency in patients with refractory disease, lower risk of suicides, better functional capacity, and an improved quality of life.[1] More recent evidence has questioned the extent of the benefits of the second generation AAPs and the degree to which their efficacy and tolerance are superior to the first generation of antipsychotics.[2,3,4,5,6,7,8,9,10]

Nevertheless, the subsequent growth in the use of AAP medications in the treatment of mental disorders has been substantial. From 1997 to 2004, the Agency for Healthcare Research and Quality (AHRQ) reports that the total expenditures on prescribed antipsychotics tripled, rising from $1.3 billion to $4.1 billion. During this same period, AHRQ estimated that the total number of purchases of antipsychotics increased from 17.4 million to 24.5 million and the total number of patients purchasing an antipsychotic medication rose from 2.2 million people to 3.4 million people. In addition, AHRQ noted the average per purchase drug expenditure for an antipsychotic more than doubled during this period, going from $76.10 to $168.20.[11]

Given the rapid growth in the use of antipsychotics and the high costs associated with antipsychotics, an area of major concern has been the prescribing patterns by both mental health and non-mental health providers that require the concurrent use of antipsychotic medications.[12,13] Although in many clinical situations the use of more than one psychotropic medication from the same or a different class is indicated,[14,15] policymakers and researchers are concerned that there are patients receiving psychiatric medication combinations (polypharmacy) that are not well supported by clinical research.[16]

One increasingly common pattern of patient treatment for mental disorders is a written prescription that requires concurrent antipsychotic medications.[17,18,19,20] Support for the practice of prescribing concurrent antipsychotic medications is largely confined to case reports and open-label trials[21,22] rather than double-blind trials.[23] In a study of data from Medicaid enrollees diagnosed with schizophrenia, for example, there was a four-fold increase from 3.3 percent to 13.7 percent in the percentage of patients receiving antipsychotic polypharmacy between 1999 and 2005.[24] Concurrent antipsychotic polypharmacy is also common in mood disorders.[25] In a study of patients with treatment-refractory mood disorders discharged from the US National Institute of Mental Health Biological Psychiatry Branch, the percentage taking three or more concurrent antipsychotic medications increased from 3.3 percent in 1974–1979 to 43.8 percent in 1990–1995.[26]

The use of concurrent antipsychotic prescriptions has been of particular concern in the Florida Medicaid population for both adults and children because of the lack of evidence regarding their use.[27,28,29,30] According to guidelines from the Florida Medicaid Drug Therapy Management Program for Behavioral Health (MDTMP) their guidelines for comprehensive best practice regarding the use of psychotherapeutic drugs states:

> In view of the absence of evidence indicating its efficacy or safety, the use of antipsychotic combinations is discouraged and warrants critical scrutiny. Better proven treatment strategies … should be utilized before a trial of antipsychotic polypharmacy is implemented.[31]

Concerns raised by the Florida Medicaid program were realized when the death of a child was linked to the concurrent antipsychotic prescriptions, an event that generated national headlines.[32,33,34,35] In light of these growing concerns, our investigation focuses on three central questions related to the concurrent antipsychotic prescribing patterns and costs of Medicaid prescribers in the State of Florida.

- First, what are the trends of Medicaid psychotherapeutic prescriptions, prescribers, and patients and their costs for the four-year period July 2006 through June 2010?
- Second, what have been the antipsychotic prescribing patterns of Florida Medicaid prescribers who have written one or more unusual psychotherapeutic medication prescriptions for an adult or a child? More specifically, we ask, what have been the prescribing patterns for subgroups among these prescribers: (1) prescribers that have at least one patient with two or more unusual psychotherapeutic medications in every quarter, (2) adult and child antipsychotic prescribers representing the top 350 concurrent antipsychotic prescribers, and (3) a group limited to just 13 of the top antipsychotic prescribers.
- Finally, focusing on the costs of these antipsychotics, we ask what share of Florida total Medicaid drug expenditures are attributable to antipsychotic drugs and what portion of the total is attributable to the top 13 prescribers.

We begin by briefly describing the background on the Florida Medicaid program, the population it covers, and our methods of identifying Medicaid prescribers who write antipsychotic prescriptions that are not supported by the evidence-based research or should only be considered under extraordinary circumstances, especially in very young children. We then report our results for Florida Medicaid prescribers that have written at least one prescription that was not recommended and how different groups of Medicaid prescribers impact the total number of prescriptions being written for the adult and children populations. Next, we summarize the numbers of patients, prescriptions, providers, and costs of these prescriptions. Finally, we discuss the program and policy implications.

**The Florida Medicaid Context**

In Florida, the Agency for Health Care Administration (AHCA) develops and carries out policies related to the Medicaid program. Currently Medicaid serves nearly 3 million beneficiaries in Florida, more than half of whom are children and adolescents 20 years of age or younger. Estimated expenditures for Fiscal Year 2010-11 (July 2010 through June 2011) are approximately $20.2 billion.[36]

Most eligible individuals have the choice of enrolling in an HMO or in a fee-for-service program called MediPass in which care is managed by a designated primary care physician. There are currently 12 HMOs available to Medicaid enrollees; however, not all HMOs operate in all counties, resulting in limited choice in some of the more sparsely populated rural areas. HMOs are paid prospectively for the care of their enrollees using risk-adjusted capitation rates. These rates include all but a few highly specialized mental health services as well as all pharmacy services. In the MediPass program most mental health services

are also paid for using capitated arrangements with managed behavioral health care organizations that operate on an area basis (the state's 67 counties are grouped into 11 area offices that serve as local liaisons to providers). However, all pharmacy expenditures for MediPass enrolled individuals are paid for on a fee-for-service basis.

In addition to the traditional HMO and MediPass programs, two areas of the state with highly concentrated Medicaid populations, Broward County and Duval and surrounding counties, participate in Medicaid reform pilot projects in which most enrollees and most services are provided by managed care organizations that are paid on a capitated basis.

In June 2009, of the 2,453,040 million beneficiaries who were covered by the Medicaid program, 828,625 (33.8 percent) individuals were enrolled in HMOs, 828,448 (33.8 percent) in Medipass and 311,563 (12.7 percent) in Medicaid reform pilot sites. In addition, there are 531,364 (21.7 percent) individuals who are exempted from involvement in any managed care arrangement.[37]

**Rising Expenditures of Antipsychotics in Florida Medicaid**

The increased use of psychotherapeutic prescriptions and the associated rise in expenditures in Florida has been of particular concern to a variety of stakeholders. This trend has been fueled by large and rapid increases in enrollment. A report from the Kaiser Commission on Medicaid and the Uninsured reports that the Florida Medicaid program experienced one of the largest enrollment increases of any of the states, increasing 16.3 percent over the June 2008 to June 2009 period.[12]

Figure 1 reports the number of psychotherapeutic medications, patients, prescriptions written, providers, and costs for behavioral prescriptions for all Florida Medicaid patients for fiscal years 2006/7 through 2009/10 aggregated by adults and children. Over this period, Medicaid patient participation increased by 29 percent for both adults and children. For adults, the increase was only 3.1 percent while, for children, the number participating more than doubled from 62,781 to 135,203 children, a 115.4 percent increase. Paralleling this growth in Medicaid patients were double digit increases in both the number of prescriptions and the number of prescribers. For prescriptions, there was a 30.4 percent increase in the number of prescriptions with increases of 19.4 percent and 72.4 percent for adults and children, respectively.

Overall, the number of prescribers grew 48.5 percent over the four-year period with the number of adults growing 43.2 percent while the number of prescribers that wrote a prescription for children grew to 64.6 percent. Substantial increases are also evident in the cost of behavioral prescriptions. As shown in Figure 1, over the four-year period, Florida Medicaid behavioral drug expenditures grew 32.1 percent from $249 million to $330 million. The increase in prescription costs for children was more than double that of adults over the four-year period—54.7 percent versus 21.8 percent. Thus, although the overall Medicaid expenditures on pharmaceuticals in Florida were also growing during this time, the rates of growth for psychotherapeutic medications, specifically atypical antipsychotics and antidepressants, were growing at a much greater rate.[38,39]

**Program Development and Implementation**

The Florida Legislature's initial response to the growth in these expenditures was the

**Figure 1. Number of Florida Behavioral Patients, Scripts, Prescribers, and Costs, and Percent Change by Adult and Children, Fiscal Years, 2006/07–2000/10**

| | FY 2006/07 | FY 2007/08 | FY 2008/09 | FY 2009/10 | % Change 06/07-09/10 |
|---|---|---|---|---|---|
| | | | **Adults** | | |
| Number of Patients | 209,969 | 219,606 | 217,067 | 216,529 | 3.1% |
| Number of Scripts | 2,200,099 | 2,533,147 | 2,223,384 | 2,625,442 | 19.3% |
| Number of Prescribers | 24,218 | 25,927 | 29,454 | 34,669 | 43.2% |
| Costs | $171,612,560 | $184,027,175 | $184,410,796 | $209,049,388 | 21.8% |
| | | | **Child** | | |
| Number of Patients | 62,781 | 61,859 | 61,644 | 135,203 | 115.4% |
| Number of Scripts | 581,539 | 611,055 | 532,013 | 1,002,390 | 72.4% |
| Number of Prescribers | 7,966 | 8,066 | 8,674 | 13,111 | 64.6% |
| Costs | $77,869,131 | $77,834,301 | $80,789,761 | $120,469,671 | 54.7% |
| | | | **Total Adult and Child** | | |
| Number of Patients | 272,750 | 281,465 | 278,711 | 351,732 | 29.0% |
| Number of Scripts | 2,781,638 | 3,144,202 | 2,755,397 | 3,627,832 | 30.4% |
| Number of Prescribers | 32,184 | 33,993 | 38,128 | 47,780 | 48.5% |
| Costs | $249,481,691 | $261,861,476 | $265,200,557 | $329,519,059 | 32.1% |

creation, through proviso language in the 2004 General Appropriations Act, of collaborative efforts between the state and five of the largest manufacturers of psychotherapeutic medications. Through this collaboration, the manufacturers provided funding for the implementation of a Behavioral Pharmacy Management Program and guaranteed a savings of $34 million off projected expenditures on psychotherapeutic medications for FY 2004-05.

The Legislature amended the law in May 2005 and implemented a preferred drug list beginning in July, 2005.[40] The new law eliminated the role of the manufacturers in the management of Medicaid pharmacy expenditures and restarted the program at the Florida Mental Health Institute at the University of South Florida using exclusively state funds. The new MDTMP began operations in December 2005. The goals of the MDTMP as articulated in Chapter 409.912 Florida Statutes were the following: (1) improve the quality of care and behavioral health drug prescribing practices based on best practices guidelines; (2) improve patient adherence; (3) reduce clinical risk; and (4) lower costs.

Evidence-based psychotherapeutic guidelines for the treatment of major mental illnesses in adults and emotional disturbances in children were developed by MDTMP and are updated every two years on a rotating basis. Based on these guidelines, a series of unusual psychotherapeutic medication indicators (UPMIs) were identified and applied as filters to analyze Medicaid pharmacy claims.

The analyses identified (1) prescriptions that appeared inconsistent with the

guidelines, and (2) the prescribers whose prescriptions frequently triggered the indicators. These professionals were then targeted for interventions designed to reduce the numbers of their prescriptions that triggered UPMIs and monitored over time for possible follow-up actions. The separate steps in the program were:

*1. Guideline Development and Best Practice Recommendations*

The first step in program implementation was to convene a series of panels to formulate specific psychotherapeutic medication guidelines for the treatment of serious mental illness in adults and serious emotional disturbances in children. The panels included national experts, representatives from the Departments of Psychiatry of three Florida State Universities, psychiatrists in private practice and those working as employees in publically funded agencies, primary care physicians with a focused interest in behavioral health, medical directors of prepaid public mental health plans in Florida, representatives from the state Medicaid Program, and other relevant departments of state government. The experts were identified through literature searches and through the recommendations of their peers. The experts who participated in each of the panels are listed on the MDTMP Web site, *http://medicaidmentalhealth.org.*

At each panel, information from more than 100 evidence-based monographs and other relevant treatment guidelines issued by national specialty societies were reviewed by the participants. An exhaustive literature search was done to ensure that the most up-to-date evidence was considered in the development of the guidelines. Following presentations by national experts, there was a systematic and structured panel discussion led by an expert facilitator about the appropriate medication treatment of the disorders under consideration. Specific clinical questions were used to identify and guide the discussions. Topics of when to and when not to use medications, how to use medications, and how to monitor both the benefits and risks of medications were considered. Emphasis was placed on providing individualized, specifically targeted psychotherapeutic medication treatment as part of a comprehensive treatment plan developed in the context of a therapeutic alliance.

More than 30 best-practice recommendations were developed by the June 2006 expert panel for children. Medication guidelines were formulated for assessment and treatment of child and adolescent depression, attention-deficit hyperactivity disorder, bipolar disorder, severe tic disorders, and impulsive aggression in the context of other psychiatric disorders. Age-specific guidelines were developed as appropriate for children 0–5 years, 6–12 years, and 13–17 years old.

Similarly, guidelines were developed from panel discussions focused on adults for the treatment of schizophrenia, bipolar 1, and major depressive disorders. These guidelines were initially developed by the previously described state/manufacturers collaboration in the winter of 2005. The adult guidelines were reviewed and updated in the summer of 2007 and again in the summer of 2009. The children's guidelines were updated in 2008 and again in the fall of 2010. The guidelines are prefaced by a set of Principles of Practice for Children/Adolescents and Adults that outline the absolute basic requirements to be met before initiating medication treatment. The current versions of the guidelines can be

found at *http://medicaidmentalhealth.org*. The guidelines are disseminated in a variety of ways including print and electronic versions.

*2. Unusual Psychotherapeutic Medication Indicators (UPMIs)*

In addition to the formulation of evidence-based psychotherapeutic treatment guidelines the expert panels were asked to develop several "unusual psychotherapeutic medication indicators" derived from the guidelines. The UPMIs are data screens that identify prescribing behaviors that are either not supported by evidence or that produce marginal benefits or increased risks, or both, and therefore should be relatively rare and warrant greater scrutiny. Prescriptions that trigger these indicators represent potential opportunities for improving care. The six UPMIs developed and used for single prescribers in this analysis of child and adult prescriptions are listed below:

1. Adults 18 & Older: Similar Class Pharmacotherapy—Concurrent use of 2 or more antipsychotics for 60 days
2. Adults 18 & Older: Similar Class Pharmacotherapy—Concurrent use of 3 or more antipsychotics for 60 days
3. Adults 18 & Older: Similar Class Pharmacotherapy—Concurrent use of 2 or more antipsychotics for longer than 90 days
4. Children & Adolescents Ages 6–17: Similar Class Pharmacotherapy—Concurrent use of 2 or more antipsychotics for 60 days
5. Children & Adolescents Ages 6–17: Similar Class Pharmacotherapy—Concurrent use of 3 or more antipsychotics for 60 days
6. Children & Adolescents Ages 6–17: Concurrent use of 2 or more antipsychotics for longer than 90 days

*3. Analysis of Claims*

These UPMIs were then used in the quarterly analysis of Medicaid pharmacy claims data to identify patients whose prescriptions triggered a UPMI and their associated prescribing clinicians. Prescribers were ranked based on their number of prescriptions that triggered the indicators and tracked over subsequent quarters to assess any changes in their prescribing behavior.

**Database Creations and Analytical Methods**

Beginning in the third quarter of 2007 Medicaid claims data were analyzed to identify any patient whose prescriptions for psychotherapeutic medications triggered one or more UPMIs as well as the characteristics of each patient. The clinician associated with each of these prescriptions was then recorded. The nature of each UPMI triggered for each patient was determined as well as whether the UPMI was the result of the actions of a single prescriber or in the case of UPMI that involved duplicate therapies, multiple prescribers (*e.g.,* 2 or more antipsychotics longer than 60 days when one antipsychotic prescription was written by one prescriber and the other prescription was written by a different prescriber). Individual files were created for each clinician whose prescriptions triggered one or more UPMIs, and the file included all prescriptions for psychotherapeutic medications written by that prescriber including those that did not trigger a UPMI.

Clinicians were then grouped into two categories based on the median age of all their patients. Those whose total patient

population had a median age less than 18 years old were classified as child prescribers and those with a median age greater than 18 years old were categorized as adult prescribers.

Based on the UPMI definitions defined above, we developed three categories of concurrent antipsychotic use for both adults and children derived from the numbers of patients and written prescriptions that were defined as egregious: (1) two antipsychotics for 60 days (2AP60), (2) three antipsychotics for 60 days (3AP60), and (3) two antipsychotics for 90 days (2AP90).

Adult and child prescribers were ranked separately from high to low according to the number of prescriptions they wrote that triggered an antipsychotic UPMI. Based on these rankings, in addition to the total concurrent antipsychotic prescribers to hit a UPMI (TOTCAPP), we identified several subgroups of concurrent antipsychotic prescribers that hit a UPMI. First, we identified the subgroup of concurrent prescribers that appeared in all 12 quarters (CAPPALL12). That is, all concurrent antipsychotic prescribers who had at least one of the three indicators—2AP60, 3AP60, 2AP90—in every quarter. Next, we identified both the adult prescribers that ranked in the top 250 (TOP250) among adult antipsychotic prescribers and the child prescribers that ranked in the top 100 (TOP100) child antipsychotic prescribers. These two groupings—TOP250 and TOP100—represented roughly 10 percent of the overall prescribers during the three-year period that hit a UPMI. In addition, we created a subgroup for adult and child prescribers that aggregated the TOP250 and TOP100 prescribers with those prescribers that were in all 12 quarters (TOP250ALL12 and TOP100ALL12). Finally, we separated the antipsychotic subgroup represented by the overall top 13 (TOP13) antipsychotic prescribers.

## Results

### Adult Antipsychotic UPMI Patterns

Figure 2 reports the total numbers of antipsychotic prescriptions and total numbers of patients for 2AP60, 3AP60, and 2AP90 for the adult population broken out by five groups of prescribers for 12 quarters over the Q3-2007 to Q2-2010 timeframe. The five groups of antipsychotic prescribers are: (1) All Prescribers (TOTCAPP), (2) Prescribers Present in All Periods (CAPPALL12), (3) Top 250 Prescribers (TOP250), (4) Top 250 Prescribers Present in All Periods (TOP250ALL12), and (5) Top 13 (TOP13) prescribers.

As reported in Figure 1, there were 34,669 adult prescribers in the State of Florida in 2009/10 that wrote Medicaid prescriptions for behavioral patients. However, over the three-year period, only 1,961 unique adult prescribers wrote an antipsychotic prescription that hit a UPMI in at least one of the quarters, 5.7 percent. In the initial quarter of our study, the 3rd quarter of 2007, 730 unique prescribers wrote at least one UPMI while 688 unique prescribers wrote a UPMI in the last quarter, the 2nd quarter of 2010. For the 12 quarters, the highest number of unique prescribers to hit a UPMI was 818 in Q1-2009. Of these 1,961 prescribers, only 233 (11.9 percent) unique prescribers appeared in all 12 quarters while just 160 (8.2 percent) unique prescribers were in all 12 quarters and also among the top 250 antipsychotic prescribers.

## Figure 2. Mean and Total Number of Adult Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year

| All Adult Prescribers (TOTCAPP) | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 91.9 | 67,060 | 87.3 | 62,439 | 79.6 | 64,333 | 82.1 | 64,775 | 83.7 | 68,195 | 86.1 | 68,345 | 82.2 | 67,208 | 85.0 | 69,067 | 90.2 | 71,652 | 92.3 | 69,190 | 88.0 | 64,362 | 93.1 | 64,027 | 86.6 | 800,653 | 1.3% | -4.5% |
| Total # of AP Patients | 32.2 | 23,516 | 31.8 | 22,711 | 29.0 | 23,443 | 29.6 | 23,364 | 29.4 | 23,968 | 29.9 | 23,709 | 30.2 | 24,713 | 30.4 | 24,702 | 34.0 | 27,017 | 33.8 | 25,324 | 32.9 | 24,071 | 34.5 | 23,757 | 31.4 | 290,295 | 6.7% | 1.0% |
| Total # of 2 AP RXs for 60 | 16.5 | 12,015 | 18.0 | 12,855 | 20.1 | 16,241 | 14.3 | 11,293 | 14.7 | 11,992 | 15.8 | 12,513 | 14.7 | 12,029 | 15.8 | 12,815 | 17.6 | 13,991 | 16.9 | 12,695 | 14.1 | 10,281 | 16.7 | 11,465 | 16.2 | 150,185 | 1.2% | -4.6% |
| Total # of 2 AP Patients for 60 Days | 3.2 | 2,361 | 3.6 | 2,547 | 3.7 | 2,977 | 2.9 | 2,306 | 2.9 | 2,398 | 3.1 | 2,500 | 3.0 | 2,492 | 3.1 | 2,548 | 3.3 | 2,603 | 2.9 | 2,144 | 3.0 | 2,169 | 3.2 | 2,180 | 3.2 | 29,225 | -2.1% | -7.7% |
| Total # of 3 AP RXs for 60 | 1.9 | 1,386 | 1.9 | 1,379 | 1.6 | 1,327 | 1.7 | 1,318 | 2.0 | 1,650 | 2.2 | 1,744 | 1.9 | 1,568 | 2.2 | 1,784 | 2.0 | 1,583 | 2.6 | 1,921 | 1.3 | 916 | 1.7 | 1,148 | 1.9 | 17,724 | -13.8% | -17.2% |
| Total # of 3 AP Patients for 60 Days | 0.2 | 156 | 0.2 | 162 | 0.2 | 157 | 0.2 | 150 | 0.2 | 182 | 0.2 | 198 | 0.2 | 183 | 0.2 | 194 | 0.2 | 158 | 0.3 | 218 | 0.2 | 135 | 0.2 | 137 | 0.2 | 2,030 | -7.3% | -12.2% |
| Total # of 2 AP RXs for 90 | 17.1 | 12,457 | 16.2 | 11,572 | 12.1 | 9,742 | 19.1 | 15,043 | 20.0 | 16,323 | 20.1 | 15,934 | 18.7 | 15,284 | 20.7 | 16,853 | 20.7 | 16,472 | 18.3 | 13,725 | 17.3 | 12,663 | 16.9 | 11,628 | 18.1 | 167,696 | -1.0% | -6.7% |
| Total # of 2 AP Patients for 90 Days | 2.6 | 1,862 | 2.6 | 1,873 | 1.9 | 1,543 | 3.1 | 2,458 | 3.1 | 2,549 | 3.2 | 2,508 | 3.0 | 2,482 | 3.3 | 2,655 | 3.3 | 2,628 | 2.8 | 2,108 | 2.8 | 2,015 | 2.6 | 1,823 | 2.9 | 26,504 | 3.7% | -2.1% |
| N of Prescribers | 730 | | 715 | | 808 | | 789 | | 815 | | 794 | | 818 | | 813 | | 794 | | 750 | | 731 | | 688 | | 1,961 | | -5.8% | |

## Figure 2. Mean and Total Number of Adult Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year

| Adult Prescribers in All 12 Qtrs (CAPPALL12) | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 189.8 | 42,320 | 180.1 | 40,164 | 181.9 | 40,564 | 185.3 | 41,327 | 191.6 | 42,721 | 191.7 | 42,759 | 180.9 | 40,347 | 185.1 | 41,286 | 194.8 | 43,444 | 191.7 | 42,746 | 178.5 | 39,813 | 176.7 | 39,404 | 185.7 | 496,895 | -7.4% | -6.9% |
| Total # of AP Patients | 65.0 | 14,504 | 64.0 | 14,261 | 64.7 | 14,432 | 65.4 | 14,583 | 65.0 | 14,503 | 64.8 | 14,443 | 64.5 | 14,383 | 63.4 | 14,145 | 69.5 | 15,499 | 67.3 | 15,010 | 64.2 | 14,311 | 63.6 | 14,189 | 65.1 | 174,263 | -2.2% | -2.2% |
| Total # of 2 AP RXs for 60 | 33.2 | 7,407 | 37.4 | 8,336 | 45.0 | 10,032 | 32.2 | 7,179 | 33.9 | 7,566 | 34.9 | 7,778 | 33.2 | 7,403 | 35.2 | 7,840 | 39.0 | 8,703 | 36.8 | 8,204 | 29.2 | 6,515 | 30.7 | 6,841 | 35.1 | 93,804 | -8.3% | -7.6% |
| Total # of 2 AP Patients for 60 Days | 6.4 | 1,424 | 7.2 | 1,599 | 8.1 | 1,817 | 6.4 | 1,435 | 6.6 | 1,472 | 6.7 | 1,502 | 6.7 | 1,491 | 6.8 | 1,523 | 7.0 | 1,556 | 6.0 | 1,344 | 6.0 | 1,332 | 5.8 | 1,284 | 6.6 | 17,779 | -10.9% | -9.8% |
| Total # of 3 AP RXs for 60 | 4.5 | 1,009 | 4.5 | 1,005 | 4.4 | 990 | 4.3 | 955 | 5.3 | 1,184 | 5.7 | 1,260 | 4.8 | 1,080 | 6.1 | 1,357 | 5.3 | 1,180 | 6.0 | 1,346 | 3.0 | 660 | 3.9 | 864 | 4.8 | 12,890 | -16.8% | -14.4% |
| Total # of 3 AP Patients for 60 Days | 0.5 | 111 | 0.5 | 116 | 0.5 | 112 | 0.5 | 103 | 0.6 | 124 | 0.6 | 141 | 0.6 | 123 | 0.7 | 145 | 0.5 | 114 | 0.7 | 150 | 0.4 | 93 | 0.4 | 100 | 0.5 | 1,432 | -11.0% | -9.9% |
| Total # of 2 AP RXs for 90 | 36.0 | 8,039 | 35.0 | 7,805 | 29.6 | 6,609 | 45.6 | 10,161 | 48.2 | 10,751 | 45.8 | 10,224 | 43.9 | 9,787 | 48.9 | 10,907 | 48.2 | 10,759 | 40.9 | 9,130 | 37.9 | 8,457 | 33.4 | 7,451 | 41.1 | 110,080 | -7.9% | -7.3% |
| Total # of 2 AP Patients for 90 Days | 5.3 | 1,180 | 5.6 | 1,245 | 4.6 | 1,034 | 7.3 | 1,630 | 7.3 | 1,634 | 7.1 | 1,579 | 7.0 | 1,566 | 7.6 | 1,685 | 7.4 | 1,659 | 6.1 | 1,363 | 5.9 | 1,326 | 5.1 | 1,148 | 6.4 | 17,049 | -2.8% | -2.7% |
| N of Prescribers | 233 | | 233 | | 233 | | 233 | | 233 | | 233 | | 233 | | 233 | | 233 | | 233 | | 233 | | 233 | | | | | |

*Continued ...*

## Figure 2. Mean and Total Number of Adult Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year *(Continued)*

| Top 250 Adult Prescribers (TOP250) | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 230.0 | 48,067 | 209.6 | 46,524 | 212.6 | 47,826 | 215.4 | 48,674 | 219.3 | 51,754 | 223.6 | 52,779 | 207.1 | 50,122 | 210.3 | 50,902 | 220.8 | 52,989 | 222.8 | 51,238 | 210.0 | 47,663 | 214.0 | 46,436 | 216.2 | 594,974 | -7.5% | -3.4% |
| Total # of AP Patients | 80.1 | 16,731 | 76.1 | 16,897 | 77.4 | 17,424 | 77.7 | 17,571 | 76.2 | 17,979 | 76.9 | 18,142 | 75.7 | 18,320 | 74.3 | 17,982 | 81.8 | 19,634 | 80.0 | 18,392 | 77.5 | 17,600 | 78.8 | 17,098 | 77.7 | 213,770 | -1.6% | 2.2% |
| Total # of 2 AP RXs for 60 | 38.2 | 7,980 | 40.4 | 8,964 | 49.7 | 11,185 | 35.2 | 7,950 | 36.4 | 8,583 | 38.4 | 9,053 | 34.8 | 8,410 | 36.7 | 8,889 | 40.6 | 9,754 | 38.7 | 8,908 | 31.6 | 7,166 | 35.0 | 7,589 | 37.9 | 104,431 | -9.2% | -4.9% |
| Total # of 2 AP Patients for 60 Days | 7.4 | 1,549 | 7.8 | 1,738 | 9.0 | 2,036 | 7.2 | 1,616 | 7.1 | 1,684 | 7.5 | 1,778 | 7.1 | 1,722 | 7.2 | 1,738 | 7.4 | 1,783 | 6.4 | 1,469 | 6.5 | 1,481 | 6.7 | 1,444 | 7.3 | 20,038 | -11.4% | -6.8% |
| Total # of 3 AP RXs for 60 | 5.3 | 1,105 | 4.7 | 1,047 | 4.5 | 1,013 | 4.7 | 1,058 | 5.5 | 1,293 | 6.0 | 1,410 | 5.1 | 1,240 | 5.9 | 1,438 | 5.4 | 1,289 | 6.5 | 1,502 | 3.1 | 712 | 4.5 | 966 | 5.1 | 14,073 | -18.8% | -12.6% |
| Total # of 3 AP Patients for 60 Days | 0.6 | 121 | 0.5 | 121 | 0.5 | 116 | 0.5 | 115 | 0.6 | 140 | 0.7 | 158 | 0.6 | 140 | 0.6 | 154 | 0.5 | 127 | 0.7 | 167 | 0.4 | 98 | 0.5 | 113 | 0.6 | 1,570 | -11.2% | -6.6% |
| Total # of 2 AP RXs for 90 | 41.3 | 8,626 | 37.4 | 8,308 | 31.5 | 7,079 | 48.7 | 11,005 | 51.3 | 12,101 | 50.5 | 11,911 | 46.3 | 11,199 | 50.7 | 12,259 | 49.6 | 11,911 | 43.5 | 10,001 | 40.1 | 9,105 | 37.5 | 8,142 | 44.2 | 121,647 | -10.0% | -5.6% |
| Total # of 2 AP Patients for 90 Days | 6.1 | 1,268 | 6.0 | 1,326 | 4.9 | 1,106 | 7.9 | 1,784 | 7.9 | 1,858 | 7.8 | 1,845 | 7.5 | 1,814 | 7.8 | 1,895 | 7.8 | 1,870 | 6.5 | 1,505 | 6.3 | 1,431 | 5.8 | 1,267 | 6.9 | 18,967 | -3.7% | -0.1% |
| N of Prescribers | 250 | | 250 | | 250 | | 250 | | 250 | | 250 | | 250 | | 250 | | 250 | | 250 | | 250 | | 250 | | 250 | | | |

## Figure 2. Mean and Total Number of Adult Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year *(Continued)*

| Top 250 Prescribers in All 12 Qtrs (TOP250ALL12) | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 247.7 | 39,634 | 235.0 | 37,601 | 238.1 | 38,096 | 242.0 | 38,719 | 251.4 | 40,219 | 252.8 | 40,455 | 238.1 | 38,098 | 242.8 | 38,845 | 255.7 | 40,908 | 252.3 | 40,371 | 234.1 | 37,455 | 232.1 | 37,133 | 243.5 | 467,534 | -6.7% | -6.3% |
| Total # of AP Patients | 85.0 | 13,600 | 83.7 | 13,396 | 85.1 | 13,615 | 85.8 | 13,733 | 85.6 | 13,688 | 85.5 | 13,673 | 85.2 | 13,639 | 83.3 | 13,323 | 91.4 | 14,622 | 88.7 | 14,198 | 84.4 | 13,507 | 83.7 | 13,389 | 85.6 | 164,383 | -1.6% | -1.6% |
| Total # of 2 AP RXs for 60 | 42.4 | 6,782 | 47.7 | 7,635 | 57.5 | 9,207 | 40.7 | 6,514 | 43.5 | 6,961 | 44.6 | 7,143 | 42.3 | 6,762 | 44.9 | 7,176 | 50.1 | 8,015 | 47.2 | 7,550 | 37.3 | 5,965 | 39.0 | 6,243 | 44.8 | 85,953 | -8.6% | -7.9% |
| Total # of 2 AP Patients for 60 Days | 8.2 | 1,305 | 9.2 | 1,464 | 10.4 | 1,670 | 8.2 | 1,307 | 8.5 | 1,354 | 8.7 | 1,385 | 8.6 | 1,368 | 8.7 | 1,398 | 9.0 | 1,439 | 7.7 | 1,239 | 7.6 | 1,222 | 7.4 | 1,179 | 8.5 | 16,330 | -10.7% | -9.7% |
| Total # of 3 AP RXs for 60 | 6.1 | 974 | 5.8 | 931 | 5.9 | 938 | 5.7 | 905 | 7.0 | 1,124 | 7.6 | 1,208 | 6.4 | 1,028 | 8.0 | 1,287 | 7.1 | 1,138 | 7.9 | 1,256 | 3.9 | 622 | 5.2 | 834 | 6.4 | 12,245 | -16.8% | -14.4% |
| Total # of 3 AP Patients for 60 Days | 0.7 | 107 | 0.7 | 106 | 0.7 | 105 | 0.6 | 97 | 0.7 | 118 | 0.8 | 135 | 0.7 | 115 | 0.9 | 136 | 0.7 | 110 | 0.9 | 139 | 0.5 | 85 | 0.6 | 97 | 0.7 | 1,350 | -10.3% | -9.3% |
| Total # of 2 AP RXs for 90 | 46.3 | 7,412 | 45.0 | 7,196 | 37.8 | 6,042 | 57.8 | 9,241 | 62.1 | 9,939 | 59.2 | 9,468 | 56.3 | 9,000 | 63.2 | 10,104 | 62.0 | 9,919 | 52.6 | 8,411 | 48.3 | 7,733 | 42.7 | 6,834 | 52.8 | 101,299 | -8.5% | -7.8% |
| Total # of 2 AP Patients for 90 Days | 6.8 | 1,085 | 7.1 | 1,142 | 5.9 | 944 | 9.3 | 1,488 | 9.4 | 1,509 | 9.1 | 1,460 | 9.0 | 1,444 | 9.8 | 1,561 | 9.6 | 1,531 | 7.9 | 1,256 | 7.6 | 1,216 | 6.6 | 1,056 | 8.2 | 15,692 | -2.7% | -2.7% |
| N of Prescribers | 160 | | 160 | | 160 | | 160 | | 160 | | 160 | | 160 | | 160 | | 160 | | 160 | | 160 | | 160 | | 160 | | | |

*Continued ...*

## Figure 2. Mean and Total Number of Adult Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year *(Continued)*

| | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| Top 13 Prescribers (TOP13) | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 728.5 | 9,471 | 685.6 | 8,913 | 739.7 | 9,616 | 764.2 | 9,935 | 815.8 | 10,605 | 837.2 | 10,883 | 797.3 | 10,365 | 830.5 | 10,797 | 879.9 | 11,439 | 890.5 | 11,576 | 831.2 | 10,806 | 822.9 | 10,698 | 801.9 | 125,104 | 11.5% | 13.0% |
| Total # of AP Patients | 254.8 | 3,312 | 255.5 | 3,322 | 271.3 | 3,527 | 282.2 | 3,668 | 286.0 | 3,718 | 288.5 | 3,751 | 296.6 | 3,856 | 288.4 | 3,749 | 304.5 | 3,958 | 306.3 | 3,982 | 295.1 | 3,836 | 291.1 | 3,784 | 285.0 | 44,463 | 12.5% | 14.3% |
| Total # of 2 AP RXs for 60 | 101.9 | 1,325 | 125.4 | 1,630 | 137.4 | 1,786 | 111.6 | 1,451 | 119.5 | 1,554 | 123.4 | 1,604 | 111.4 | 1,448 | 128.5 | 1,670 | 132.8 | 1,726 | 132.4 | 1,721 | 109.6 | 1,425 | 120.0 | 1,560 | 121.2 | 18,900 | 15.1% | 17.7% |
| Total # of 2 AP Patients for 60 Days | 19.8 | 257 | 23.9 | 311 | 26.4 | 343 | 22.2 | 289 | 23.7 | 308 | 24.3 | 316 | 23.2 | 301 | 24.8 | 323 | 25.0 | 325 | 23.0 | 299 | 22.7 | 295 | 22.5 | 293 | 23.5 | 3,660 | 12.3% | 14.0% |
| Total # of 3 AP RXs for 60 | 20.3 | 264 | 19.5 | 253 | 17.8 | 231 | 15.2 | 198 | 23.2 | 302 | 30.9 | 402 | 26.9 | 350 | 30.4 | 395 | 24.8 | 322 | 31.4 | 408 | 21.2 | 276 | 29.0 | 377 | 24.2 | 3,778 | 30.0% | 42.8% |
| Total # of 3 AP Patients for 60 Days | 2.2 | 29 | 2.2 | 29 | 1.9 | 25 | 1.6 | 21 | 2.5 | 32 | 3.5 | 45 | 2.9 | 38 | 3.1 | 40 | 2.4 | 31 | 3.4 | 44 | 2.8 | 37 | 3.1 | 40 | 2.6 | 411 | 27.5% | 37.9% |
| Total # of 2 AP RXs for 90 | 102.2 | 1,329 | 112.6 | 1,464 | 94.0 | 1,222 | 145.2 | 1,887 | 158.9 | 2,066 | 159.6 | 2,075 | 145.1 | 1,886 | 175.4 | 2,280 | 174.4 | 2,267 | 160.7 | 2,089 | 148.2 | 1,926 | 136.6 | 1,776 | 142.7 | 22,267 | 25.2% | 33.6% |
| Total # of 2 AP Patients for 90 Days | 15.1 | 196 | 18.8 | 245 | 15.6 | 203 | 24.6 | 320 | 25.4 | 330 | 25.5 | 331 | 24.1 | 313 | 27.1 | 352 | 27.7 | 360 | 24.8 | 322 | 23.5 | 306 | 21.0 | 273 | 22.8 | 3,551 | 28.2% | 39.3% |
| N of Prescribers | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | | |

There is considerable variation as shown in the data in Figure 2 among adult prescribers and the subgroups of adult prescribers. The average adult prescriber over the three-year period wrote 86.6 antipsychotic prescriptions for 31.4 patients during their medical treatments. On average, of these antipsychotic prescriptions 16.2 of the prescriptions were 2AP60 written for 3.2 patients; 1.9 of the prescriptions were 3AP60 written for 0.2 patients; and 18.1 of the prescriptions were 2AP90 written for 2.9 patients.

The contrast between the average Medicaid prescriber and high-volume prescriber is striking. For example, the top adult antipsychotic prescriber (not shown) wrote 28,553 antipsychotic prescriptions over the three-year period of which 1,822 were 2AP60 (6.4 percent). The prescriber with the highest number of 2AP60 over the three-year period wrote 9,949 antipsychotic prescriptions and 24.9 percent (2,475) of them were 2AP60. In both cases, these prescribers were in all 12 periods. At the other extreme, there were 524 (26.7 percent) prescribers who appeared only one time in the 12 quarters in the dataset and they averaged 15.3 antipsychotic prescriptions for 5.8 patient encounters. For these 524 prescribers, over the three years, they wrote an average of just 4.1 prescriptions that were 2AP60—typically, for only 1 patient.

Among all the Medicaid adult prescribers that wrote at least one 2AP60 during the three-year period, they wrote a total of 800,653 prescriptions for 290,295 patients in three-years (Figure 2). Over the 12-quarter period, the total number of antipsychotic prescriptions declined 4.5 percent for the all provider group while the number of patients receiving antipsychotics increased 1.0 percent. The greatest number of antipsychotic prescriptions in a quarter—71,652—peaked in the 3rd quarter of 2009 while the lowest number of prescriptions overall—62,439—occurred in Q4-2007, a 14.8 percent difference.

Overall and for each of the prescriber subgroups with the exception of the Top 13 in Figure 2, the total number of 2AP60, 3AP60, and 2AP90 adult prescriptions and patients declined over the 12-quarter period. The largest declines were typically in the antipsychotic prescriptions for the 3AP60 UPMIs for each of these groups. In contrast, the Top 13 prescribers all showed double-digit percentage gains over the 12 quarters with the largest gains being for prescribers with 3AP60 and 2AP90 UPMIs.

The influence of the subgroups of adult prescribers on the number of prescriptions and number of patients is notable. The top 250 prescribers wrote 594,974 antipsychotic prescriptions representing 74.2 percent of all the antipsychotic prescriptions written. The 160 prescribers that were in all 12 quarters and also among the top 250 prescribers wrote a total of 467,534 antipsychotic prescriptions. That is, among the 1,961 unique prescribers in Florida Medicaid that wrote at least one 2AP60, the 160 prescribers in this subgroup represent 58.4 percent of all the prescriptions among this population while just the top 13 prescribers represent 15.6 percent of all the antipsychotic prescriptions written.

In fact, in any of the three subgroups—prescribers present in all periods, top 250 prescribers, and top 250 prescribers present in all periods—the number of 2AP60 prescriptions written by the prescribers in these subgroups represent well over half of all the 2AP60 prescriptions that were written by group's prescribers—62.5 percent, 69.5 percent, and 58.4 percent, respectively.

The practice patterns for the adult subgroups are especially dynamic and prescribers in the various subgroups were increasingly likely over the study period to write antipsychotic prescriptions for their patients. Moving from the all-prescribers category to the category of adult prescribers that are in all 12 quarters in Figure 2 shows that the mean number of antipsychotic prescriptions written and the number of patients per prescriber typically more than doubles overall. As the prescriber categories focus on more exclusive sets of prescribers, the mean number of antipsychotic prescriptions and number of patients treated with antipsychotics continues to rise. Finally, for the Top 13 prescribers, the mean number of antipsychotic prescriptions written and mean number of patients treated with antipsychotics is nearly 10 times greater than the respective means for the all-adult prescriber category. Similar patterns of escalation in antipsychotic prescriptions and patients are evident among each of the UPMI measures although the magnitude of the differences is not as large.

**Child Antipsychotic UPMI Patterns**

Figure 3 reports the means and total numbers of antipsychotic prescriptions and total numbers of patients on 2AP60, 3AP60, and 2AP90 for the child Medicaid population again broken out by five groups of prescribers for 12 quarters over the Q3-2007 to Q2-2010 timeframe. For children, the five groups of antipsychotic prescribers are: (1) All Prescribers (TOTCAPP), (2) Prescribers Present in All Periods (CAPPALL12), (3) Top 100 Prescribers (TOP100), (4) Top 100 Prescribers Present in All Periods (TOP100ALL12), and (5) Top 13 prescribers (TOP13).

There were far fewer Medicaid prescribers that wrote a prescription for a child during the three-year period. Only 501 unique child prescribers wrote an antipsychotic prescription that hit at least one UPMI in one or more of the 12 quarters. Compared to adult prescribers that hit a UPMI, the number of child prescribers represent about a quarter of the adult prescribers (1,961). Typically, the number of child Medicaid prescribers to hit these three UPMIs averaged between 150 prescribers and 200 prescribers per quarter. The number of unique child Medicaid prescribers that were in all 12 quarters falls to just 37 prescribers while only 32 unique child prescribers were in all 12 quarters and were also among the top 100 antipsychotic child prescribers.

Similar to the adult Medicaid prescribers, there is also extensive variation among child prescribers who wrote at least one antipsychotic prescription to hit a UPMI during the three years. As shown in Figure 3, the typical child prescriber averaged 78 antipsychotic prescriptions for 32 children. The top child antipsychotic prescriber wrote 3,056 antipsychotic prescriptions (not shown) for 1,174 children over the 3-year period. Of these children, 114 children received 694 antipsychotic prescriptions that lasted 60 days while 112 children received 585 antipsychotic prescriptions for 90 days. Of the 501 unique child prescribers in the three-year period that had written a 2AP60 prescription, 146 (29.1 percent) appeared just one time in the 12 quarters and 81 prescribers appeared just twice (16.2 percent). These 227 low-volume prescribers, who appeared two times or fewer during the three years (representing 45.3 percent of all child the prescribers), and whose patients hit the UPMI, averaged 5.7 2AP60 prescriptions for 1.3 children for the 12-quarter period.

## Figure 3. Mean and Total Child Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year

| All Child Prescribers (TOPCAPP) | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 78.2 | 13,286 | 79.2 | 12,517 | 74.0 | 13,625 | 76.7 | 13,568 | 72.9 | 14,005 | 76.0 | 14,138 | 79.1 | 14,705 | 83.3 | 13,000 | 90.3 | 12,455 | 76.9 | 14,912 | 79.4 | 13,894 | 78.3 | 12,378 | 78.3 | 162,483 | 0.2% | -6.8% |
| Total # of AP Patients | 31.9 | 5,430 | 32.9 | 5,203 | 30.3 | 5,584 | 31.5 | 5,575 | 29.8 | 5,730 | 31.1 | 5,776 | 32.4 | 6,029 | 32.8 | 5,119 | 37.9 | 5,227 | 31.8 | 6,169 | 33.7 | 5,898 | 33.0 | 5,209 | 32.3 | 66,949 | 3.2% | -4.1% |
| Total # of 2 AP RXs for 60 | 8.0 | 1,360 | 9.1 | 1,440 | 9.1 | 1,681 | 8.4 | 1,480 | 7.4 | 1,416 | 7.3 | 1,357 | 7.4 | 1,370 | 9.6 | 1,504 | 10.1 | 1,392 | 9.6 | 1,854 | 6.8 | 1,192 | 8.6 | 1,366 | 8.4 | 17,412 | 8.1% | 0.4% |
| Total # of 2 AP Patients for 60 Days | 1.6 | 276 | 1.8 | 290 | 1.8 | 326 | 1.6 | 292 | 1.5 | 292 | 1.5 | 280 | 1.5 | 278 | 1.9 | 294 | 1.7 | 230 | 1.8 | 355 | 1.7 | 290 | 1.7 | 267 | 1.7 | 3,470 | 4.1% | -3.3% |
| Total # of 3 AP RXs for 60 | 0.5 | 87 | 0.3 | 54 | 0.3 | 56 | 0.5 | 92 | 0.5 | 93 | 0.5 | 91 | 0.4 | 82 | 0.6 | 94 | 0.5 | 66 | 0.6 | 107 | 0.3 | 60 | 0.6 | 102 | 0.5 | 984 | 26.1% | 17.2% |
| Total # of 3 AP Patients for 60 Days | 0.0 | 6 | 0.0 | 7 | 0.0 | 8 | 0.1 | 11 | 0.1 | 10 | 0.0 | 8 | 0.1 | 10 | 0.1 | 11 | 0.0 | 6 | 0.1 | 12 | 0.1 | 11 | 0.1 | 11 | 0.1 | 111 | 97.3% | 83.3% |
| Total # of 2 AP RXs for 90 | 7.2 | 1,220 | 7.4 | 1,167 | 6.7 | 1,231 | 8.5 | 1,510 | 8.1 | 1,546 | 7.7 | 1,430 | 7.2 | 1,343 | 9.3 | 1,453 | 8.6 | 1,187 | 8.1 | 1,569 | 7.4 | 1,294 | 7.7 | 1,214 | 7.8 | 16,164 | 7.1% | -0.5% |
| Total # of 2 AP Patients for 90 Days | 1.2 | 203 | 1.2 | 196 | 1.1 | 203 | 1.5 | 274 | 1.5 | 281 | 1.3 | 244 | 1.3 | 242 | 1.6 | 251 | 1.3 | 179 | 1.3 | 257 | 1.3 | 228 | 1.3 | 206 | 1.3 | 2,764 | 9.2% | 1.5% |
| N of Prescribers | 170 | | 150 | | 184 | | 177 | | 192 | | 186 | | 186 | | 156 | | 138 | | 194 | | 175 | | 158 | | 501 | | -7.1% | |

*Continued ...*

## Figure 3. Mean and Total Child Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year *(Continued)*

| Child Prescribers in | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| All 12 Qtrs (CAPPALL12) | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 122.4 | 4,530 | 122.6 | 4,537 | 130.4 | 4,824 | 129.8 | 4,801 | 125.7 | 4,651 | 131.7 | 4,872 | 134.5 | 4,975 | 134.5 | 4,975 | 132.9 | 4,916 | 133.9 | 4,954 | 135.7 | 5,022 | 132.1 | 4,886 | 130.5 | 57,943 | 9.7% | 7.9% |
| Total # of AP Patients | 50.1 | 1,852 | 50.6 | 1,871 | 53.1 | 1,964 | 52.3 | 1,936 | 51.6 | 1,911 | 54.7 | 2,024 | 54.7 | 2,023 | 53.8 | 1,991 | 55.6 | 2,056 | 53.3 | 1,972 | 56.6 | 2,096 | 55.6 | 2,057 | 53.5 | 23,753 | 13.6% | 11.1% |
| Total # of 2 AP RXs for 60 | 14.9 | 552 | 17.4 | 644 | 18.6 | 688 | 16.9 | 625 | 14.9 | 553 | 14.6 | 541 | 14.9 | 552 | 16.8 | 623 | 15.6 | 576 | 20.4 | 753 | 14.0 | 518 | 15.0 | 556 | 16.2 | 7,181 | 0.9% | 0.7% |
| Total # of 2 AP Patients for 60 Days | 2.9 | 108 | 3.4 | 125 | 3.6 | 135 | 3.2 | 117 | 2.9 | 108 | 2.9 | 109 | 3.0 | 110 | 3.3 | 121 | 2.6 | 95 | 3.7 | 136 | 3.2 | 118 | 2.7 | 101 | 3.1 | 1,383 | -8.0% | -6.5% |
| Total # of 3 AP RXs for 60 | 0.8 | 30 | 0.8 | 31 | 1.2 | 43 | 2.2 | 83 | 2.2 | 81 | 2.2 | 80 | 1.5 | 57 | 1.8 | 67 | 1.2 | 43 | 1.7 | 64 | 0.9 | 33 | 1.1 | 40 | 1.5 | 652 | 41.0% | 33.3% |
| Total # of 3 AP Patients for 60 Days | 0.1 | 4 | 0.1 | 4 | 0.1 | 5 | 0.2 | 9 | 0.2 | 8 | 0.2 | 7 | 0.2 | 6 | 0.2 | 8 | 0.1 | 4 | 0.2 | 6 | 0.2 | 6 | 0.1 | 5 | 0.2 | 72 | 30.8% | 25.0% |
| Total # of 2 AP RXs for 90 | 13.4 | 495 | 14.9 | 553 | 14.6 | 540 | 18.0 | 667 | 18.8 | 697 | 16.8 | 622 | 14.1 | 521 | 17.5 | 648 | 14.6 | 542 | 19.3 | 714 | 15.6 | 579 | 13.9 | 513 | 16.0 | 7,091 | 4.5% | 3.6% |
| Total # of 2 AP Patients for 90 Days | 2.2 | 82 | 2.5 | 91 | 2.4 | 90 | 3.1 | 115 | 3.0 | 112 | 2.8 | 105 | 2.5 | 91 | 2.9 | 109 | 2.2 | 83 | 3.0 | 112 | 2.6 | 98 | 2.3 | 84 | 2.6 | 1,172 | 3.0% | 2.4% |
| N of Prescribers | 37 | | 37 | | 37 | | 37 | | 37 | | 37 | | 37 | | 37 | | 37 | | 37 | | 37 | | 37 | | 37 | | | |

## Figure 3. Mean and Total Child Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year *(Continued)*

| Top 100 Child Prescribers (TOP100) | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 132.3 | 9,523 | 132.5 | 9,672 | 139.0 | 10,289 | 137.4 | 10,166 | 135.0 | 10,128 | 132.9 | 10,363 | 134.1 | 10,731 | 140.9 | 10,286 | 140.2 | 10,233 | 136.2 | 11,307 | 140.5 | 10,537 | 138.6 | 9,009 | 136.6 | 122,244 | 4.8% | -5.4% |
| Total # of AP Patients | 53.1 | 3,826 | 54.2 | 3,953 | 56.9 | 4,207 | 55.4 | 4,097 | 54.3 | 4,076 | 54.4 | 4,242 | 54.7 | 4,379 | 55.3 | 4,040 | 58.6 | 4,281 | 56.1 | 4,654 | 59.9 | 4,492 | 58.6 | 3,806 | 55.9 | 50,053 | 10.2% | -0.5% |
| Total # of 2 AP RXs for 60 | 11.3 | 816 | 13.3 | 968 | 14.9 | 1,104 | 13.9 | 1,032 | 11.7 | 879 | 10.5 | 820 | 11.3 | 900 | 14.4 | 1,052 | 13.4 | 977 | 14.6 | 1,213 | 10.3 | 774 | 13.0 | 845 | 12.7 | 11,380 | 14.7% | 3.6% |
| Total # of 2 AP Patients for 60 Days | 2.3 | 166 | 2.6 | 192 | 2.9 | 212 | 2.7 | 197 | 2.3 | 175 | 2.2 | 168 | 2.3 | 181 | 2.8 | 204 | 2.2 | 158 | 2.7 | 225 | 2.5 | 184 | 2.4 | 158 | 2.5 | 2,220 | 5.4% | -4.8% |
| Total # of 3 AP RXs for 60 | 0.4 | 30 | 0.6 | 44 | 0.5 | 40 | 1.1 | 80 | 1.2 | 90 | 1.0 | 80 | 0.8 | 60 | 0.9 | 67 | 0.8 | 57 | 1.0 | 82 | 0.6 | 42 | 0.8 | 51 | 0.8 | 723 | 88.3% | 70.0% |
| Total # of 3 AP Patients for 60 Days | 0.1 | 4 | 0.1 | 5 | 0.1 | 6 | 0.1 | 9 | 0.1 | 9 | 0.1 | 7 | 0.1 | 7 | 0.1 | 8 | 0.1 | 5 | 0.1 | 9 | 0.1 | 9 | 0.1 | 6 | 0.1 | 84 | 66.2% | 50.0% |
| Total # of 2 AP RXs for 90 | 10.1 | 725 | 10.9 | 796 | 11.4 | 842 | 14.1 | 1,041 | 13.3 | 1,000 | 11.5 | 895 | 10.7 | 853 | 13.9 | 1,014 | 11.6 | 847 | 13.3 | 1,106 | 11.3 | 850 | 11.1 | 723 | 11.9 | 10,692 | 10.5% | -0.3% |
| Total # of 2 AP Patients for 90 Days | 1.7 | 123 | 1.8 | 134 | 1.9 | 137 | 2.4 | 180 | 2.3 | 171 | 1.9 | 152 | 1.8 | 147 | 2.3 | 169 | 1.8 | 128 | 2.2 | 179 | 2.0 | 148 | 1.8 | 119 | 2.0 | 1,787 | 7.2% | -3.3% |
| N of Prescribers | 100 | | 100 | | 100 | | 100 | | 100 | | 100 | | 100 | | 100 | | 100 | | 100 | | 100 | | 100 | | 100 | | | |

*Continued ...*

## Figure 3. Mean and Total Child Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year *(Continued)*

| Top 100 Prescribers in All 12 Qtrs (TOP100ALL12) | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 137.8 | 4,409 | 137.8 | 4,411 | 147.0 | 4,704 | 145.9 | 4,669 | 141.8 | 4,537 | 148.6 | 4,755 | 150.8 | 4,824 | 151.4 | 4,845 | 149.5 | 4,785 | 151.0 | 4,833 | 153.4 | 4,909 | 149.3 | 4,778 | 147.0 | 56,459 | 10.3% | 8.4% |
| Total # of AP Patients | 56.4 | 1,805 | 57.0 | 1,823 | 59.6 | 1,907 | 58.8 | 1,882 | 58.2 | 1,861 | 61.6 | 1,970 | 61.3 | 1,960 | 60.6 | 1,940 | 62.4 | 1,997 | 60.3 | 1,928 | 64.1 | 2,052 | 62.9 | 2,013 | 60.3 | 23,138 | 14.2% | 11.5% |
| Total # of 2 AP RXs for 60 | 16.1 | 514 | 18.8 | 603 | 20.8 | 667 | 18.9 | 604 | 16.4 | 524 | 16.1 | 515 | 15.9 | 510 | 18.4 | 589 | 16.7 | 534 | 22.3 | 712 | 15.4 | 492 | 16.5 | 527 | 17.7 | 6,791 | 3.1% | 2.5% |
| Total # of 2 AP Patients for 60 Days | 3.2 | 102 | 3.7 | 118 | 4.1 | 131 | 3.5 | 113 | 3.2 | 103 | 3.3 | 104 | 3.2 | 103 | 3.6 | 115 | 2.8 | 88 | 4.0 | 129 | 3.5 | 112 | 3.0 | 96 | 3.4 | 1,314 | -7.2% | -5.9% |
| Total # of 3 AP RXs for 60 | 0.9 | 30 | 0.8 | 27 | 1.1 | 34 | 2.4 | 77 | 2.5 | 81 | 2.5 | 80 | 1.8 | 57 | 2.1 | 67 | 1.3 | 43 | 2.0 | 64 | 1.0 | 33 | 1.3 | 40 | 1.6 | 633 | 41.0% | 33.3% |
| Total # of 3 AP Patients for 60 Days | 0.1 | 4 | 0.1 | 3 | 0.1 | 4 | 0.3 | 8 | 0.3 | 8 | 0.2 | 7 | 0.2 | 6 | 0.3 | 8 | 0.1 | 4 | 0.2 | 6 | 0.2 | 6 | 0.2 | 5 | 0.2 | 69 | 30.8% | 25.0% |
| Total # of 2 AP RXs for 90 | 14.5 | 463 | 16.0 | 511 | 15.9 | 510 | 20.0 | 640 | 20.7 | 663 | 18.6 | 596 | 15.3 | 488 | 19.2 | 615 | 15.8 | 505 | 20.9 | 670 | 17.1 | 547 | 15.1 | 484 | 17.4 | 6,692 | 5.6% | 4.5% |
| Total # of 2 AP Patients for 90 Days | 2.4 | 78 | 2.6 | 84 | 2.7 | 85 | 3.5 | 111 | 3.3 | 107 | 3.1 | 100 | 2.7 | 86 | 3.3 | 104 | 2.4 | 77 | 3.3 | 105 | 2.9 | 92 | 2.5 | 79 | 2.9 | 1,108 | 1.6% | 1.3% |
| N of Prescribers | 32 | | 32 | | 32 | | 32 | | 32 | | 32 | | 32 | | 32 | | 32 | | 32 | | 32 | | 32 | | 32 | | | |

## Figure 3. Mean and Total Child Antipsychotic Prescriptions for Prescribers in the Florida Medicaid Program Hitting an Edit by Selected Prescriber Population and Quarter/Year *(Continued)*

| Top 13 Prescribers (TOP13) | Qtr/Year | | | | | | | | | | | | | | | | | | | | | | | | | | 3-Year % Change | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3-2007 | | Q4-2007 | | Q1-2008 | | Q2-2008 | | Q3-2008 | | Q4-2008 | | Q1-2009 | | Q2-2009 | | Q3-2009 | | Q4-2009 | | Q1-2010 | | Q2-2010 | | Total | | | |
| | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total | Mean | Total Scripts |
| Total # of AP RXs | 122.8 | 614 | 116.0 | 580 | 131.6 | 658 | 139.5 | 558 | 172.6 | 863 | 174.2 | 871 | 183.2 | 916 | 187.0 | 935 | 187.6 | 938 | 186.3 | 559 | 162.5 | 650 | 227.0 | 681 | 163.4 | 8,823 | 84.9% | 10.9% |
| Total # of AP Patients | 51.8 | 259 | 50.0 | 250 | 56.0 | 280 | 57.8 | 231 | 67.8 | 339 | 72.0 | 360 | 74.6 | 373 | 75.2 | 376 | 72.8 | 364 | 72.0 | 216 | 68.0 | 272 | 100.0 | 300 | 67.0 | 3,620 | 93.1% | 15.8% |
| Total # of 2 AP RXs for 60 | 12.2 | 61 | 14.0 | 70 | 16.4 | 82 | 14.0 | 56 | 18.2 | 91 | 14.2 | 71 | 16.6 | 83 | 16.6 | 83 | 19.8 | 99 | 31.0 | 93 | 12.3 | 49 | 23.3 | 70 | 16.8 | 908 | 91.3% | 14.8% |
| Total # of 2 AP Patients for 60 Days | 2.6 | 13 | 2.8 | 14 | 3.0 | 15 | 2.3 | 9 | 3.0 | 15 | 2.8 | 14 | 3.0 | 15 | 3.6 | 18 | 3.2 | 16 | 5.7 | 17 | 3.0 | 12 | 3.7 | 11 | 3.1 | 169 | 41.0% | -15.4% |
| Total # of 3 AP RXs for 60* | 0.0 | 0 | 0.0 | 0 | 0.6 | 3 | 4.8 | 19 | 6.2 | 31 | 5.8 | 29 | 5.4 | 27 | 7.4 | 37 | 7.2 | 36 | 13.0 | 39 | 3.3 | 13 | 6.7 | 20 | 4.7 | 254 | - | - |
| Total # of 3 AP Patients for 60 Days* | 0.0 | 0 | 0.0 | 0 | 0.2 | 1 | 0.5 | 2 | 0.6 | 3 | 0.6 | 3 | 0.6 | 3 | 0.8 | 4 | 0.6 | 3 | 1.0 | 3 | 0.5 | 2 | 0.7 | 2 | 0.5 | 26 | - | - |
| Total # of 2 AP RXs for 90 | 11.8 | 59 | 12.6 | 63 | 14.2 | 71 | 15.5 | 62 | 27.6 | 138 | 19.6 | 98 | 19.0 | 95 | 22.2 | 111 | 21.6 | 108 | 38.3 | 115 | 22.0 | 88 | 27.7 | 83 | 20.2 | 1,091 | 57.3% | 40.7% |
| Total # of 2 AP Patients for 90 Days | 1.8 | 9 | 2.0 | 10 | 2.4 | 12 | 2.5 | 10 | 3.6 | 18 | 3.0 | 15 | 2.8 | 14 | 3.8 | 19 | 2.8 | 14 | 5.3 | 16 | 3.3 | 13 | 3.7 | 11 | 3.0 | 161 | 50.9% | 22.2% |
| N of Prescribers | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | 13 | | | |

The total number of prescriptions written by the child prescribers was 162,483 prescriptions. Over the 12 quarters, the total number of antipsychotic prescriptions declined 6.8 percent, from 13,286 prescriptions in the first quarter of 2007 to 12,378 prescriptions in the 2nd quarter of 2010. The largest numbers of prescriptions, 14,912 were written in the 4th quarter of 2009.

Of the 501 child prescribers in Figure 3, the top 100 child prescribers wrote 122,244 antipsychotic prescriptions or 75.2 percent of all antipsychotic prescriptions. For the top 100 child prescriber subgroup and the child subgroup with the top 100 prescribers that were in all 12 periods in Figure 3, their shares of the total prescriptions dropped to 35.6 percent and 34.7 percent, respectively. The shares of antipsychotic prescriptions for these two subgroups are substantially lower than the corresponding shares in Figure 2 for the top 250 adult prescribers and top 250 adult prescribers present in all periods—69.5 percent and 58.4 percent, respectively. Thus, while the top 250 adult prescribers and top 100 child prescriber categories both represent approximately 75 percent of all the prescriptions written by prescribers who hit the UPPMI database, those adult prescribers present in all periods or those adult prescribers present in all periods and among the top adult prescribers have nearly twice the impact on the overall number of prescriptions and patients as their child counterparts.

Unlike the substantial increases in antipsychotic prescriptions and patients in the adult subgroups, the practice patterns for the child subgroups are much less dynamic. The difference between the number of antipsychotic prescriptions and patients in the all child prescriber category and the top 13 subgroup is only a 2-3 fold difference compared to the nearly 10-fold difference found in the adult top 13 subgroup.

### Costs of Antipsychotic Prescription and Role of Top Prescribers

Figure 4 reports the costs of drugs and antipsychotic drugs by quarter in Florida for the period Q1-2009 thru Q2-2010 and calculates the overall prescription costs and share of prescription costs that is attributable to antipsychotic prescriptions for the Top 13 prescribers. Overall, for the six-quarter period, antipsychotic drugs represented 51.7 percent of all Florida Medicaid behavioral drug expenditures although they accounted for only 22.6 percent of antipsychotic prescriptions. Of note, although antipsychotic expenditures have grown 5.2 percent during this period, the total cost share attributable to antipsychotic prescriptions in the Florida Medicaid program has declined 7.2 percent.

For the Top 13 prescribers, the overall costs of their behavioral health prescriptions averaged between $6 million and $7 million per quarter while their antipsychotic payments were between $4 million and $5 million per quarter. Overall, these Top 13 prescribers represented 13 percent of all Florida Medicaid drug payments, and they peaked at 14.2 percent of all drug payments in fourth quarter 2009. As a share of their Medicaid payments, 72.2 percent of their reimbursement was for antipsychotic prescriptions.

## Discussion

This rapid growth in the use of antipsychotic medications and their related costs has resulted in states developing programs to measure, monitor, and ensure their beneficial relevance to program populations. One such program, MDTMP, developed in

**Figure 4. Antipsychotic Drug Utilization and Costs Based on Paid Fee-For-Service Claims for All Florida Medicaid Prescribers and Top 13 Medicaid Prescribers, January 2009 to June 2010**

| | Q1–2009 | Q2–2009 | Q3–2009 | Q4–2009 | Q1–2010 | Q2–2010 | Total | % Change |
|---|---|---|---|---|---|---|---|---|
| **Total Expenditures** | | | | | | | | |
| Antipsychotics | $3,60,25,142 | $3,47,93,287 | $3,60,92,463 | $3,49,15,467 | $3,56,08,657 | $3,55,02,731 | $21,29,37,746 | –1.5% |
| Total Expenditures for Behavioral Drugs | $7,36,85,417 | $6,78,59,400 | $6,62,56,984 | $6,59,14,667 | $6,90,13,256 | $6,90,44,757 | $41,17,74,481 | –6.3% |
| % of Total Expenditures | 48.9% | 51.3% | 54.5% | 53.0% | 51.6% | 51.4% | 51.7% | 5.2% |
| **Total Unique Count** | | | | | | | | |
| Antipsychotics | 88,932 | 89,941 | 92,049 | 91,908 | 91,297 | 92,418 | 5,46,545 | 3.9% |
| Total Unique Count for All Drugs | 3,79,586 | 3,87,313 | 4,00,302 | 4,09,077 | 4,17,741 | 4,25,193 | 24,19,212 | 12.0% |
| % of Total Prescriptions | 23.4% | 23.2% | 23.0% | 22.5% | 21.9% | 21.7% | 22.6% | –7.2% |
| **Impact of Top 13 Prescribers** | | | | | | | | |
| Total Prescription $ for Top 13 Prescribers | $62,54,558 | $63,72,476 | $66,11,127 | $65,49,886 | $63,86,502 | $62,21,962 | $3,83,96,512 | –0.5% |
| Total $ for AP Drugs Among Top 13 Prescribers | $46,37,824 | $46,95,407 | $49,38,851 | $49,56,330 | $42,46,249 | $42,40,884 | $2,77,15,546 | –8.6% |
| % of Total Expenditures that are Antipsychotic Attributable to Top 13 Prescribers | 74.2% | 73.7% | 74.7% | 75.7% | 66.5% | 68.2% | 72.2% | –8.1% |
| % of Total Florida Antipsychotic Expenditures Attributable to Top 13 Prescribers | 12.9% | 13.5% | 13.7% | 14.2% | 11.9% | 11.9% | 13.0% | –7.2% |

the state of Florida has adopted an evidence-based approach to identify indicators of unusual psychotherapeutic medication and track their patterns of treatment and costs in Medicaid patients over a three-year period. This study reports on the prescriber prescription and cost patterns for adults and children for various groups of practitioners using three UPMI measures: two antipsychotics for 60 days (2AP60), three antipsychotics for 60 days (3AP60), and two antipsychotics for 90 days or longer (2AP90). We framed the study by addressing three questions.

First, we asked what were the overall trends of Florida Medicaid prescriptions, prescribers, and patients and their costs for the four-year period July 2006 through June 2010. For adults and children in the Florida Medicaid program the total numbers of antipsychotic prescriptions has increased dramatically, jumping 30.4 percent between FY 2006/07 and FY 2009/10; with the increase for adult prescriptions at 19.3 percent, while for children the increase was 72.4 percent. Corresponding to the increase in the number of prescriptions is a substantial increase in the costs of behavioral prescriptions. Overall behavioral drug costs increased by 32.1 percent to $330 million in FY 2009/10 with the costs for adults growing 21.8 percent over the four-year period while, for children, behavioral drug costs grew 54.7 percent.

A second question we raised related to the antipsychotic prescribing patterns of Florida Medicaid prescribers who have written one or more unusual psychotherapeutic medication indicator (UPMI) prescriptions for an adult or a child. In particular, we focused on the influence of smaller subgroups among these prescribers: prescribers who appeared in every quarter, the top 250 adult prescribers and top 100 child prescribers, and the overall impact of a small number of prescribers, that is, the top 13 prescribers in 2009. There are a number of findings to be noted.

There is a large disparity between the numbers of potential prescribers in the state of Florida and the number of prescribers that hit a UPMI. There were 2,462 unique adult and child AAP prescribers in our study during FY 2009/2010 representing 5.2 percent of the 47,780 Florida Medicaid prescribers in Figure 1. However, as we show in Figure 5, focusing on just the top 350 adult and child prescribers (top 250 adults and top100 child prescribers) in the Florida Medicaid program that hit a UPMI, compared to all the prescribers that hit a UPMI, these 350 prescribers represented less than 1 percent of total state Medicaid prescribers but together these 350 prescribers accounted for 74.5 percent of the total prescriptions and 73.8 percent of the total patients written by this group; 69.1 percent of the prescriptions and 68.1 percent of the patients that hit 2AP60 edits; 79.1 percent of the prescriptions and 77.3 percent of the patients that hit 3AP60 edits; and 72.0 percent of the prescriptions and 70.9 percent of the patients that hit 2AP90 edits.

This disparity is not as evident among children prescribers. As shown in Figure 5, the children prescribers contribute a relatively small share of this percentage. Just the 100 top child prescribers accounted for 17 percent of the total prescriptions and 19 percent of the total patients in our population; 9.8 percent of the prescriptions and 10 percent of the patients that hit 2AP60 edits; 4.9 percent of the prescriptions and 5.1 percent of the patients that hit 3AP60 edits; and 8.1 percent of the prescriptions and 8.6 percent of the patients that hit 2AP90 edits.

The substantial impact resulting from just a few top prescribers is also evident in Figure 5.

**Figure 5. Total Number and Percentage of Adult and Child Behavioral Antipsychotic Prescriptions and Patients for Prescribers in the Florida Medicaid Program Hitting an Edit**

| | # of Prescriptions for All Adults and Children | # of Prescriptions for Top 350 Adult and Child Prescribers | # of Prescriptions for Top 250 Adult Prescribers Only | # of Prescriptions for Top 250 Child Prescribers Only | # of Prescriptions for Top 13 Adult and Child Prescribers | % Share Top 350 Prescribers of Total # of Prescriptions | % Share Top 250 Adult Prescribers of Total # of Prescriptions | % Share Top 100 Child Prescribers of Total # of Prescriptions | % Share Top 13 Prescribers of Total # of Prescriptions |
|---|---|---|---|---|---|---|---|---|---|
| Total # of AP RXs | 9,63,136 | 7,17,218 | 5,94,974 | 1,22,244 | 1,33,927 | 74.5% | 61.8% | 17.0% | 13.9% |
| Total # of AP Patients | 3,57,244 | 2,63,823 | 2,13,770 | 50,053 | 48,083 | 73.8% | 59.8% | 19.0% | 13.5% |
| Total # of 2 AP RXs for 60 Days | 1,67,597 | 1,15,811 | 1,04,431 | 11,380 | 19,808 | 69.1% | 62.3% | 9.8% | 11.8% |
| Total # of 2 AP Patients for 60 Days | 32,695 | 22,258 | 20,038 | 2,220 | 3,829 | 68.1% | 61.3% | 10.0% | 11.7% |
| Total # of 3 AP RXs for 60 Days | 18,708 | 14,796 | 14,073 | 723 | 4,032 | 79.1% | 75.2% | 4.9% | 21.6% |
| Total # of 3 AP Patients for 60 Days | 2,141 | 1,654 | 1,570 | 84 | 437 | 77.3% | 73.3% | 5.1% | 20.4% |
| Total # of 2 AP RXs for 90 Days | 1,83,860 | 1,32,339 | 1,21,647 | 10,692 | 23,358 | 72.0% | 66.2% | 8.1% | 12.7% |
| Total # of 2 AP Patients for 90 Days | 29,268 | 20,754 | 18,967 | 1,787 | 3,712 | 70.9% | 64.8% | 8.6% | 12.7% |
| N of Prescribers | 2,462 | 350 | 250 | 100 | 13 | 350 | 250 | 100 | 13 |

Just focusing on the top 13 prescribers for both prescriptions and patients, we see that they represent between 11.7 percent and 21.6 percent of all the UPMIs prescriptions and patients among the 2,462 Medicaid prescribers that hit a UPMI edit. For these top 13 prescribers, their overall prescriptions and patients represent 13.9 percent and 13.5 percent, respectively, of all the prescriptions and patients aggregated in this three-year period.

Thus, for these subgroups of Florida Medicaid prescribers, we find, in general, that the top 350 prescribers account for nearly 75 percent of the UPMIs while the top 250 adults roughly account for 60 percent of the UPMIs. For the top 13 adult and children subgroup and the top 13 adult subgroup, this influence, in general, drops to the 11 percent–13 percent range.

The extent of the UPMI impact for the top children prescribers appears to be much smaller than the influence attributable to the top adult prescribers. These findings would suggest that a strategy to monitor and ensure patient safety as well as prescribing patterns that targets a relatively small number of aberrant Medicaid providers could have a substantial cost savings for the Medicaid program. However, the potential cost benefit from such a strategy would appear to be much greater if it were targeted on the top adult prescribers than the top children prescribers.

Our final question focused on the costs of antipsychotics, and we analyzed the share of total Medicaid drug expenditures in Florida for the 6 quarter period—Q1-2009 through Q2-2010—that is attributable to antipsychotic drugs, and that share is attributable to the top 13 prescribers. Our findings indicate that the top 13 prescribers accounted for more than $38 million in Medicaid prescriptions over this period, of which nearly $28 million (72.2 percent) was for antipsychotic prescriptions. Overall, these 13 top prescribers accounted for 13 percent of the total spent on antipsychotics by the Florida Medicaid program and 9.3 percent of the total expenditure by the state for all drugs.

The identification of high-cost practice patterns has been termed "cost-intensive providers." A recent study published in the *Journal of Occupational and Environmental Medicine*, in which researchers analyzed five years of claims data from the Louisiana Workers' Compensation Corporation from 1998 to 2002, found that a small group of physicians—only 3.7 percent—accounted for more than 72 percent of the workers' compensation costs. The authors referred to physicians in this group as cost-intensive providers, and they suggested that an examination of practice patterns could have a profound impact on overall costs.[41]

It is important to acknowledge that most physicians practice prudently but prescribers who engage in cost-intensive practices need to be scrutinized. As we continue to debate the nation's health care system and look for cost savings, it is important to analyze how practice patterns drive costs before we can effectively improve or reform the system. Moreover, as we search for ways to improve patient outcomes, high-volume practices that engage in unusual prescribing patterns need to be monitored and profiled. Although our results indicate that there generally has been a decline in prescriptions and patients that hit UPMIs over the three-year period in adults, for children this pattern is mixed. Given the growing importance of monitoring and improving concurrent antipsychotic prescriptions for both adults and children, further research is needed to identify and implement effective interventional strategies.

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# Trend Analysis of Key Solvency Ratios for Health Plans in Medicaid Managed Care

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The focus of this article is to assess the solvency of health plans that manage Medicaid members across key plan traits, specifically Medicaid dominant or plans with more than 75 percent Medicaid members, and plans owned by publicly traded companies, and sponsored by health care providers. The study accessed National Association of Insurance Commissioners (NAIC) financial data and computed key solvency ratios for 117 Medicaid health plans over a five-year time trend from 2007 to 2011. A mean test compared the mean values for each year and for the entire study period on risk-based capital (RBC), cash-flow margin and debt to total capital ratios across these plan traits. For all years except 2008 Medicaid dominant plans had a lower RBC ratio for all four out of five years. Cash-flow margin ratio for Medicaid dominant plans was only lower in 2011 than non-Medicaid dominant plans. From 2007 to 2010, debt to total capital was higher for plans owned by publicly traded companies than non-publicly traded companies. Given the potential for an expanding Medicaid market, Medicaid health plans have reduced their risk of insolvency by increasing the RBC over time and reducing their debt capital. However between 2010 and 2011 cash-flow margin ratio decreased by almost 180 basis points for Medicaid dominant plans.

**Key words:** *Publicly traded health plans, Medicaid dominant health plans, solvency ratios, risk-based capital, RBC.*

## Introduction

In 2011, there were more than 53 million Medicaid beneficiaries in the United States, which represents a 21 percent increase in Medicaid enrollment from the pre-economic recession of 42.3 million Medicaid members in 2007.[1,2] Although the Medicaid rate of growth in members slowed to 4.4 percent in 2011 compared to more than a 7 percent increase in the prior periods of 2009 and 2010,[3] Medicaid is still a major cost driver of state budgets. To curtail this rising Medicaid cost within state budgets, states continue to contract with managed care organizations (MCOs).

In 2010, 48 percent of Medicaid members were enrolled in risk-based comprehensive MCOs. Out of 306 commercial and Medicaid-only managed care plans, 163 plans served only the Medicaid population while 143 plans offered not only a Medicaid product but a commercial or Medicaid product as well.[4] By 2011 more than half of Medicaid beneficiaries were enrolled in comprehensive, full-service MCOs.[5] With the onset of the Affordable Care Act (ACA) in 2014, Medicaid enrollment growth is expected to increase by 17 million by 2016.[6,7,8] Under ACA, states are expected to expand enrollment to childless adults below the 138 percent federal poverty level as well as adult members with disabilities. However, to reduce their state Medicaid budgets, 32 states are currently moving ahead before ACA and enrolling children with special needs in managed care programs while 33 states are enrolling adults with disabilities.[9]

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*J Health Care Finance* 2013; 40(1):68–78

Given the lack of experience in managing this high-cost population, MCOs are expected to face greater financial risk in controlling the medical claims of this new population.

Several prior studies[10,11] analyzed the financial performance of Medicaid plans but focused on the financial performance, specifically the medical loss ratio, administrative cost ratio, and operating margin ratio of the Medicaid line of business, rather than key solvency ratios. Analyzing the financial performance of Medicaid dominant plans and the plan traits of Medicaid plans, a recent study by McCue[12] found that plans with more than 75 percent of their enrollment in Medicaid had a higher Medicaid operating profit margin than plans that were multi-product plans. In addition, the study found that Medicaid plans owned by publicly traded companies and sponsored by health care providers did not earn higher Medicaid operating profit margins than their counterparts. However, an earlier study by Hurley *et al*.,[13] found a higher operating profit margin ratio for the Medicaid plans owned by publicly traded companies.

In contrast to these prior studies, the primary aim of this study is to analyze over time the financial solvency ratios of Medicaid health plans, which are computed from the financial accounts for the entire health plan. A secondary aim of the study is exploratory in nature and conducts a descriptive analysis of these solvency measures by key plan traits. These plan traits relate to the percentage of Medicaid members enrolled as well as plan ownership traits, which include plans owned by publicly traded companies and sponsored by health care providers. Financial data of these plans are accessed from the 2011 Five Year Historical Data form from the National Association of Insurance Commissioners (NAIC) annual statements, which provides key financial accounts to compute the solvency ratios for 2007 to 2011.[14] In terms of research questions, the study will address whether Medicaid plans with certain traits are financially sound and will avoid any risk of insolvency. Other research-related questions include: Are health plans that serve primarily the Medicaid line of business financially sound? Are health plans sponsored by health care providers financially sound?

## Methodology

CMS Medicaid Managed Care Enrollment Report for 2011 lists 332 at-risk-based managed care plans. However, in reviewing the list, the study found only 238 comprehensive, full-service, at-risk Medicaid health plans.[15] Financial data to compute solvency ratios for the health plans were accessed from the annual statements from the National Association of Insurance Commissioners (NAIC). Forty-four Medicaid managed care health plans from three states (Arizona, California, and Oregon) did not report data to NAIC and were excluded from the analysis. In addition, in the state of New York there were nine health plans that do not report data to NAIC and only reported the data to the state's Department of Insurance or Department of Health. From NAIC data, 185 comprehensive, full-service health plans were identified. The study was only able to collect solvency data for all five years for 117 health care plans that offered a Medicaid Managed Care Product and had ratio values within the 5th and 95th percentiles.[16] These outlier / missing value plans were either smaller membership or startup plans, or both, which contributes to a greater variability in financial ratios. As a result of these exclusions of plans, the final sample may not be representative of all

Medicaid health plans, since they exclude plans from the states of Arizona, California, and Oregon as well as smaller start-up plans.

Health plan organizational and enrollment data were analyzed to categorize the three plan traits: Medicaid dominant status, publicly traded status, and provider-sponsored status. Using the prior studies of Felt-Lisk and Yang;[17] Hurley *et al.*,[18] and McCue,[19] Medicaid dominant status was defined as plans with 75 percent or more of their total membership in Medicaid. For Medicaid dominant status, 51 percent of the 117 plans were categorized as Medicaid dominant plans while 49 percent were multi-product plans.

Publicly traded status was defined as plans that were owned and operated as a subsidiary of a publicly traded managed care company while plans that were non-publicly traded represented private for-profit or nonprofit plans. For publicly traded status, 47 percent of the 117 plans were publicly traded and 53 percent were non-publicly traded plans. Provider-sponsored status was defined as plans that were sponsored, affiliated, or owned by hospitals, health care systems, or medical clinics. Plans that did not fall within this definition were defined as non-provider-sponsored plans.[20] For provider-sponsored status, 26 percent of the 117 plans were provider-sponsored plans and 74 percent were non-provider-sponsored plans.

The study analyzed three key solvency ratios: risk-based capital (RBC) ratio, cash-flow margin, and total debt to total adjusted capital.[21] The RBC is the primary ratio analyzed by state insurance examiners and is defined as the health plan's total adjusted capital divided by its authorized control capital or minimum capital level.[22] The authorized control capital is based on a formula of risk factors related to the insurance contracts, investment portfolio, and other business services of the health plan.[23] For example if a health plan's total adjusted capital drops to 200 percent of the authorized control capital, the health plan must report to the state regulators what corrective action it is taking to improve the ratio. Conversely if the health plan's total adjusted capital is less than 100 percent of the adjusted capital, the state regulators may take control of the health plan. Overall, the higher the health plan's RBC ratio the greater likelihood the plan will avoid bankruptcy and improve its financial flexibility to expand its market share and invest in assets, such as information technology, to support its membership growth.

One weakness of the RBC ratio is that it represents the financial condition at a fixed point in time and does not measure the operational funds required by the health plan to pay claims and replenish its capital position. In the case of the state of California's Department of Managed Care, the cash flow of the health plan also is used to assess the solvency of state health plans over time.[24] Therefore, for this study, the cash-flow margin ratio, which is defined as the cash flow from operations as percentage of total revenues, is measured. This advantage of this ratio is that it accounts for all sources of capital, specifically operating profits, investment income, and capital gains, and adjusts for the cash-flow changes occurring from changes in current assets and current liabilities each year.

Finally, the study will measure the other source of capital, which is debt capital, and analyze the health plan's trend in utilizing this source of capital over time. The financial ratio is defined as debt to total adjusted capital ratio.[25] Health plans increasing their use of debt can raise their financial risk and increase likelihood of insolvency.

These three financial ratios account for all lines of business within the health plan

entity. For example if the Medicaid plan offers commercial insurance the cash-flow margin ratio measures the cash flows generated from both the Medicaid and commercial lines of business. The study conducted a t-test to assess any mean differences among plan characteristics and Medicaid dominance for each year as well as the average value for all five annual periods.

**Results**

Figure 1 presents RBC ratio findings across the three main plan traits. For the Medicaid dominant plans the lowest RBC ratio for both categories occurred in 2009, which was during the height of the credit crisis when returns on most security investments were negative. However, after 2009, the Medicaid dominant plans' total adjusted capital increased from an average of 3.99 times their authorized control capital in 2009 to an average of 4.59 times their authorized control capital in 2011. Similarly the non-Medicaid dominant plans increased their total adjusted capital from an average of 4.54 times their authorized capital in 2009 to an average of 5.41 times their authorized control capital in 2011. For all the years except 2008, as well as the average value for the entire five-year time frame, the Medicaid dominant plans' RBC ratio was significantly lower than non-Medicaid dominant plans.

For publicly traded status and provider-sponsored status, there were no significant differences over time. For publicly traded and non-publicly traded plans, the RBC ratio did decrease from 2007 to 2009 but then trended upward in 2010 and 2011. The same outcome occurred for provider-sponsored and non-provider sponsored plans in that there was an upward trend in the RBC ratio after 2009.

Figure 2 presents cash-flow margin ratio findings across the three main plan traits. For Medicaid dominant status, there was no significant difference for all the years as well as no difference in the average value for all years, except 2011. In 2011, cash-flow margin ratio was marginally significantly lower for the Medicaid dominant plans. In 2011 Medicaid dominant plans generated an average cash-flow margin ratio of 2.01 percent which is significantly lower than the average cash-flow margin ratio of 3.51 percent for Non-Medicaid dominant plans. For the Medicaid dominant plans, their average cash-flow margin ratio fluctuated over time. In 2007 the cash-flow margin ratio was 4.23 percent but declined to 2.87 percent in 2009. However in 2010, the average cash-flow margin ratio increased to 3.89 percent. The trend analysis for the Non-Medicaid dominant plans also decreased from 4.64 percent in 2007 to 1.88 percent in 2009. However since 2009, the average cash-flow margin ratio exhibited an upward trend and increased to 3.51 percent.

For the other two plan traits of publicly traded status and provider-sponsored status, there were only two significant findings. In 2007, publicly traded plans had an average cash-flow margin ratio of 5.66 percent compared to 3.34 percent for non-publicly traded plans. In addition, the average cash-flow margin for all five years was significantly higher (3.87 percent vs. 2.90 percent) for publicly traded plans compared to their non-publicly traded counterparts. However, over time, for publicly traded plans, the average cash-flow margin ratio had declined dramatically from 5.66 percent in 2007 to 2.34 percent in 2011. Except for 2009, non-publicly traded plans' average cash-flow margin ratio has remained above 3 percent for each year.

**Figure 1. Mean and Standard Deviation of RBC Ratio for Medicaid Health Plans by Plan Traits and Time: 2007 to 2011**

**Medicaid Dominant Status**

| | | Medicaid Dominant n=60 | | Non-Medicaid Dominant n=57 | | |
|---|---|---|---|---|---|---|
| | | Mean | Std Dev | Mean | Std Dev | |
| RBC | 2011 | 4.59 | 1.39 | 5.41 | 2.13 | * |
| RBC | 2010 | 4.52 | 1.56 | 5.33 | 2.39 | ** |
| RBC | 2009 | 3.99 | 1.64 | 4.54 | 1.89 | ** |
| RBC | 2008 | 4.14 | 1.61 | 4.66 | 2.00 | |
| RBC | 2007 | 4.05 | 1.61 | 5.15 | 2.36 | * |
| | All yrs | 4.26 | 1.27 | 5.02 | 1.92 | * |

**Publicly Traded Status**

| | | Publicly Traded n=55 | | Non-Publicly Traded n=62 | |
|---|---|---|---|---|---|
| | | Mean | Std Dev | Mean | Std Dev |
| RBC | 2011 | 4.90 | 1.57 | 5.07 | 2.04 |
| RBC | 2010 | 4.80 | 2.06 | 5.02 | 2.02 |
| RBC | 2009 | 4.07 | 1.69 | 4.42 | 1.86 |
| RBC | 2008 | 4.14 | 1.55 | 4.62 | 2.01 |
| RBC | 2007 | 4.39 | 1.70 | 4.76 | 2.36 |
| | All yrs | 4.46 | 0.19 | 4.78 | 0.24 |

**Provider Sponsored status**

| | | Provider-Sponsored n=86 | | Non-Provider-Sponsored n=31 | |
|---|---|---|---|---|---|
| | | Mean | Std Dev | Mean | Std Dev |
| RBC | 2011 | 4.69 | 1.72 | 5.10 | 1.86 |
| RBC | 2010 | 4.58 | 1.81 | 5.04 | 2.11 |
| RBC | 2009 | 4.09 | 1.86 | 4.32 | 1.76 |
| RBC | 2008 | 4.42 | 1.98 | 4.39 | 1.77 |
| RBC | 2007 | 4.34 | 2.07 | 4.67 | 2.08 |
| | All yrs | 4.42 | 1.71 | 4.70 | 1.63 |

* significant at .01 level
** significant at .05 level

For provider-sponsored plans, the average cash-flow margin ratio declined from 4.42 percent in 2007 to 1.54 percent in 2009. However since 2009, the ratio was back above 3 percent. For non-provider-sponsored plans, the average cash-flow margin ratio has varied over each year and has declined from 3.35 percent in 2010 to 2.58 percent in 2011.

**Figure 2. Mean and Standard Deviation of Cash-Flow Margin Ratio for Medicaid Health Plans by Plan Traits and Time: 2007 to 2011 (Percentage Values)**

**Medicaid Dominant Status**

| | | Medicaid Dominant n=60 | | Non Medicaid Dominant n=57 | | |
|---|---|---|---|---|---|---|
| | | Mean | Std Dev | Mean | Std Dev | |
| Cash-flow margin | 2011 | 2.01 | 6.30 | 3.51 | 4.52 | *** |
| Cash-flow margin | 2010 | 3.89 | 5.79 | 2.97 | 3.93 | |
| Cash-flow margin | 2009 | 2.87 | 4.52 | 1.88 | 4.83 | |
| Cash-flow margin | 2008 | 3.28 | 6.50 | 4.36 | 6.21 | |
| Cash-flow margin | 2007 | 4.23 | 6.08 | 4.64 | 7.09 | |
| | All yrs | 3.25 | 2.40 | 3.47 | 2.82 | |

**Publicly Traded Status**

| | | Publicly Traded n=55 | | Non-Publicly Traded n=62 | | |
|---|---|---|---|---|---|---|
| | | Mean | Std Dev | Mean | Std Dev | |
| Cash-flow margin | 2011 | 2.34 | 6.90 | 3.10 | 3.99 | |
| Cash-flow margin | 2010 | 3.93 | 6.13 | 3.00 | 3.64 | |
| Cash-flow margin | 2009 | 2.96 | 4.51 | 1.88 | 4.81 | |
| Cash-flow margin | 2008 | 4.49 | 6.66 | 3.20 | 6.06 | |
| Cash-flow margin | 2007 | 5.66 | 7.44 | 3.34 | 5.51 | ** |
| | All yrs | 3.87 | 2.71 | 2.90 | 2.44 | ** |

**Provider Sponsored status**

| | | Provider-Sponsored n=31 | | Non Provider-Sponsored n=86 | | |
|---|---|---|---|---|---|---|
| | | Mean | Std Dev | Mean | Std Dev | |
| Cash-flow margin | 2011 | 3.18 | 3.57 | 2.58 | 6.10 | |
| Cash-flow margin | 2010 | 3.70 | 2.92 | 3.35 | 5.54 | |
| Cash-flow margin | 2009 | 1.54 | 4.23 | 2.69 | 4.82 | |
| Cash-flow margin | 2008 | 3.76 | 6.20 | 3.82 | 6.45 | |
| Cash-flow margin | 2007 | 4.42 | 4.76 | 4.43 | 7.13 | |
| | All yrs | 3.32 | 2.82 | 3.37 | 2.54 | |

* significant at .01 level
** significant at .05 level
*** significant at .10 level

Figure 3 presents Debt to Total Adjusted Capital ratio findings across the three plan traits. For Medicaid dominant status, there was no significant difference for all the years as well as in the average value for all years. Medicaid dominant plans

have reduced their average Debt to Total Adjusted Capital ratio from 1.39 in 2007 to 0.99 in 2011. Non-Medicaid dominant plans also lowered their average Debt to Total Adjusted Capital ratio over time from 1.27 in 2008 to 1.06 in 2011.

For publicly traded status, the average Debt to Total Adjusted Capital ratio was significantly higher for plans owned by publicly traded companies in every year except 2011 compared to plans not owned by publicly traded companies. The average value for all five years is also significantly higher for publicly traded plans (1.29), compared to non-publicly traded plans (1.09).

For provider-sponsored status, the average Debt to Total Adjusted Capital ratio was significantly lower for plans affiliated with a health care provider compared to non-affiliated plans for 2007 and 2008 as well as the average value for all five years. For 2011, both provider-sponsored and non-provider-sponsored plans' Debt to Total Adjusted Capital ratio was slightly above one, indicating an equivalent amount of debt to total capital.

## Discussion and Implications

The aim of this study was to assess over time the financial solvency of health plans that offer Medicaid product across key plan traits of Medicaid dominant status, publicly traded status, and provider-sponsored status. Under ACA, solvency measures of Medicaid health plans may face greater scrutiny as a result of expanding Medicaid by 17 million members and improving the coordination of care by CMS to enroll its 9 million dual eligibles' into risk-based Medicaid managed care programs.[26] More importantly, financial instability for health plans that contract with this population may occur from inadequate risk-adjusted rates to compensate for the higher medical expenses and specialized services of these dual eligible members and special needs members. In 2011, the average health plan had adequate levels of capital that covered at least four times the authorized level. The study also found in 2011 that only two plans had an RBC ratio below two, which required the health plans to take corrective action and file a report with their respective state insurance commissioners.

However, Medicaid dominant plans, specifically plans with more than 75 percent of their members in Medicaid, had a lower proportion of adjusted capital to authorized capital than non-Medicaid dominant plans. There are several concerns going forward for Medicaid dominant plans in terms of their ability to restock their capital reserves. First, Medicaid dominant plans generated lower cash-flow margin in 2011 than their counterparts, which means lower cash reserves to increase their current capital position. Second, continued state budget constraints on Medicaid may reduce Medicaid rates and cash flow for Medicaid dominant plans since they depend heavily on the Medicaid line of business. However, Medicaid dominant plans owned by publicly traded companies or affiliated with providers can depend upon their parent organization to help fund their capital position.

The trend analysis of the RBC ratio across all plan traits reflects the way the economic credit crisis of 2008 resulted in substantial realized and unrealized capital losses from security investments and may have contributed a substantial reduction in the RBC ratio in 2009 from the prior years. The Medicaid dominant plans had the lowest average RBC in 2009 with a ratio value of 3.99 while non-Medicaid dominant plans incurred the

**Figure 3. Mean and Standard Deviation of Debt to Total Adjusted Capital Ratio for Medicaid Health Plans by Plan Traits and Time: 2007 to 2011**

**Medicaid Dominant Status**

| | | Medicaid Dominant n=60 | | Non-Medicaid Dominant n=57 | | |
|---|---|---|---|---|---|---|
| | | **Mean** | **Std Dev** | **Mean** | **Std Dev** | |
| Debt to Total Adjusted Capital | 2011 | 0.99 | 0.40 | 1.06 | 0.70 | |
| Debt to Total Adjusted Capital | 2010 | 1.18 | 0.83 | 1.11 | 0.61 | |
| Debt to Total Adjusted Capital | 2009 | 1.29 | 0.88 | 1.23 | 0.65 | |
| Debt to Total Adjusted Capital | 2008 | 1.17 | 0.56 | 1.27 | 0.66 | |
| Debt to Total Adjusted Capital | 2007 | 1.39 | 0.69 | 1.16 | 0.51 | |
| | All yrs | 1.20 | 0.48 | 1.16 | 0.51 | |

**Publicly Traded Status**

| | | Publicly Traded n=55 | | Non-Publicly Traded n=62 | | |
|---|---|---|---|---|---|---|
| | | **Mean** | **Std Dev** | **Mean** | **Std Dev** | |
| Debt to Total Adjusted Capital | 2011 | 1.01 | 0.40 | 1.03 | 0.68 | |
| Debt to Total Adjusted Capital | 2010 | 1.29 | 0.86 | 1.02 | 0.57 | ** |
| Debt to Total Adjusted Capital | 2009 | 1.42 | 0.84 | 1.12 | 0.68 | ** |
| Debt to Total Adjusted Capital | 2008 | 1.38 | 0.72 | 1.07 | 0.45 | * |
| Debt to Total Adjusted Capital | 2007 | 1.36 | 0.66 | 1.20 | 0.58 | *** |
| | All yrs | 1.29 | 0.52 | 1.09 | 0.45 | ** |

**Provider Sponsored status**

| | | Provider-Sponsored n=31 | | Non-Provider-Sponsored n=86 | | |
|---|---|---|---|---|---|---|
| | | **Mean** | **Std Dev** | **Mean** | **Std Dev** | |
| Debt to Total Adjusted Capital | 2011 | 1.05 | 0.76 | 1.01 | 0.48 | |
| Debt to Total Adjusted Capital | 2010 | 1.03 | 0.52 | 1.19 | 0.79 | |
| Debt to Total Adjusted Capital | 2009 | 1.18 | 0.85 | 1.29 | 0.75 | |
| Debt to Total Adjusted Capital | 2008 | 1.04 | 0.43 | 1.28 | 0.65 | ** |
| Debt to Total Adjusted Capital | 2007 | 1.13 | 0.39 | 1.33 | 0.68 | *** |
| | All yrs | 1.08 | 0.50 | 1.22 | 0.49 | *** |

* significant at .01 level
** significant at .05 level
*** significant at .10 level

highest average RBC in 2009 with a ratio value of 4.54. However, in 2010 and 2011, the RBC ratio increased across all plan traits, which may have been driven by the improvement in investment earnings during this time frame for all plans. Obviously findings of this nature show how the RBC ratio of health plans may vary to the volatility of the security markets. Yet, for the average plan, the economic recession did not cause the RBC ratio to fall below the 200 percent level under the RBC for Health Organizations Model Act, which requires plans to file a report to state insurance commissioners on what corrective steps they plan to take to improve their RBC ratio.

Publicly traded plans only generated higher cash-flow margins from non-publicly traded plans in one annual time period, 2007 as well as the average value for all five years. The high variation in cash-flow margin may have impacted the ability to achieve a significant outcome. However, when averaging this ratio over a five year period, the findings show a higher cash-flow margin for the publicly traded plans. This outcome is somewhat expected given the financial pressure of publicly traded companies to grow their cash-flow per share each quarter in order to increase their stock price.

The amount of debt relative to total adjusted capital had significant differences in the publicly traded status comparison. Except for 2011, publicly traded plans had significantly higher amounts of debt relative to total adjusted capital than non-publicly traded plans. It appears that health plans owned by publicly traded companies are able to take on more debt because they possess the financial backing of their parent corporation to pay off any debt, as well as better access to capital. In 2010, publicly traded plans had 29 percent more debt than capital while non-publicly traded plans had an almost equivalent amount of debt to capital. However, by 2011, publicly traded plans had either paid off a portion of their debt or increased their capital position to achieve the same amount of debt to adjusted capital ratio as the non-publicly traded plans. Evidently lowering their dependency on debt capital and reducing their credit risk exposure because of the looming Medicaid expansion from ACA may have been the impetus for plans owned by publicly traded plans to reduce this ratio.

Future work should examine the effect of covering the high-cost population of dual eligibles on the financial solvency of health plans. As more states expand coverage of this population in Medicaid managed care plans, these plans face greater costs, which may impact their ability to generate the positive cash flow to maintain as well as improve their capital position and overall solvency.

**Study Limitations**

Overall, the focus of this study was a descriptive analysis of financial solvency ratios with regards to specific Medicaid managed care plan traits. Empirical studies should follow up on this analysis by controlling for market (market size of the Medicaid population and competition among health plans) and policy factors (state payment rates and mandatory enrollment) that may affect the variation of these solvency ratios.

The primary limitation of this study was the reduction in sample size of health plans relative to the total population of 238 full-service comprehensive, risk-based plans due to several factors. First, 44 Medicaid health insurers in three states (Arizona, California, and

Oregon) as well as nine plans in New York did not submit financial data to NAIC. Therefore the findings of this study cannot be generalized to these states. Second, the study excluded 67 plans for missing and outlier ratios and resulted in a final sample of 117 Medicaid health plans that reported data to NAIC, which represents almost 50 percent of the initial population of full-service, comprehensive Medicaid plans. The excluded plans with outlier ratios were primarily smaller membership, start-up plans. Therefore, the final sample of 117 health plans were more likely large, stable Medicaid plans that have been serving the Medicaid market for at least five years. In addition, the sampled Medicaid health plans do not represent the states of Arizona, California, Oregon, and, to some extent, New York, since not all plans in New York reported data to NAIC.

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the study identified 238 comprehensive, full-service Medicaid health plans from the CMS report.

16. Comparing the final sample of 117 health plans with plan trait data to the initial sample of 185 NAIC plans shows just a few minor differences. The final sample represents almost half of the total population of Medicaid plans (117/238 = 49%). The initial sample of 185 plans had 43 percent publicly traded plans, 28 percent nonprofit plans, and 62 percent Medicaid dominant plans, and median Medicaid membership of 59,000 members. The final sample of 117 health plans had 47 percent publicly traded plans, 28 percent nonprofit plans, and 51 percent Medicaid dominant plans, and had a median Medicaid membership of 75,000 members. Thus the plan traits were similar to the initial population in terms of publicly traded and nonprofit plans. However, the final sample had a slightly lower representation in terms of Medicaid dominant plans and was more likely to include larger plans.
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# Are Physicians Profit or Rent Seekers? Some Evidence from State Economic Growth Rates

***Mary Reilly and Rexford E. Santerre***

Previous research has debated whether physicians act as profit- or rent-seekers. We argue that these two models of physician behavior can be tested by observing empirically the relationship between physician density and economic growth rates. A direct (inverse) relationship provides evidence for the profit-seeking (rent-seeking) theory of physician behavior. We empirically examine the impact of physician density on the economic growth of all US states over the period from 1973 to 2009. The empirical analysis generally finds a statistically significant and direct relationship between physician density and the growth of gross state product. The results are robust with respect to state- and time-fixed effects, individual state time trends, and 2SLS (two-stage least squares) estimation. Thus, in support of the profit-seeking theory of physician behavior, the findings reveal that physicians generally have a positive impact on the growth of the US economy.

**JEL Codes:** I11; I10; J44

**Key words:** *Supplier-induced demand, Roemer's Law, rent-seeking behavior, physician behavior.*

## Introduction

For more than 40 years or so, economists have been seriously questioning the efficiency implications of physician behavior. Two vastly different, general theories of physician behavior have emerged over those years. One theory treats physicians as being efficient producers of medical services. As efficient producers, physicians keep people healthy, permitting them to be productive members of society. Moreover, when people do get sick, physicians restore their health, allowing them to return to their previous activities more quickly. Empirical studies, including Grubaugh and Santerre,[1] Or, Wang, and Jamison,[2] and Starfield *et al.*,[3] have found that more physicians, particularly primary care physicians, are associated with better health outcomes, such as lower mortality rates. By keeping laborers healthy and working, this "profit-seeking" behavior of physicians contributes positively to the growth of an economy.[4]

The alternative theory treats physicians as "rent seekers" rather than profit seekers. According to this rent-seeking theory, physicians, particularly when they are more plentiful within a given geographical area, induce the demand for their services. This wasteful practice is referred to as supplier-induced demand (SID) and is consistent with Roemer's law that "a built bed is a filled bed." In support of this rent-seeking theory, studies beginning with Newhouse,[5] Evans,[6] Farley,[7] and Fuchs[8] find that physicians sometimes capitalize on their asymmetric information, as compared to patients,

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*The authors thank Resul Cesur for his comments on an earlier version of this paper.*

*J Health Care Finance* 2013; 40(1):79–92

by increasing the demands for their services. More recently, in agreement with these older studies, Baicker and Chandra[9] show that lower health care quality and higher health care spending occur when specialists are more numerous.[10] This type of physician behavior may keep laborers out of work for longer periods than clinically necessary and thereby negatively impact the growth of an economy.

In addition to engaging in SID, an increased number of physicians (and complementary inputs such as nurses and various types of therapeutic and diagnostic equipment) may be related to a slower-growing economy. The increased number means fewer individuals are involved in more socially productive types of occupations (and uses) if physicians are seeking rents rather than profits. Simply put, too many physician services come at the cost of too few productive activities in society such that the growth of the economy suffers because of an inefficient overall allocation of resources. Thus, if physicians are rent-seekers, they contribute negatively to the growth of an economy because of SID but also because the physicians and related inputs are inefficiently employed.[11]

Which type of behavior dominates over the other at the margin is an empirical question that previously studies have not asked or answered. To fill this gap in the literature, this paper empirically analyzes how the number of physicians impacts the growth of an economy at the state level. A panel data set of US states over the period from 1973 to 2009 is used in the empirical analysis. The empirical results suggest that, for most state-year observations, profit-seeking dominates over rent-seeking as more physicians normally contribute to faster economic growth. For a few observations, however, rent-seeking impulses overwhelm profit-seeking activities.

## Empirical Model Relating Physician Density to State Economic Growth

To isolate a causal relationship between the current number of physicians and state economic growth, the model must account for other factors known to influence the rate at which an economy grows. Thus, following the economic growth literature (for example, Barro[12]; Brumm[13]; Mankiw, *et al.*[14]) we specify the relationship between the number of physicians and economic growth in the following manner:

$$YGR = f(CPHYS; LGSP, PPOPGR, FPOPGR, EMPL, ED, SINV, SCTAX) \quad (1)$$

where *YGR* = growth of the state economy over the next few years, *CPHYS* = current number of physicians per 100,000 residents in the base year, *LGSP* = logarithm of state gross domestic product (or GSP) per capita in the base year; *PPOPGR* = population growth over the last few years; *FPOPGR* = population growth over the next few years; *EMPL* = employment penetration rate in the base year; *ED* = level of education in the base year; *SINV* = level of state public investment spending in the base year; and *SCTAX* = state effective corporate income tax rate in the base year.

Like most other studies on economic growth, the level of GSP per capita is included as an independent variable in the estimation equation. Neoclassical growth theory predicts that states with initially low levels of GSP will grow at a faster rate than states with initially higher levels of GSP, other things being equal. According to this conditional convergence hypothesis, a negative coefficient estimate should be found on baseline GSP.

The state's population growth rate also is included in the estimation equation following

previous studies. Neoclassical growth theory normally predicts that an increase in the rate of population growth reduces the rate of economic growth as society shifts its savings from capital to children. Thus, an inverse relationship is expected between past population growth, PPOPGR, and economic growth. Here, we also control for future population growth, FPOPGR, in addition to past population growth. From an econometric standpoint it stands to reason that more physicians will be drawn to areas where population is expected to grow. If so, failure to specify future population growth will bias the estimated coefficient on the current number of physicians. If faster future population growth reflects more labor moving into a state, a positive rather than negative coefficient estimate may be found on this variable.

The employment penetration rate captures the number of workers employed in the state economy relative to population. Controlling for overall employment is particularly important because we are interested in how one specific type of labor, physician labor, affects economic growth. That is, if the employment penetration rate is not specified, physician labor may capture the trend in overall labor over time. All other factors held constant, a state economy is expected to grow more rapidly when more labor resources are employed. Hence, a direct relationship is expected between employment penetration and economic growth.

Growth models also typically control for human capital differences across observations. For example, Barro[15] finds that countries starting with a higher level of educational attainment grow faster for a given level of initial gross domestic product per capita. Brumm[16] includes the percentage of the population with at least 12 years of schooling as a measure of human capital. Although years of schooling likely provide a better measure of human capital differences, these data are not available at the state level for the years covered by this study. Thus, we follow Hickman and Olney[17] and use enrollment in higher education as a measure of human capital. To directly control for size differences across states, these college enrollment figures are expressed on a per capita basis.

Munnell[18] makes the case that public investment spending on infrastructure should be included in economic growth models. State investment spending typically includes expenditures directed towards maintaining existing infrastructures and building new infrastructures. Munnell suggests including spending on highways as they help to efficiently transport goods to market and transport people to their jobs in the labor market, and can therefore have an impact on growing the economy. Expenditures on police services may also influence economic growth as these services help to protect private property rights. Given these considerations and data availability, we combine state spending on highways, police, public welfare, and natural resources to create a measure of state investment spending and express the combined amount in per capita terms. The expectation is that greater state investment spending enables the economy to grow more rapidly over the next few years.[19]

The burden of the state's tax structure is also specified in the estimation equation as a control variable (Brumm[20]). Here, we focus on the effect of the state corporate income tax rate. According to economic theory, high tax rates distort the efficient allocation of resources and thereby slow the growth of an economy. In this case, a relatively high corporate income tax rate in some states may

create an incentive for investors to allocate more of their capital to businesses in states with lower tax rates (Harberger[21]). If so, a negative coefficient estimate should be found on this state corporate income tax rate variable.

The main independent variable under consideration is the current number of physicians per 100,000 people in the state. The sign of the estimated coefficient on this variable identifies whether physicians help quicken (positive sign) or slow (negative sign) the growth of a state economy, other things being equal. A positive coefficient estimate on physician density reflects that physicians contribute to economic growth by keeping people healthy and productive. In contrast, a negative coefficient estimate indicates demand inducement, an inefficient employment of physician and complementary medical resources, or both.

***Sample and Data Sources***

For each of the 50 states, economic growth, *YGR*, is measured by the average annual growth rate of GSP over the next three years. Three-year growth rates are used to even out swings in the business cycle. The empirical analysis focuses on 11 different base years beginning in 1973 and ending in 2006 and allows for 3 base years of analysis during each full decade (for example, 1980, 1983, and 1986). The three years between the base years should mean that serial correlation poses less of a problem because external shocks have time to die down between periods. Also, the three-year period between observations allows more time for state economies to adjust to external forces such as an increased number of physicians. The entire time period under investigation begins in 1973 and ends in 2009 (after allowing for three years of economic growth) because data on one or a few of the variables are not available either before or after those dates.

GSP, measured in current dollars, and total employment data come from the Bureau of Economic Analysis.[22] Population data are obtained from the Bureau of the Census. Future and past population growth rates are calculated based on three years into the future and three years from the past. The data for the number of physicians per 100,000 residents and higher education enrollment figures (both public and private) are found in various issues of the *Statistical Abstract of the United States*. State investment spending and corporate tax rate figures are obtained from the *Book of the States*. The highest nonfinancial rate for each state was taken and then adjusted for federal deductibility. If for a particular year data are not available for either state investment spending or the corporate tax rate, then figures are interpolated using the adjacent years. Descriptive statistics and data sources are provided in Figure 1 for all of the variables used in the estimation equations.

## Empirical Findings Regarding The Impact of Physician Density on Economic Growth

Recall that the objective of this study is to determine whether additional physicians speed up or slow down the growth of a state economy. As such, it is crucial that other factors be held constant so we can isolate a cause-and-effect relationship between the current number of physicians and the future growth of a state economy. With that goal in mind, note that equation 1 holds constant GSP per capita, past and future population growth, employment penetration, level of

**Figure 1. Descriptive Statistics and Data Sources**

| | Mean | Maximum | Minimum | Std. Dev. | Data Source |
|---|---|---|---|---|---|
| Annual Growth of GSP Per Capita (%) | 5.492 | 23.52 | –9.06 | 3.07 | 1 |
| State GSP Per Capita ($) | 22,470 | 66,422.67 | 4,493.21 | 12,554 | 1 |
| Past Population Growth | 0.035 | 0.213 | –0.054 | 0.035 | 2 |
| Future Population Growth | 0.031 | 0.195 | –0.078 | 0.032 | 2 |
| Employment Penetration Rate | 0.554 | 0.742 | 0.371 | 0.066 | 1 |
| Education (College Enrollment as a Percent of State Population) | 5.32 | 9.16 | 2.67 | 1.01 | 3 |
| Public Investment Spending Per Capita ($) | 822.61 | 4,324.39 | 127.11 | 591.98 | 4 |
| Effective State Corporate Tax Rate | 0.062 | 0.138 | 0.00 | 0.027 | 4 |
| Physicians Per 100,000 Population | 199.94 | 462.00 | 90.00 | 62.26 | 3 |
| Physician and Hospital Spending Per Capita | 1,925 | 5,138 | 413 | 1,011 | 5 |
| Dental Spending Per Capita | 160 | 432 | 32 | 89 | 5 |
| Fraction Old | 0.122 | 0.185 | 0.029 | 0.02 | 2 |
| Fraction in Poverty | 0.130 | 0.270 | 0.037 | 0.04 | 2 |

1. Bureau of Economic Analysis
2. Bureau of the Census
3. Statistical Abstract of the United States
4. Book of the States
5. Centers for Medicare and Medicaid Studies

education, public investment spending, and the state effective corporate tax rate. However, some omitted, immeasurable factors may influence both the current number of physicians per capita and future growth of a state economy. If so, this unobservable heterogeneity may result in endogeneity bias and thus, at best, we can only draw inferences about association among and not causation between the number of physicians and state economic growth.

Given this potential endogeneity problem, all specifications involving equation 1 include state- and time-fixed effects. Specification of the state-fixed effects helps to control for any time-invariant omitted variables, such as political institutions, that may influence why some states grow quickly and others do not. The time-fixed effects control for common factors influencing economic growth that all states face over time such as new technologies. In another specification, individual state time trends are also included in the estimation equation such that each state is allowed to have its own growth rate over time. The individual state time trends should capture any omitted variables trending over time that simultaneously influence both the number of physicians and rate of state economic growth.

In yet another specification, equation 1 is estimated using the two-stage least square (2SLS) procedure along with both fixed effects and the individual state time trends.

2SLS estimation seems particularly important because physicians may be drawn to states with greater growth potential due to potentially more output to redistribute to themselves. Or it might be the case that physicians are naturally drawn to states with either worsening or improving population health over time. Population health is difficult, at best, to measure.

As an instrumental variable in the 2SLS analysis, we use the physician-to-population ratio three years prior. Several studies, including Evans, Froeb and Werden,[23] Davis,[24] and Bates, Hilliard, and Santerre,[25] have used a lagged measure of market structure as an instrument. Also, it is generally agreed that lagged values of the suspected endogenous variable often serve as good instruments when serial correlation can be ruled out (Maddala[26] and Kennedy[27]). In the forthcoming estimations, all standard errors are clustered at the state level when estimating the various regression equations. Clustering makes standard errors fully robust against arbitrary heteroskedasticity and serial correlation (Wooldridge[28]).

Murray[29] notes that analysts sometimes use long lags of potential instruments on the basis that longer lags reduce any correlation between the instrument and the disturbances in the error term of the original ordinary least squares (OLS) regression equation. However, he points out that more distant lags are also more likely to be weakly correlated with the troublesome suspected endogenous variable. Given this trade-off, the three-year lagged value of the physician-to-population ratio seems to be appropriate.[30]

Figure 2 shows the multiple regression results associated with a linear relationship between the current number of physicians and future economic growth. The first column in the table shows the independent variables and the specifications for each equation (such as the inclusion of state-fixed effects). The second column in Figure 2 shows the results of the basic OLS model with state- and time-fixed effects. About 73 percent of the variation in economic growth can be attributed to the factors included in the model. According to the regression results, the current number of physicians per capita has a direct effect on the future growth of GSP. Its estimated coefficient is statistically significant at the one percent level. This finding implies that physicians contribute positively to economic growth at the margin. Specifically, if the number of physicians increases by one more per 100,000 people, the rate of economic growth increases by 0.029 percentage points. This result lends support for the profit-seeking theory of physician behavior.

The third column in Figure 2 shows the results of the second OLS model. Unlike the first model, this equation also includes an individual time trend for each state. Nearly 80 percent of the variation in economic growth is now explained by the model. The current number of physicians is again found to have a positive and statistically significant effect on the future growth of GSP. The point estimate of 0.049 suggests an even larger effect of physicians on economic growth than the one shown in column 2, although it is slightly less precisely estimated. The fourth column in Figure 2 reports the results from the 2SLS model that also includes state- and time-fixed effects and individual state time trends. Once again, current physician density is found to have a positive effect on the future growth of GSP with an estimated coefficient of 0.064. However, compared to the first two regression models, its coefficient is even less precisely estimated.

**Figure 2. Multiple Regression Results for a Linear Relationship Between Number of Physicians and Economic Growth, 1973–2009**

| | **Dependent Variable:** Average rate of GSP Growth Per Capita over the Next 3 Years | | |
|---|---|---|---|
| **Independent Variables** | Estimated Coefficient (t-statistic) | | |
| Constant | 146.088*** (12.16) | 170.797*** (6.30) | 159.904*** (5.35) |
| **Physicians Per 100,000 Population** | **0.029*** (3.85)** | **0.049*** (3.03)** | **0.064** (2.14)** |
| GSP Per Capita | –15.268*** (–11.98) | –26.068*** (–18.54) | –25.900*** (–18.19) |
| Past Population Growth | –12.394*** (3.07) | –15.266*** (3.90) | –15.111*** (3.86) |
| Future Population Growth | 35.383*** (89.10) | 30.528*** (8.31) | 29.992*** (7.95) |
| Employment Penetration Rate | 17.183*** (2.99) | 48.841*** (6.45) | 47.930*** (6.32) |
| Education | –0.032 (–0.13) | –0.056 (–0.19) | –0.027 (0.09) |
| Public Investment Spending | –0.002*** (–3.92) | –0.001 (–1.37) | –0.001 (–1.53) |
| Effective State Corporate Tax Rate | –12.055 (–1.09) | –23.048* (–1.95) | –24.479** (–2.04) |
| Time Fixed Effects | Yes | Yes | Yes |
| State Fixed Effects | Yes | Yes | Yes |
| Individual State Time Trends | No | Yes | Yes |
| Two-Stage Least Squares | No | No | Yes |
| Adjusted $R^2$ | 0.732 | 0.798 | 0.797 |
| Number of Observations | 550 | 550 | 550 |

1. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1, percent levels, respectively.
2. Standard errors clustered at the state level.

In terms of the control variables, GSP per capita is shown to have an inverse and statistically significant effect on economic growth, which is in support of the convergence hypothesis as explained above. The estimated coefficients on the past and future population growth rates are statistically significant and are negative and positive, respectively. The former is expected whereas the latter likely implies that future population growth is influenced by the migration of laborers. As anticipated, a direct relation is found between the employment penetration rate and economic growth. In contrast, both education and state investment spending are not found to have a direct and statistically significant effect on

economic growth, likely because of the way these variables are crudely measured.[31] Lastly, the effective state corporate tax rate is shown to have a negative and statistically significant effect on economic growth in the latter two specifications, as economic theory predicts.

The less-precisely estimated coefficient on the physician-to-population ratio in the fourth column of Figure 2, and consideration of the Magee[32] curve, motivated us to experiment with a nonlinear relationship.[33] Figure 3 shows the multiple regression results for a

**Figure 3. Multiple Regression Results for a Non-Linear Relationship Between Number of Physicians and Economic Growth, 1973–2009**

| | **Dependent Variable:** Average GSP Growth Per Capita over the Next 3 Years | |
|---|---|---|
| **Independent Variables** | Estimated Coefficient (t-statistic) | |
| Constant | 24.191<br>(0.41) | –134.243<br>(–1.51) |
| **Physicians Per 100,000 Population** | **0.138*****<br>**(3.86)** | **0.256*****<br>**(3.99)** |
| **(Physicians Per 100,000 Population)$^2$** | **–0.0002*****<br>**(–2.70)** | **–0.0004*****<br>**(–3.96)** |
| GSP Per Capita | –25.711***<br>(–19.05) | –24.970***<br>(–17.40) |
| Past Population Growth | –15.125***<br>(3.96) | –14.604***<br>(3.69) |
| Future Population Growth | 28.776***<br>(7.99) | 25.850***<br>(6.65) |
| Employment Penetration Rate | 46.100***<br>(6.24) | 41.344***<br>(5.29) |
| Education | –0.185<br>(–0.64) | –0.227<br>(–0.77) |
| Public Investment Spending | –0.001<br>(–1.02) | –0.001<br>(–1.12) |
| Effective State Corporate Tax Rate | –23.217**<br>(–2.04) | –26.997**<br>(–2.25) |
| Time Fixed Effects | Yes | Yes |
| State Fixed Effects | Yes | Yes |
| Individual State Time Trends | Yes | Yes |
| Two-Stage Least Squares | No | Yes |
| Adjusted $R^2$ | 0.803 | 0.793 |
| Number of Observations | 550 | 550 |

1. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.
2. Standard errors clustered at the state level.

nonlinear relationship between the number of physicians and economic growth. The second column shows the OLS model with both fixed effects and individual state time trends. Note that the coefficient estimate on the linear term is positive and the coefficient estimate on the squared term is negative. This means that the number of physicians per capita has an inverted-U effect on the rate of economic growth. This inverted U-effect shows up even under 2SLS estimation as reported in column 3.[34] In both cases, the results for the control variables remain qualitatively unchanged from the previous results.

By taking the first derivative of the estimated equations in Figure 3 and setting the resulting expression equal to zero, we can determine the current physician density at which economic growth begins to slow. The calculated threshold points indicate that only a relatively few state-year observations contribute to the downward portion of the economic growth curves as reflected in the estimated nonlinear relationships. Interestingly, the relevant states are all located in northeastern US: Connecticut, Maryland, Massachusetts, and New York. We suspect that there is a large number of specialists relative to primary care physicians in these states. Unfortunately, we cannot directly test this suspicion because the necessary data on the number of specialists by year and state are unavailable to us.

For the most part, the multiple regression results indicate that economic growth shares a direct relationship with physician density. The troubling issue, however, is that physician density may still be correlated with another variable that is not captured by the included independent variables, the state and time fixed effects, or the individual state time trends, or not completely purged by the 2SLS approach. If so, the observed statistical relationship between physician density and economic growth may simply reflect a spurious correlation rather than the desired cause and effect relationship. Thus, to help identify whether a cause and effect relationship is being captured between physician density and economic growth, the following experiment is performed.

Both the profit- and rent-seeking models of physician behavior predict that the chain of causation runs theoretically from physician density through medical care spending to economic growth rates. Under the profit-seeking model, the direct relationship between physician density and medical care spending occurs because the time costs associated with medical care are lower when more physicians are available within an area. In contrast the direct relationship between physician density and medical care spending under the rent-seeking model holds because of demand-inducement and an inefficient allocation of medical resources. The difference is that the profit-seeking model predicts that medical care spending raises economic growth because it positively impacts health, whereas the rent-seeking theory suggests that medical care spending slows economic growth because of its wasteful aspect. With that in mind, the two links in the chain are examined individually: first, how the number of physicians impacts medical care spending, and then how medical care spending influences economic growth. Since the previous analysis indicates that a direct relationship holds between physician density and economic growth for most of the state-year observations, direct relationships are expected both between physician density and health care spending and health care spending and economic growth.[35]

As a placebo test, we also examine empirically how physician density impacts dental spending and how dental care spending influences economic growth. Physicians have much less, if any, control over dental spending, and dental care is less likely to positively impact productivity than hospital and physician care do. Thus, a direct relationship should not be observed between physician density and dental care spending. Nor should dental care spending similarly impact economic growth as hospital and physician spending do. If similar direct relationships are detected, then an actual cause-and-effect relationship between the number of physicians and economic growth remains doubtful.

Data for the different types of medical care spending come from the state health accounts at the Centers for Medicare and Medicaid Services. The data start in 1980 rather than 1973 so some yearly observations are lost. Figures 4 and 5 show the abbreviated multiple regression results associated with these auxiliary tests. Both OLS and 2SLS results are reported. The three-year lagged counterpart for each variable is used as an instrument for the 2SLS procedure. In addition to state- and time-fixed effects, individual state time trends, and the same covariates as before, the fraction elderly and poor are also included as additional control variables. These latter variables control for the possibility that physicians move to areas with greater federal funding for Medicare and Medicaid.[36]

As anticipated, physician density is associated with additional spending on medical care. In particular, one more physician per 100,000 people is associated with $7 to $13 more spent on hospital and physician care per capita. In addition, the placebo test indicates that physician density is not correlated with dental spending. As previously mentioned, physicians have much less control over dental spending although they may

**Figure 4. Abbreviated Multiple Regression Results for the Relationship Between Physician Density and the Two Types of Health Care Spending, 1980–2009**

| Independent Variable | Estimated Coefficient (t-statistic) | | | |
|---|---|---|---|---|
| | **Dependent Variable:** Hospital and Physician Spending Per Capita | | **Dependent Variable:** Dental Spending Per Capita | |
| **Physicians per 100,000 Population** | **7.020*** (4.97)** | **13.451*** (4.70)** | **0.024 (0.21)** | **–0.058 (–0.24)** |
| Two-Stage Least Squares | No | Yes | No | Yes |
| Adjusted $R^2$ | 0.992 | 0.991 | 0.993 | 0.993 |
| Number of Observations | 450 | 450 | 450 | 450 |

1. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.
2. Standard errors clustered at the state level.
3. Fraction elderly and poor in addition to the covariates listed in Figure 3.
4. State- and time-fixed effects and individual state time trends specified in all models.
5. Three-year lagged counterpart acts as instrument in 2SLS

**Figure 5. Abbreviated Multiple Regression Results for the Relationship Between the Two Types of Health Care Spending and Economic Growth, 1980–2009**

| | **Dependent Variable:** Average GSP Growth over the Next 3 Years | | | |
|---|---|---|---|---|
| Independent Variable | Estimated Coefficient (t-statistic) | | | |
| **Hospital and Physician Spending Per Capita** | **0.002** (2.33)** | **0.005*** (3.32)** | | |
| **Dental Spending Per Capita** | | | **–0.019* (–1.77)** | **–0.057* (–1.69)** |
| Two-Stage Least Squares | No | Yes | No | Yes |
| Adjusted $R^2$ | 0.702 | 0.714 | 0.699 | 0.727 |
| Number of Observations | 450 | 400 | 450 | 400 |

1. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.
2. Standard errors clustered at the state level.
3. Fraction elderly and poor in addition to the covariates listed in Figure 3.
4. State- and time-fixed effects and individual state time trends specified in all models.
5. Three-year lagged counterpart acts as instrument in 2SLS.

refer patients to dental practices when they receive their annual checkups.

Also as expected, the results show a direct relationship between the level of hospital and physician spending and economic growth. The estimated coefficients on the hospital and physician spending variable suggest that an additional $1 of spending raises economic growth by 0.002 to 0.005 percentage points. In contrast, the results for dental care spending show an inverse rather than direct relationship between dental care spending and economic growth. Perhaps the additional spending on dental procedures pertains to cosmetic rather than curative care at the margin or the additional dental care spending comes at the cost of general-health-restoring physician and hospital care.[37]

Multiple regression results should be judged not only by the soundness of the methodology and the credibility of the data but also by the plausibility of the results. If we look at the 2SLS point estimate in Figure 4, the implication is that an additional doctor per 100,000 people raises health care spending by $13 per capita. In the typical state with 5 million people, the additional doctor per 100,000 translates into 50 more doctors and about $65 million of additional spending on hospital and physician care. This means that each of those 50 additional physicians gain potential control over $1.3 million of additional hospital and physician resources during the year. In 1995, the midyear of the data used in our analysis, the United States spent about $562 billion on hospital and physician care. During that same year, 720,000 physicians operated in the United States. Thus, about $780,000 of hospital and physician services were potentially available to a physician in 1995, on average. Consequently, the estimated marginal hospital and physician cost per physician of $1.3 million compares favorably to the actual average

hospital and physician costs of $780,000 per physician in 1995. It is the case, however, that the margin is above the average when it comes to unit costs per physician.

Similarly, the 2SLS point estimate in Figure 5, indicates that $1 of additional spending on hospital and physician care per capita, which amounts to $5 million in the typical state, raises economic growth by 0.005 percentage points, or from 5.492 to 5.497 percent, on average. When applied to the average GSP for the sample, the $5 million of additional spending results in GSP increasing by $5.6 million in the typical state. The implied spending multiplier of 1.12 seems reasonable. Thus, considering all of the results together, the findings seem to suggest that, in general, greater physician density is strongly related to faster economic growth, which provides support for the profit-seeking theory of physician behavior, at least on the margin.

## Summary and Conclusions Regarding the Impact of Physician Density of Economic Growth

Previous research has debated whether physicians act as profit- or rent-seekers at the margin. We argue that these two models of physician behavior can be tested by observing empirically the relationship between physician density and rates of economic growth. A direct (inverse) relationship between physician density and economic growth provides support for the profit-seeking (rent-seeking) theory of physician behavior. We use a panel data set of US states over the period 1973 to 2009 to test this hypothesis.

For the most part, the empirical analysis shows a statistically significant and direct relationship between the current number of physicians per capita and future growth of GSP for the years tested. The results are robust with respect to state- and time-fixed effects, individual state time trends, and 2SLS estimation. These findings thus reveal that physicians generally have a positive impact on the growth of the US economy. If physicians are efficient and keep the population healthy, then the economy grows faster—which our results show is normally the case.

Before closing we should point out one major shortcoming of this study is that we could not address any differences in state economic growth that might arise from more primary care physicians versus more specialists in each state. Studies such as Starfield *et al.*,[38] and Goodman and Grumbach[39] argue that primary care physicians are more effective than specialists at lowering overall mortality rates for common conditions, which may mean that primary care physicians are more productive than specialists in terms of economic growth. Our data did not allow us to distinguish among the two types of physicians. Although specialists may represent the marginal physicians in an empirical sense, looking further at the effect of specialists on GDP growth as compared to the effect of primary care physicians on GDP growth may lead to different conclusions. Thus, examining the different effects of specialist and primary care doctors on the growth of the economy might be a fruitful extension of this analysis.

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# The Impact of Computerized Physician Order Entry on Medication Errors and Adverse Drug Events

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**Objectives**. Medication errors and adverse drug events (ADEs) are common, costly, and clinically important problems. This research was conducted to determine whether computerized physician order entry (CPOE) improves the quality of care by increasing patient safety and decreasing medication errors at the King Fahad Medical City Hospital (KFMCH) of the Kingdom of Saudi Arabia (KSA).

**Methods**. The study utilized a cross-sectional research design. Questionnaires were distributed to physicians in various departments who used the system for more than six months. The study was conducted in Riyadh at KFMCH, which is the largest medical complex hospital in the Middle East, in the outpatient setting.

**Key findings**. Ninety-three physicians participated in the study; the response rate was 31 percent. Only descriptive analyses were conducted. Results showed that 88 percent of the physicians agreed that the use of CPOE improved their performance and 76 percent reported that the use of CPOE increased their productivity. In addition, 56 percent of the participants agreed that CPOE was a simple system and 64 percent reported that it was easy to use. However, 44 percent of the physicians agreed that CPOE lacked a user guide during medication ordering and 55 percent reported that it created new types of errors. Results showed that 234 physicians always changed their order, 179 physicians changed their order often, 175 physicians rarely changed their order, and 74 physicians never changed their order. Furthermore, 72 percent of the physicians agreed that CPOE helped them to decrease ADEs. Finally, 91 percent of the physicians agreed that CPOE reduced errors related to hand-written prescriptions.

**Key words:** *medical errors, electronic medical records, adverse drug events, Saudi Arabia.*

## Introduction

The purpose of this research was to explore the importance of computerized physician order entry (CPOE) in improving patient safety by decreasing medication errors and adverse drug events (ADEs). CPOE is defined as "the process whereby providers directly enter orders, making them more accurate and legible, receiving back any alerts or reminders that they would act on in real time and that would help reduce error, particularly medication errors."[1] Half of medication errors occur at the stages of drug ordering, dose, frequency, or route.[2] According to the Institute of Medicine, medical errors lead to between 44,000 and 98,000 deaths in the United States annually.[3] Medication errors and ADEs in the hospital setting lead to disability and death in up to 6.5 percent of hospital admissions.[4] Handwriting sometimes leads to misreading drugs with similar names.

Bates *et al*.,[5] have evaluated the efficacy of CPOE and a team intervention in preventing serious medication errors in adults in a control randomized study. In their study, Bates *et al.*,[6] enrolled all adult patients admitted to the Brigham and Women's Hospital in Boston, Massachusetts, a 726-bed tertiary-care

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*J Health Care Finance* 2013; 40(1):93–102

hospital. Bates *et al*.,[7] reported that CPOE decreased the rate of serious medication errors by more than 50 percent. Judge *et al*.,[8] investigated prescribers' responses to alerts during medication ordering in a long-term care setting to assess the extent to which the alerts affected their actions. This study was conducted in the long-stay units of a large academically affiliated long-term care facility with four years of experience using CPOE.[9] Tracking alerts for potentially appropriate actions by the prescriber included: cancellation of a drug order, replacement of an ordered drug with another choice, change in dose, order for a recommended laboratory test, or order for a recommended additional drug. Alerts related to orders for Warfarin or central nervous system side effects were most likely to engender an appropriate action.

In the area of pediatrics, Walsh *et al*.,[10] have conducted a study at Boston Medical Hospital. The authors aimed to determine whether medication errors could be reduced to half of the number reported in Bates *et al*.[11] Using time-series analysis, they found that there was a 7 percent decrease in the rate of serious medication errors. In Walsh *et al*.,[12] CPOE was measured in critically ill pediatric patients. The authors used a commercial CPOE system, so there was variation in the results compared with the other study done for adults in the Bates *et al*.,[13] study. Most of the studies in pediatrics showed significant decline in medication errors as a result of the use of a CPOE system. In a systematic review, van Rosse *et al*.,[14] evaluated the effects of CPOE on medication prescription errors, ADEs, and mortality in inpatient pediatric care and neonatal, pediatric, or adult intensive care settings. These are generally considered to be the most demanding and complex situations. The analysis was conducted to pool the outcome of measures, including medication prescription errors, ADEs, and the mortality rate. A significantly decreased risk of medication prescription errors with the use of CPOE was found in all studies. There was an insignificant decrease in the number of ADEs associated with the use of CPOE. Mortality rates were not significantly influenced by CPOE.

Koppel *et al*.,[15] focused on the types of medication errors facilitated by CPOE. They tried to identify and quantify the role of CPOE in facilitating prescription error risks. The authors undertook a comprehensive, mixed-methods study of CPOE-related factors that enhanced the risk of prescription errors. The study was conducted at a major urban tertiary-care teaching hospital with 750 beds, 39,000 annual discharges, and a widely used CPOE system that was operational from 1997 to 2004. They found that the CPOE system facilitated 22 types of medication errors, including inflexible ordering formats that generated inaccurate orders. Therefore, clinicians and hospitals must attend to the errors they cause in addition to the errors they prevent.

In a systematic review, Wolfstadt *et al*.,[16] analyzed the relative risk reduction on ADEs associated with using CPOE with Clinical Decision Support System (CDSS). CPOE with CDSS contributed to a statistically significant ($p \leq .05$) decrease in ADEs in 5 of the 10 studies. In four studies, the authors reported an insignificant reduction in ADE rates. Finally, in one study, no change in ADE rate was found. Most of the studies showed a significant reduction in medication errors and ADEs.

The objectives of the present study were to determine whether (1) CPOE improved the quality of care by increasing patient safety and decreasing medication errors

at KFMCH of KSA and (2) CPOE helped physicians to reduce ADEs. The independent variable was CPOE and the dependent variables were medication errors and ADEs. The study examined the usability of the CPOE system and the prescribers' reactions to alerts during drug ordering.

## Materials and Methods

### Study Design

In this cross-sectional study, questionnaires were distributed to physicians who used the CPOE system for more than six months. A cross-sectional study design was chosen because the sample contained only one group. Further, the physicians were randomly selected. No control group was used, as it was considered unethical to withhold the CPOE system from a department and unsuitable to use another hospital as a comparative group. After the implementation of the CPOE system at KFMCH, only the post-test of the intervention of the CPOE system was measured.

### Setting

The study was conducted in Riyadh at KFMCH, which is the largest medical complex hospital in the Middle East and has four hospitals with a total of 1,395 beds. KFMCH consists of the main hospital, maternity hospital, pediatric hospital, rehabilitation center, and primary care clinics. The rehabilitation center was excluded from the study because it was difficult to collect questionnaires from that center, as the center is working only twice a week. The study was conducted in the outpatient setting because the system was implemented there first. The implementation of the system is ongoing in the inpatient setting.

### Sample

All physicians from different departments who used the CPOE were invited to participate in the study. Whereas 300 questionnaires were distributed to physicians, only 93 were returned. Therefore, the response rate was 31 percent. All physicians who used the CPOE for over six months were included in the study, regardless of specialty or years of experience at KFMCH. Interns were excluded from the study, as they were not familiar with the system. The results of this study can be generalized to other hospitals using the same system in the same situations. The physicians were tested once, so testing is not an issue.

### Research Approval

Research approval for the study was granted in July 2010 by the external research review committee (ERRC), a subcommittee of the Institutional Review Board at KFMCH. Research approval also was granted in September 2010 by the King Saud bin Abdulaziz University of Health Sciences research committee.

### Data Collection

Questionnaires were used to collect data for this study. Different methodologies were utilized to gather a sufficient number of questionnaires to overcome obstacles, such as physicians' limited time and availability and their willingness to complete the questionnaires. First, the questionnaires were given to the head nurses of the department in each area at KFMCH, including the main hospital, maternity hospital, pediatric hospital, and primary care clinics. A total of 100 questionnaires were administered to each area. Further, the departments were visited twice a week in order to check the response

of physicians. After three months, only 34 completed questionnaires were returned.

To increase this number, another method was employed. The questionnaires were distributed to physicians who attended *The First International Conference of Health Information Management entitled towards e-HIM: Current Situation and Future Direction* held on November 27-28, 2010, at KFMCH. The conference was organized by the health information management department at KFMCH. Permission was obtained from the conference coordinator. In addition, questionnaires were distributed to the physicians in person, and completed assessments were collected. Moreover, the questionnaires were administered in person twice a week during visits to KFMCH until a total of 93 were collected. Data collection began on August 7, 2010, and ended on December 29, 2010. The response rate was approximately 31 percent.

**Data Analysis**

Data from the questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS; version 18). Only descriptive analyses were conducted, discussed, and reported. For general practice information and demographic data, different information was collected from the questionnaires.

**Instruments**

The questionnaire was divided into three sections. The first section was designed to describe the demographic data and specialty of the physicians. It was divided into 10 categories according to specialty: general practice (GP), surgeon, internal medicine (Int-Med), obstetrics and gynecology (OB/GYN), ear, nose, and throat (ENT), orthopedic (ortho), pediatric surgery (ped surg), pediatric, ophthalmology (opth), and others. The history of the physicians' use of the CPOE was categorized as from 6 months to 1 year, from 1 to 2 years, and longer than 2 years since the CPOE system had been implemented at KFMCH for longer than 2 years. Physicians' experience in clinical practice was categorized as from 1 to 2 years, from 2 to 5 years, from 5 to 10 years, and more than 10 years.

The second part of the questionnaire measured the usability of the CPOE (independent variable), a computer-based system for ordering medication that has common features for automating the medication ordering process. A Likert-type instrument was used to assess the degree of usefulness. Other factors that can affect causality and influence the results, such as physician experience and specialty, were considered. The third part of the questionnaire measured the dependent variables, which were medication errors (*i.e.*, errors during drug ordering, such as an inaccurate or incomplete order). Prescribers' reactions to any inaccurate or incomplete order were assessed. Different kinds of medication errors were measured, such as missing or inaccurate allergy information (*e.g.*, an order received in a pharmacy without proper allergy information; improper dose/quantity or omitted dose/quantity; improper or omitted frequency, that is, incorrect medication frequency prescribed or omitted), medication duplication (*e.g.*, two or more medications in the same therapeutic class), drug/drug interaction (*e.g.*, a medication prescribed with a potential interaction), and illegible order, that is, unreadable handwriting that makes transcription difficult.

All types of medication errors mentioned above were placed in one group. In addition, the frequency of prescribers' reactions to

alerts was measured. The second dependent variable was ADEs (*i.e.*, injury as a result of medication use). The frequency of ADEs was also measured. Other factors that might affect the study results were history, length of time since the system was implemented in the hospital, physician experience, and length of time that they have been using the system. Testing was not an issue because the participants were tested once.

## Results and Discussion

### Demographic Analyses

Respondents were divided into ten categories according to their specialty. The descriptive statistics collected from the questionnaires showed that the majority of the respondents were from pediatrics, OB/GYN, and "other" (a few physicians reported their specialties: cardiology, anesthesiology, intensive care, dentistry, endocrinology, family and community medicine, and oncology; some of them did not mention the specialties). Results showed that the most frequently reported specialty was "other." However, 6.45 percent were in GP, 7.52 percent were in surgery, 2.15 percent were in int-med, 10.75 percent were in OB/GYN, 4.3 percent were in ENT, 1.07 percent were in opth, 5.37 percent were in ortho, 29.03 percent were in "other," 5.37 percent were in ped surg, and 27.95 percent were in pediatrics (see Figure 1). Results also showed that 26 percent of the physicians had used the CPOE for 6 months to 1 year, 33 percent had used it from 1 to 2 years, and 41 percent had used it for longer than 2 years. However, the mean of 2.15, the standard deviation of 0.8, and the variance of 0.65 indicated that there were no significant differences in the responses to this question. Results also showed that 22 percent of physicians were in clinical practice for 5 to 10 years, 41 percent were in practice for longer than 10 years, 19 percent were in practice for 2 to 5 years, and 18 percent were in practice from 1 to 2 years. The standard deviation of 1.15 and

**Figure 1. Sample Demographics Analysis**

| Speciality | Frequency | Percent |
|---|---|---|
| GP | 6 | 6.45 |
| Surgery | 7 | 7.52 |
| Int-med | 2 | 2.15 |
| OB/GYN | 10 | 10.75 |
| ENT | 4 | 4.3 |
| Opth | 1 | 1.07 |
| Ortho | 5 | 5.37 |
| Other | 27 | 29.03 |
| Ped Surg | 5 | 5.37 |
| Pedia | 26 | 27.95 |
| Total | 93 | 100.0 |

variance of 1.33 indicated that differences existed in the answers to this question.

**Measuring the Usability of CPOE**

In the second part of the questionnaires, the usability of CPOE was evaluated by asking each participant to select responses on a 5-point Likert–type instrument to measure the performance of prescribers with regard to medication ordering. Figure 2 shows the percentage of measuring the performance, productivity, ease of use, complexity, lack of guidance, facilitation of new errors, and decrease in medication errors by using CPOE. Results as shown in Figure 2 indicate that 48 percent of participants strongly agreed and 40 percent agreed that the CPOE improved their performance (mean = 1.67, SD = 0.77, and variance = 0.6). The percentage and frequency of productivity improvement were measured in the same way. Results showed that 35.5 percent strongly agreed and 38.7 percent agreed that CPOE showed productivity improvement (mean = 1.92, SD = 0.86, and variance = 0.74). This finding means that most of the respondents believed that CPOE increased their productivity. From the previous results, it is clear that CPOE increased physicians' performance and productivity.

When asked whether the CPOE was a complex system, 33 percent of the respondents were neutral, 29 percent disagreed, and 19 percent agreed it was (Figure 2). Yet, 9 percent strongly agreed and 3 percent strongly disagreed. Given the standard deviation of 1 and variance of 1, some physicians did not view the CPOE system as complex. It is possible that they need additional training or time to learn about the system.

Another question was included to determine if there was a conflict in responses regarding the CPOE's complexity and to check if the CPOE could be used easily by physicians. When asked whether it was easy to use the system, 7 percent of the participants strongly agreed, 52 percent agreed, 23 percent were neutral, 9 percent disagreed, and 1 percent strongly disagreed (Figure 2). However, 43 percent of the respondents agreed that the CPOE lacked a user guide during medication ordering (Figure 2). That is, they believed that the CPOE was not a complex system and could be used easily

**Figure 2. Measuring the Usability of CPOE**

| | | | Percentage Agreement | | | | |
|---|---|---|---|---|---|---|---|
| **Questionnaire** | **N** | **Missing** | **Strongly Agree** | **Agree** | **Neutral** | **Disagree** | **Strongly Disagree** |
| Performance | 93 | 0 | 48.4% | 39.8% | 8.6% | 3.2% | 3.2% |
| Productivity | 91 | 2 | 35.5% | 38.7% | 19.4% | 4.3% | |
| Complexity | 93 | 0 | 9% | 19% | 33% | 29% | 3% |
| Ease of use | 92 | 1 | 7% | 52% | 23% | 9% | 1% |
| Lack of guidance | 92 | 1 | 12.9% | 43.0% | 26.9% | 16.1% | |
| Decrease in medication errors | 93 | 0 | 25.8% | 52.7% | 11.8% | 7.5% | 2.2% |
| Creation of new errors | 93 | 0 | 8.6% | 46.2% | 23.7% | 19.4% | 2.2% |

by physicians, but thought that it needed improvement and guidance. The most important question was whether the CPOE decreased medication errors. Of the participants, 52.7 percent agreed that it did, whereas 25.8 percent strongly agreed as shown in Figure 2 (SD = 0.9, variance = 0.87).

The application of a new system might create new types of errors. In order to check the existence of new types of errors, the participants were asked if the CPOE facilitated new types of error. Results as shown in Figure 2 indicate that most physicians (46 percent) agreed, although 9 percent strongly agreed, 24 percent were neutral, 19 percent disagreed, and 2 percent strongly disagreed. Therefore, after the implementation of the CPOE system, the organization should recognize errors and try to solve them to improve patient safety.

**Measuring Prescribers' Reactions to Alerts During Drug Ordering**

The CPOE is supported by the CDSS to help physicians in decision making during the drug ordering process. The third part of the questionnaire was important because it described the prescribers' reactions to alerts during drug ordering. Figure 3 describes the valid percentage of prescribers' reactions to alerts or reminders in the drug ordering process. Results showed that, for drug allergies, 62 percent of physicians always changed their medical order, whereas 18 percent often changed their medical order, 15 percent rarely changed their medical order, and 5 percent never changed their medical order (Figure 3). With regard to prescribers' responses to alerts due to omitted dose or quantity, results showed that 35 percent of them always changed their medical order, 39 percent often changed their medical order, 19 percent rarely changed their medical order, and 7 percent never changed their medical order (Figure 3). The average and mode of physicians choose often (SD = 0.9, variance = 0.84). With regard to the omitted frequency, results as shown in Figure 3 indicate that 35 percent of the physicians always changed their medical order, 32 percent often changed their medical order, 27 percent rarely changed their medical order, and 6 percent never changed their medical

**Figure 3. Measuring the Valid Percentage of Prescribers' Reactions to Alerts During Drug Ordering**

| Type of Alert | Always | Often | Rarely | Never | N | Missing |
|---|---|---|---|---|---|---|
| Allergy | 61.6 | 18.6 | 15.1 | 4.7 | 86 | 7 |
| Omitted Dose or Quantity | 34.9 | 38.6 | 19.3 | 7.5 | 83 | 10 |
| Omitted Frequency | 34.5 | 32.1 | 27.4 | 6 | 84 | 9 |
| Medication Duplication | 34.1 | 29.4 | 28.2 | 8.2 | 85 | 8 |
| Drug/Drug Interaction. | 38.8 | 25.9 | 24.7 | 10.6 | 85 | 8 |
| Dose Range | 24.7 | 35.8 | 25.9 | 13.6 | 81 | 12 |
| Drug-Lab Interaction | 27.2 | 21.0 | 32.1 | 19.8 | 81 | 12 |
| Over-Riding Alert | 24.7 | 14.3 | 40.3 | 20.8 | 77 | 16 |

order. The average response was often and the mode was always (SD = 0.93, variance = 0.86). With regard to medication duplication, 34 percent of the physicians always changed their medical order, 30 percent often changed their medical order, 28 percent rarely changed their medical order, and 8 percent never changed their medical order (Figure 3). The average response was often and the mode was always (SD = 0.97, variance = 0.95).

With regard to the drug/drug interaction alert, results as shown in Figure 3 indicate that 39 percent of physicians always changed their medical order, 26 percent often changed their medical order, 25 percent rarely changed their medical order, and 10 percent never changed their medical order. The average response was often and the mode was always (SD = 1, variance = 1). With regard to the dose range, 25 percent of physicians always changed their medical order, 36 percent often changed their medical order, 26 percent rarely changed their medical order, and 13 percent never changed their medical order (Figure 3). The average response and the mode was often (SD = 1, variance = 1). Further, 27 percent of the physicians chose always, 21 percent chose often, 32 percent chose rarely, and 13 percent chose never when asked if they changed their medical order due to drug-lab interaction as shown in Figure 3. The average response was often and the mode was rarely (SD = 1, variance = 1). This finding was expected because few drugs have drug-lab interactions. With regard to overriding alerts, 25 percent of physicians chose always, 14 percent chose often, 40 percent chose rarely, and 21 percent chose never overriding alert. The average response and the mode was rarely overriding this alert (SD = 1, variance = 1).

In general, results showed 234 choices for always, 179 choices for often, 175 choices for rarely, and 74 choices for never. That is, more physicians always change their medical order as a result of all of the alerts.

### General Questionnaires to Complete the Drug Ordering Process Safely

The electronic prescribing process reduced the medication errors related to handwritten prescriptions (*i.e.*, transcribing). The mean and the mode values of the results as shown in Figure 4 suggests that the majority of physicians (91 percent) agreed that the system reduced the errors related to handwritten prescriptions (SD = 0.28, variance = 0.08). After reviewing responses to the questions about whether CPOE improved their medication knowledge, the mean and mode values of the results (Figure 4) indicate that most physicians (77 percent) agreed that CPOE helped to improve their medication knowledge (SD = 0.4, variance = 0.2). This finding suggests that the CPOE improved physicians' medication

**Figure 4. General Questions to Complete the Drug Ordering Process Safely**

| Questionnaires | N | Yes | No |
|---|---|---|---|
| CPOE reduces the errors related to handwritten prescriptions | 91 | 91% | 9% |
| CPOE helps to decrease adverse drugs events (ADEs) | 90 | 72% | 28% |
| CPOE improves physicians' medication knowledge | 90 | 77% | 23% |

knowledge. When asked whether they thought that the CPOE helped to decrease ADEs, most of physicians (72 percent) agreed that it did (SD = 0.4, variance = 0.2).

In summary, the results showed that the CPOE improved physicians' practice by improving their performance and productivity. Specifically, 88 percent agreed that use of CPOE improved their performance in regard to medication ordering. Further, 76 percent agreed that the use of CPOE increased their productivity. Moreover, results showed that the CPOE system was not a complex system for physicians, but 56 percent of the participants endorsed the need for additional training and time to learn about the system. Further, 64 percent of the participants agreed that the system was easy to use, although 44 percent agreed that the CPOE lacked a user guide during medication ordering. Most importantly, 79 percent of the physicians believed that the CPOE decreased medication errors in drug ordering. The application of the new system might create new types of errors. Results showed that the majority of physicians (55 percent) agreed that CPOE created new types of medication errors. Therefore, after implementation of the CPOE system, the organization should recognize and correct errors that may be facilitated by CPOE.

The CPOE was supported by the CDSS to help physicians in decision making during the drug ordering process and acts as a reminder during drug prescribing. Many medication errors can occur, such as orders received in a pharmacy without proper allergy information, improper dose strength prescribed, dose strength omitted, incorrect medication frequency prescribed, omitted medication frequency, medication duplication (*e.g.*, two or more medications in the same therapeutic class), drug/drug interaction (*e.g.*, a medication was prescribed that had a potential interaction), and illegible handwritten orders that impeded transcribing.

## Timeline

The study took seven months. The first five months involved the distribution and collection of the questionnaires, which began on August 7, 2010, and ended on December 29, 2010. Ninety-three questionnaires were returned. The next six months were devoted to data entry and analysis. During the seventh month, the results and final report were revised and summarized. The final report was completed on February 29, 2011 (see Figure 5).

## Limitations

More accurate medication error measurements could be collected using a reliable instrument, but it was more difficult to apply for the researcher. A quantitative and reliable measurement should be used to

**Figure 5. Timeline for the Study**

| 7 August | September | October | November | 29 December | January | 29 February |
|---|---|---|---|---|---|---|
| Data Distribution | | | Data Collection | | Data Entry and Analysis | Writing Results and Report |
| Phase (1) | | | Phase (2) | | Phase (3) | Phase (4) |

gather accurate data, rather than questionnaires. However, questionnaires were used due to the limited resources available to the researcher. Medication error measurements would be more accurate if other measures, such as assessing every medication order entered using the CPOE system. For example, on a biweekly basis for six months, periodic electronic audit trails of all alerts triggered by the CDSS might be collected with electronic files of all medication-related actions. However, only questionnaires were used at this stage as a baseline, although other measures will be used in future studies.

## Conclusion

Medication errors and ADEs are major issues in the health care arena. In addition, the automation of a drug prescribing process can decrease medication errors and help physicians to detect ADEs. Most physicians always change their drug prescribing order after receiving an alert from the CPOE system. Moreover, their decision supports capability, which directs physicians to write a legible order. This, in turn, affects the quality of health care and patient safety. Patient safety can be improved through the medications' five rights: "ensuring the right patient, right drug, right time, right dose, and right route." Therefore, CPOE can guarantee some of these rights. After implementation of the CPOE system, attention should be paid to errors that might be created by the system, in addition to providing adequate training for users if necessary.

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