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ORIGINAL ARTICLE

# Minimum Nurse Staffing Legislation and the Financial Performance of California Hospitals

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**Objective.** To estimate the effect of minimum nurse staffing ratios on California acute care hospitals' financial performance.

**Data Sources/Study Setting.** Secondary data from Medicare cost reports, the American Hospital Association's (AHA) Annual Survey, and the California Office of Statewide Health Planning and Development (OSHPD) are combined from 2000 to 2006 for 203 hospitals in California and 407 hospitals in 12 comparison states.

**Study Design.** The study employs a difference-in-difference analytical approach. Hospitals are grouped into quartiles based on pre-regulation nurse staffing levels in adult medical-surgical and pediatric units (quartile 1 = lowest staffing). Differences in operating margin, operating expenses per day, and inpatient operating expenses per discharge for California hospitals within a staffing quartile during the period of regulation are compared to differences at hospitals in comparison states during the same period.

**Data Collection/Extraction Methods.** Hospital data from Medicare cost reports are merged with nurse staffing measures obtained from AHA and from OSPHD.

**Principal Findings.** Relative to hospitals in comparison states, operating margins declined significantly for California hospitals in quartiles 2 and 3. Operating expenses increased significantly in quartiles 1, 2, and 3.

**Conclusions.** Implementation of minimum nurse staffing legislation in California put substantial financial pressure on some hospitals.

**Key Words.** Nurse staffing ratios, hospitals, financial performance, California, AB394

In the past decade, 15 states and the federal government have proposed or enacted legislation or adopted regulations addressing nurse staffing in acute care hospitals; only California has legislation mandating minimum nurse staffing ratios (American Nurses Association 2010a,b). Staffing ratios are controversial because it is unknown whether the benefits outweigh the costs of

complying with the standards (Buerhaus 2010). The potential cost is substantial. Direct costs of nursing, 80 percent of which are salaries and benefits, have been shown to comprise approximately 44 percent of the total direct costs of inpatient care (Kane and Siegrist 2002) and 30 percent of all hospital expenditures (Welton 2011). Moreover, it has been shown that the staffing regulations were accompanied by increases in nurse wages (Mark, Harless, and Spetz 2009). If mandated staffing standards put additional financial pressure on hospitals, unintended consequences such as unit or hospital closures, lower technology or infrastructure investments, or reductions in quality or access may ensue.

Proponents argue that legislating nurse-to-patient ratios in hospitals will improve both working conditions for nurses and safety and quality of care for patients. In turn, some of the hospital costs of complying with the ratios should be offset by fewer complications, shorter patient stays, and fewer readmissions; less need for temporary and traveling nurses; and lower nursing staff turnover (Coffman, Seago, and Spetz 2002; Steinbrook 2002). However, opponents cite insufficient evidence that nurse staffing ratios improve patient safety and quality of care (Institute of Medicine 1996; Lang et al. 2004). Research also suggests that nurse staffing ratios alone may be insufficient to reduce nurse turnover (Coffman, Seago, and Spetz 2002), and even when turnover declines, the financial benefits are less than the costs of increasing nursing hours (Needleman 2008).

Existing evidence is insufficient to say with certainty whether minimum nurse staffing legislation positively or negatively affects hospital financial performance; thus, research is needed to inform nurse staffing debates going forward. Evidence on the financial implications may influence states' decisions about nurse staffing laws, or the design of alternative approaches for addressing nurse staffing (Azam 2010). California's experience provides an opportunity to assess the effect of state-wide mandatory ratios on hospitals' financial performance. Using data from 2000 to 2006, we investigate the impact of the staffing regulation on California hospitals' financial performance compared to a group of hospitals in 12 states that do not have such staffing regulations.

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## BACKGROUND AND LITERATURE REVIEW

In October 1999, the California legislature passed Assembly Bill 394 (AB394) mandating minimum licensed nurse-to-patient ratios. Licensed nurses include registered nurses (RNs) and licensed vocational/practical nurses (LVNs/LPNs). Draft regulations were released in January 2002, and implemented in January 2004. The regulations specify different minimum staffing ratios by type of patient care unit to reflect differences in patient needs and acuity. The California ratios reflect richer staffing levels than are common among hospitals (Aiken et al. 2002), and early evidence suggested that across the affected patient care units, between 15 and 41 percent of California hospitals were not in compliance with the minimum ratios prior to the mandates (Coffman, Seago, and Spetz 2002).

One study of the effects of the legislation found increases of 20 percent in RN hours of care per patient day and 7.4 percent in total nursing hours of care per patient day on medical-surgical units in 68 acute care hospitals (Donaldson et al. 2005). Other research showed a statewide increase of 16.2 percent in licensed nurse staffing between 1999 and 2006 (Spetz et al. 2009). Preliminary estimates of the direct cost of complying with the legislation ranged from $198,000 to $2.3 million per hospital (Coffman, Seago, and Spetz 2002; Spetz 2004).

Despite the importance of nursing costs in hospital budgets, little empirical research has examined the effect of changes in nurse staffing on hospital financial performance. Prior studies largely focused on the effects of hospital-specific changes to or differences in nurse staffing as opposed to the effects of legislated staffing policies, and all predated AB394. One early descriptive study found higher patient care costs and longer lengths of stay on a nursing unit with lower staffing levels as compared to a unit with more nurses per patient (Flood and Diers 1988). At the organizational level, declines in total hospital staffing, including nurses, have been associated with reduced costs (Hadley, Zuckerman, and Iezzoni 1996). A longitudinal study incorporating hospital fixed effects found that increases in RN staffing led to increases in hospital operating expenses but no statistically significant changes in operating margins (McCue, Mark, and Harless 2003).

Other studies have addressed the financial implications of nursing skill mix. Higher levels of RNs were associated with higher nursing expenses in one study (Glandon, Colbert, and Thomasma 1989); however, another study found no association between nursing skill mix and personnel costs or total

operating costs per adjusted admission (Bloom, Alexander, and Nuchols 1997). Higher use of RNs versus LPNs produced a net financial benefit for hospitals; however, financial benefits exceeded costs only when total nursing hours remained unchanged (Needleman et al. 2006). Similarly, in a simulation of the effects of changes in nursing skill mix, increasing RN staffing was cost-effective as an intervention to improve mortality in hospitals; however, it was not cost saving (Rothberg et al. 2005).

In summary, there is mixed evidence on whether the costs of increased nurse staffing or skill mix are offset by reductions in other costs. As previous findings are based primarily on differences in staffing across hospitals, they may not be applicable in the case of state-wide mandated ratios, where nurse wages are likely to be affected (Mark, Harless, and Spetz 2009). Moreover, much of the existing evidence may have been influenced by the simultaneity of nurse staffing and financial performance, whereby hospitals with poor financial performance may have cut nurse staffing to remain solvent. New evidence on the relationship between nurse staffing ratios and financial performance is needed to inform the ongoing debate over the merits of minimum nurse staffing legislation.

## CONCEPTUAL FRAMEWORK

Economic models of production suggest that, for a given level of quality and output volume, hospitals will use labor and capital inputs up to the point where their marginal revenue products are equal to their marginal costs (Avery and Shultz 2007). Assuming a delivery technology that minimizes input costs, total cost will increase with increases in either volume or quality (Avery and Shultz 2007). Minimum nurse staffing legislation that requires hospitals to meet certain nurse-to-patient ratios is intended to increase quality and reduce adverse patient outcomes. This type of regulated approach to increasing quality constrains hospitals' input choices, including their ability to substitute less expensive labor and/or capital for licensed nurses (Buerhaus 2010). Therefore, AB394—a law that forced many hospitals to increase their use of licensed nurses—would be expected to increase labor costs for hospitals with nurse staffing below the mandated minimum standards. Labor costs increases could arise from growth in the number of employees, overtime pay, or increases in skill mix (McCue, Mark, and Harless 2003; Needleman 2008), as well as through increases in

market wages for nurses that occurred following the implementation of AB394 (Mark, Harless, and Spetz 2009).

Although labor costs are likely to increase, there are several reasons why the effect on operating margins is ambiguous. First, increases in nurse staffing may produce offsetting cost savings through avoided adverse outcomes and hospital days (Needleman et al. 2006; Dall et al. 2009). Second, theory suggests that hospitals may respond to higher labor costs by changing other elements of production such as increasing outpatient volume or shifting production away from unprofitable activities and toward higher revenue-generating procedures and/or services (Newhouse 1970; Hoerger 1991).

Although there is evidence to suggest that hospitals in California may eventually reap cost savings from improvements in quality brought about by changes in nurse staffing (Aiken et al. 2002; Needleman et al. 2002; Needleman and Buerhaus 2003; Mark et al. 2004; Seago, Spetz, and Mitchell 2004; Mark, Harless, and McCue 2005; Joseph 2007; Kane et al. 2007; Mark and Harless 2007; Mark, Harless, and Berman 2007; Kaestner and Guardado 2008; Harless and Mark 2010), the benefits thus far do not appear to be immediate (Donaldson et al. 2005) or may not be sufficient to offset the cost of complying with the legislation. Reports indicate that some hospitals in California closed units following implementation of the minimum nurse staffing standards (Center for Studying Health System Change 2005). A recent study also showed reductions in growth rates of uncompensated care among county and for-profit hospitals following implementation of the staffing ratios (Reiter et al. 2011).

Based on our conceptualization of minimum nurse staffing legislation as a constraint on hospitals' input choices, and our review of existing evidence showing that increases in total nursing hours raise costs beyond the value of quality-related cost offsets, we hypothesize that hospital total and inpatient operating expenses will increase following passage of AB394. As hospitals with the lowest nurse staffing levels in the pre-regulation period would be expected to increase staffing the most, we hypothesize that the magnitude of the increase in expenses will be negatively associated with hospitals' pre-regulation nurse staffing levels. Although hospitals may eventually achieve cost offsets, and may shift production away from unprofitable activities such as uncompensated care, because of the pervasiveness of nurse staffing and the magnitude of nursing labor costs, we expect the overall effect of the nurse staffing legislation during the period of our study will be a reduction in hospital operating margins, particularly among hospitals with the lowest levels of pre-regulation nurse staffing.

## STUDY SAMPLE, DATA, AND MEASURES

The study sample includes all short-term general hospitals in California ($n$ = 203) and in 12 comparison states ($n$ = 407) with an average daily census >20, and cost report periods in 2000–2006.[1] The 12 comparison states were selected as part of a larger study of the effects of AB394, including the effects on quality of care. To be included, states were required to have (1) no nurse staffing legislation or regulations before or during the study period, and (2) available data to compute key quality measures. For our analysis, we combine data from multiple sources. Hospital data, including financial performance measures, number of beds, ownership, payer mix, and teaching status, come from annual Medicare cost reports filed with the Centers for Medicare and Medicaid Services. Data on hospital system status, location within a metropolitan statistical area (MSA), latitude and longitude (from which estimates of seismic risk were obtained), and nurse staffing in non-California hospitals come from the American Hospital Association's (AHA) Annual Survey. Data on nurse staffing levels for California hospitals come from California's Office of Statewide Health Planning and Development (OSHPD).

### *Financial Performance Measures*

We use three measures of financial performance as outcome variables: (1) operating margin, defined as the difference between operating revenue and operating expenses divided by operating revenue; (2) total operating expenses per adjusted patient day, which reflects expenses incurred to produce operating revenue; and (3) inpatient operating expenses per discharge, which includes salaries and other expenses associated with the provision of inpatient care. Operating margin is a ratio and, therefore, included untransformed in our regression analysis. Operating expenses are converted to constant 2007 dollars using the consumer price index. Expense values are log-transformed so that coefficients are semi-elasticities (proportional differences).

### *Pre-Regulation Nurse Staffing Measures*

To distinguish California hospitals expected to be more or less affected by the regulations, we group hospitals into quartiles based on their nurse staffing levels in 2000 and 2001 prior to when draft staffing regulations were announced. California hospitals in the lowest pre-regulation staffing quartile (quartile 1)

are expected to be most affected by the regulations, and those in the highest pre-regulation staffing quartile (quartile 4) least affected.

For hospitals in California, OSHPD nurse staffing data are detailed so pre-regulation staffing quartiles can be created directly for inpatient nurse staffing. We include nurses working in medical-surgical and pediatric units. Intensive care units are excluded because they have much higher levels of staffing and because AB394 did not mandate changes in staffing for these units. For hospitals outside of California, the AHA survey provides data on hospital RN and LPN/LVN full-time equivalents (FTEs), but the FTEs are hospital wide and hence include nurses attending to outpatients as well as inpatients. One method of allocating nurse hours to inpatients is the adjusted patient day method, but previous research has shown this approach to underestimate inpatient staffing (Needleman et al. 2002). Therefore, we use inpatient nurse staffing in the California OSHPD database as *validation data* to estimate the proportion of nurse FTEs from the AHA data who worked in medical-surgical and pediatric units (Bound, Brown, and Mathiowetz 2001; Harless and Mark 2006). Further explanation of the construction of nurse staffing estimates is provided in Appendix SA2.

### *Control Variable Measures*

We control for potential confounders that may have affected hospital financial performance. First, overlapping the period in which staffing regulations were implemented, hospitals in California had to assess seismic risk and report to the state government, take preliminary measures to brace nonstructural elements, and plan to retrofit or replace buildings most at risk of collapse before January 2008 (or January 2013 if the hospital applied for an extension). This exposure to the cost of retrofitting was highly variable both across the state and within metropolitan areas. We used peak ground acceleration (PGA), the maximum ground acceleration expected with a 10 percent probability over a 50-year period (Chang and Jacobson 2008). Based on PGA values from the U.S. Geological Survey, all hospitals were categorized in a set of two dummy variables—hospitals having the highest risk (PGA at or above the 75th percentile value for our sample) or medium risk (PGA between the 50th and 75th percentiles values) (U.S. Geological Survey 2002). Only hospitals in California had PGA sufficiently high to place them in these categories.

We control for observable hospital characteristics likely to affect hospital financial performance, including number of beds, ownership, teaching status, system status, location in an MSA, percent Medicare days, and percent

Medicaid days. Hospital size is measured by the number of beds. Ownership is measured by dummy variables reflecting for-profit, district, and other government-owned hospitals (not-for-profit = reference). Teaching status is measured by a dummy variable for minor teaching hospital (ratio of resident FTEs to hospital beds between 0 and 0.25) and major teaching hospital (ratio of 0.25 or greater). System status and location in an MSA are measured by dummy variables equal to one if a hospital reported being a member of a system or reported location within an MSA during the period. Percent Medicare and percent Medicaid are measured based on reported numbers of inpatient days covered by Medicare/Medicaid versus other payers; quadratic terms for both variables are also included.

## MODEL AND ESTIMATION

We apply a difference-in-difference analytical approach, estimating the difference in financial performance for California hospitals within a staffing quartile during the period of regulation compared to the difference in financial performance at hospitals in comparison states during the same period. As we construct staffing quartiles on a state-by-state basis, we also include state fixed effects. Our regression model is presented below:

$$y_{i,s,t} = \eta_s + \theta\, \mathit{Quartile}_i + \tau\, \mathit{Period}_t + X_{i,s,t}\beta + \delta_1\, \mathit{Quartile}_i \times \mathit{Period}_t + \delta_2\, CA \times \mathit{Quartile}_i + \delta_3\, CA \times \mathit{Quartile}_i \times \mathit{Period}_t + u_{i,s,t}$$

$\eta_s$ represents the state fixed effects. $\mathit{Quartile}_i$ represents a complete set of quartile dummy variables, where pre-regulation staffing quartiles are constructed separately for hospitals in California and in each of the 12 comparison states. $\mathit{Period}_t$ represents a set of variables defining three time periods: the transition between the time draft regulations were announced but before they were effective (January 2002–December 2003); the period when initial staffing regulations were in effect (January 2004–March 2005); and the period when final staffing regulations were in effect (April 2005 to the end of our study period in January 2006). Time period variables are constructed based on the proportion of days in a Healthcare Cost Report Information System (HCRIS) reporting period falling in the respective periods. $X_{i,t}$ represents the control variables previously described.

The parameter $\delta_3$ estimates the impact of the staffing regulation under the assumptions of our model. The model allows for differences in financial performance across quartiles, differences across quartiles within California

before the period of regulation, and differences across time periods. The set of parameters represented by $\delta_3$, however, indicates the within quartile difference in financial performance specific to California during the period of regulations.

In addition to providing regression results for the model presented above, we also estimate a model augmented with all two-way interactions: between state fixed effects and quartile dummy variables, time period variables, and the control variables represented by $X_{i,t}$; between quartiles and $X_{i,t}$; and between period variables and $X_{i,t}$. This specification allows, for example, for the effect of a variable such as percent Medicare to be different by staffing quartile, time period, and by state.

## RESULTS

### *Descriptive Results*

Table 1 shows means and standard deviations for key variables for all hospitals in the study sample by location and pre-regulation staffing quartile. The number of hospitals and the number of observations in each quartile in California and comparison states are given at the bottom of the table. Differences in the number of observations occur because we excluded observations where the cost report covered fewer than 360 days and because we could not include observations where there was missing AHA data. Differences are not due to hospital closures as we required hospitals to have complete observations before and after the advent of regulations. The number of hospitals in each quartile in the comparison states can differ because we constructed quartiles separately for each state.

In all quartiles, mean operating margin is lower for hospitals in California than in the 12 comparison states, and mean operating expenses per day and per discharge are higher for California hospitals than for hospitals in comparison states. Compared to the 12 comparison states, California hospitals have higher LPN/LVN staffing (measured by FTEs per 1,000 adult and pediatric inpatient days) and slightly higher licensed nurse staffing. California also has a considerably higher proportion of for-profit hospitals (and lower proportion of not-for-profit hospitals) in quartiles 1 and 3, and a higher proportion of public hospitals in quartiles 3 and 4. Across all quartiles, hospitals in California have a lower percentage of inpatient days covered by Medicare and a greater percentage covered by Medicaid than hospitals in comparison states.

Table 2 presents the mean changes in staffing levels and operating expenses from the pre-regulation period and indicates statistically significant

Table 1: Variable Means (Standard Deviations) by Pre-Regulation Staffing Quartile

| | *Quartile 1* | | *Quartile 2* | | *Quartile 3* | | *Quartile 4* | |
|---|---|---|---|---|---|---|---|---|
| *Variable* | *CA* | *12 States* | *CA* | *12 States* | *CA* | *12 States* | *CA* | *12 States* |
| Operating margin | −0.048 (0.212) | 0.031 (0.131) | −0.068 (0.290) | −0.017 (0.215) | −0.085 (0.359) | 0.015 (0.105) | −0.024 (0.197) | −0.001 (0.137) |
| Expenses per APD (thousands of 2007 dollars) | 2.084 (0.508) | 1.804 (0.559) | 2.269 (0.642) | 1.951 (0.567) | 2.460 (0.987) | 1.950 (0.550) | 2.743 (0.953) | 1.967 (0.580) |
| Expenses per discharge (thousands of 2007 dollars) | 1.438 (0.470) | 1.165 (0.362) | 1.537 (0.466) | 1.263 (0.370) | 1.695 (0.742) | 1.243 (0.428) | 1.855 (0.722) | 1.260 (0.454) |
| RN FTEs per 1,000 adult and ped. IPDs | 2.49 (0.64) | 2.27 (0.77) | 2.92 (0.76) | 2.68 (0.78) | 3.06 (0.65) | 3.06 (0.79) | 3.60 (0.81) | 3.67 (1.05) |
| LPN/LVN FTEs per 1,000 adult and ped. IPDs | 0.40 (0.33) | 0.24 (0.23) | 0.39 (0.32) | 0.27 (0.24) | 0.46 (0.38) | 0.29 (0.28) | 0.47 (0.46) | 0.34 (0.33) |
| Licensed nurse FTEs per 1,000 adult and ped. IPDs | 2.89 (0.65) | 2.50 (0.74) | 3.31 (0.74) | 2.96 (0.76) | 3.52 (0.57) | 3.35 (0.76) | 4.07 (0.70) | 4.02 (1.03) |
| Not-for-profit | 0.46 (0.50) | 0.68 (0.47) | 0.62 (0.49) | 0.63 (0.48) | 0.49 (0.50) | 0.73 (0.45) | 0.69 (0.46) | 0.74 (0.44) |
| For-profit | 0.42 (0.49) | 0.25 (0.43) | 0.22 (0.42) | 0.16 (0.37) | 0.29 (0.45) | 0.17 (0.38) | 0.16 (0.37) | 0.18 (0.39) |
| District | 0.05 (0.22) | 0.01 (0.08) | 0.03 (0.16) | 0.07 (0.25) | 0.05 (0.23) | 0.05 (0.23) | 0.07 (0.25) | 0.06 (0.25) |
| Public | 0.08 (0.27) | 0.07 (0.25) | 0.13 (0.34) | 0.14 (0.35) | 0.17 (0.38) | 0.05 (0.22) | 0.08 (0.28) | 0.02 (0.13) |
| Major teaching hospital | 0.05 (0.23) | 0.07 (0.26) | 0.10 (0.31) | 0.13 (0.34) | 0.21 (0.41) | 0.13 (0.33) | 0.17 (0.37) | 0.09 (0.29) |
| Minor teaching hospital | 0.19 (0.39) | 0.27 (0.44) | 0.30 (0.46) | 0.32 (0.47) | 0.12 (0.33) | 0.25 (0.43) | 0.20 (0.40) | 0.25 (0.43) |
| System hospital | 0.64 (0.48) | 0.80 (0.40) | 0.75 (0.44) | 0.78 (0.41) | 0.75 (0.43) | 0.76 (0.43) | 0.79 (0.40) | 0.74 (0.44) |

*continued*

Table 1. *Continued*

| | *Quartile 1* | | *Quartile 2* | | *Quartile 3* | | *Quartile 4* | |
|---|---|---|---|---|---|---|---|---|
| *Variable* | *CA* | *12 States* | *CA* | *12 States* | *CA* | *12 States* | *CA* | *12 States* |
| Located in MSA | 0.95 (0.23) | 0.68 (0.47) | 0.88 (0.33) | 0.80 (0.40) | 0.92 (0.28) | 0.81 (0.39) | 0.85 (0.36) | 0.84 (0.37) |
| Number of beds | 153.41 (80.88) | 193.77 (107.66) | 204.34 (143.61) | 211.57 (120.13) | 194.52 (115.13) | 222.64 (166.17) | 199.35 (126.14) | 155.30 (125.86) |
| Percent Medicare inpatient days | 31.20 (12.45) | 42.12 (11.99) | 28.61 (12.07) | 39.77 (13.63) | 26.01 (11.34) | 39.27 (13.34) | 31.61 (11.64) | 39.79 (13.72) |
| Percent Medicaid inpatient days | 15.17 (12.19) | 9.54 (5.72) | 16.78 (11.24) | 9.74 (7.32) | 16.17 (12.41) | 8.72 (6.43) | 12.57 (8.34) | 9.18 (7.52) |
| Peak ground acceleration (PGA) | 0.42 (0.18) | 0.05 (0.07) | 0.45 (0.17) | 0.05 (0.08) | 0.41 (0.20) | 0.05 (0.07) | 0.41 (0.19) | 0.05 (0.06) |
| PGA high risk | 0.21 (0.41) | 0.00 (–) | 0.33 (0.47) | 0.00 (–) | 0.21 (0.41) | 0.00 (–) | 0.26 (0.44) | 0.00 (–) |
| PGA medium risk | 0.26 (0.44) | 0.00 (–) | 0.27 (0.45) | 0.00 (–) | 0.24 (0.43) | 0.00 (–) | 0.26 (0.44) | 0.00 (–) |
| Number of observations | 185 | 575 | 193 | 543 | 203 | 594 | 230 | 559 |
| Number of hospitals | 51 | 106 | 51 | 100 | 50 | 103 | 51 | 98 |

*Notes.* APD, adjusted patient day; IPD, inpatient day; LPN, licensed practical nurse; LVN, licensed vocational nurse; MSA, metropolitan statistical area; RN, registered nurse.

differences in changes that occurred in California compared to the changes in the comparison state hospitals in the same quartile. The increase in LVN/LPN staffing in California is highest in quartile 1, but the increases in quartiles 2 and 3 are also relatively large when contrasted with the decreases in LVN/LPN staffing in comparison states. Although California quartile 1 hospitals had the largest increase in RN staffing in the initial period and the second highest (after quartile 2) increase in the final period, the differential change compared to comparison state hospitals was smallest in quartile 1 in the initial and final periods. Inpatient operating expenses per discharge increased significantly more in California hospitals in the initial and final regulation periods as compared to hospitals in the 12 comparison states.

Figure 1 shows mean operating margin over time by pre-regulation staffing quartile. In all four quartiles, mean operating margins for hospitals in California are generally below those of hospitals in the 12 comparison states, are negative for much of the study period, and differ substantially by quartile over the four periods. For example, for California hospitals in quartile 1, operating margins decline markedly in the transition and initial periods, with the most notable decline during the period initial regulations took effect. In contrast, mean operating margin increases during the transition period for hospitals in the 12 comparison states, then declines slightly over time but remains positive. Mean operating margins in quartile 4 rise over time both in California and the comparison states, but with greater improvement among California hospitals.

### *Regression Results*

Table 3 presents the results of our difference-in-difference analysis. Only estimates for the difference-in-difference parameters are presented; full regression results are provided in Appendix SA2. Table 3 shows the estimated effect of AB394 on California hospitals' operating margins, operating expenses per adjusted patient day, and inpatient operating expenses per discharge by quartile and period. Columns 1, 3, and 5 of Table 3 show results of the base difference-in-difference regressions. Columns 2, 4, and 6 show results of the models, including the two-way interactions. Although there are some changes between the two models, the difference-in-difference coefficients for operating margin are similar for both.

With the exception of quartile 4, estimates of the effect on operating margin are generally negative and quite large in absolute value in both the base model and the model with two-way interactions; however, contrary to

Table 2: Change or Percentage Change in Key Variables from the Pre-Regulation Period, by Pre-Regulation Staffing Quartile

| | | *Quartile 1* | | *Quartile 2* | | *Quartile 3* | | *Quartile 4* | |
|---|---|---|---|---|---|---|---|---|---|
| | *Regulatory Period* | *CA* | *12 States* | *CA* | *12 States* | *CA* | *12 States* | *CA* | *12 States* |
| Change from pre-regulation period | | | | | | | | | |
| RN staffing | Transition | 0.260 | 0.152 | 0.332* | 0.109 | 0.111 | 0.120 | 0.133** | −0.140 |
| | Initial | 0.691* | 0.414 | 0.628** | 0.262 | 0.492** | 0.159 | 0.404*** | −0.172 |
| | Final | 0.909 | 0.669 | 1.002*** | 0.449 | 0.765*** | 0.221 | 0.721*** | −0.027 |
| LVN/LPN staffing | Transition | 0.063 | −0.015 | 0.028 | 0.013 | −0.038 | −0.026 | −0.140** | −0.031 |
| | Initial | 0.123* | −0.038 | 0.050 | −0.029 | 0.079* | −0.069 | −0.130 | −0.084 |
| | Final | 0.106* | −0.032 | 0.105* | −0.042 | 0.038* | −0.082 | −0.175 | −0.107 |
| Licensed nurse staffing | Transition | 0.323* | 0.137 | 0.360* | 0.122 | 0.074 | 0.094 | −0.007 | −0.171 |
| | Initial | 0.814*** | 0.376 | 0.678*** | 0.233 | 0.571*** | 0.091 | 0.273*** | −0.256 |
| | Final | 1.015* | 0.636 | 1.106*** | 0.407 | 0.803*** | 0.139 | 0.546*** | −0.134 |
| Percentage change from pre-regulation period | | | | | | | | | |
| Expenses per APD | Transition | 7.9* | 12.3 | 11.3 | 11.0 | 12.1 | 12.5 | 13.3 | 11.8 |
| | Initial | 20.9 | 26.2 | 22.3 | 22.7 | 23.4 | 23.5 | 28.6** | 20.6 |
| | Final | 26.8* | 35.1 | 35.5 | 34.8 | 35.0 | 33.5 | 36.8* | 28.8 |
| Expenses per discharge | Transition | 24.7 | 20.2 | 30.2** | 16.2 | 18.3 | 16.3 | 26.7* | 17.3 |
| | Initial | 47.5*** | 30.8 | 59.3*** | 28.8 | 40.5** | 27.1 | 47.5** | 30.3 |
| | Final | 66.7*** | 42.3 | 70.2*** | 38.1 | 61.7*** | 36.3 | 59.8*** | 37.7 |

*Notes*. Asterisks indicate statistically significant difference between mean change in California versus mean change in 12 comparison states within a staffing quartile and regulatory period.
*$p < .05$,
**$p < .01$,
***$p < .001$.
APD, adjusted patient day; LPN, licensed practical nurse; LVN, licensed vocational nurse; RN, registered nurse.

our initial expectation that the greatest effect on operating margins would occur among hospitals with the lowest pre-regulation nurse staffing, the estimates suggest that California hospitals in quartiles 2 and 3 suffered the largest decreases in operating margins relative to hospitals in the same pre-regulation staffing quartiles in the comparison states. In the model with two-way interactions, during the transition, initial and final regulation periods, operating margins for California hospitals in quartile 2 are estimated to be 6.7, 10.8, and 11.8 percentage points lower, respectively, than hospitals in the second staffing quartile in the 12 comparison states and the estimate in the final regulation period is statistically significant. For quartile 3 hospitals, operating margins are estimated to be 8.9, 11.7, and 11.6 percentage points lower than hospitals in the same quartile in comparison states and the estimates are statistically significant in the transition and final regulation periods. Although the point estimates for quartile 1 hospitals are also negative, only the estimate for the initial period in the base model is statistically significant. Estimates suggest no statistically significant differences in operating margins between California and comparison state hospitals in quartile 4 in any of the regulation periods.

Estimates of the effect of AB394 on operating expenses per adjusted patient day and inpatient operating expenses per discharge are generally con-

Figure 1: Mean Operating Margin by Pre-Regulation Staffing Quartile

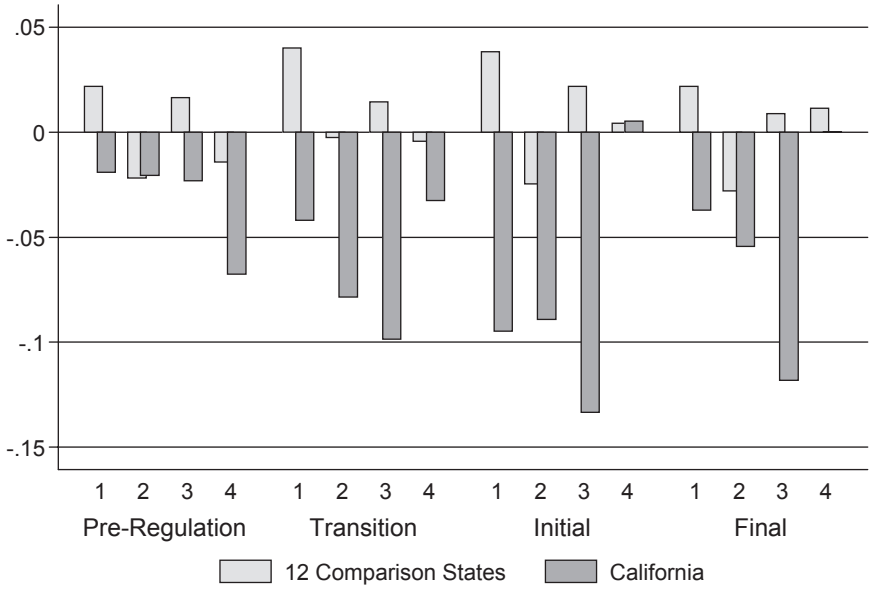

Table 3: Difference-in-Difference Estimates for Operating Margin, Natural Log of Operating Expenses per Adjusted Patient Day, and Natural Log of Inpatient Operating Expenses per Discharge

| | | *Operating Margin* | | *ln (Expenses per APD)* | | *ln (Expenses per Discharge)* | |
|---|---|---|---|---|---|---|---|
| | *Regulatory Period* | *Base Model* | *With Two-Way Interactions* | *Base Model* | *With Two-Way Interactions* | *Base Model* | *With Two-Way Interactions* |
| Quartile 1 | Transition | 0.009 (0.056) | −0.018 (0.079) | −0.030 (0.041) | 0.070 (0.050) | −0.043 (0.063) | −0.040 (0.064) |
| | Initial | −0.100* (0.049) | −0.116 (0.068) | −0.010 (0.040) | 0.087 (0.050) | 0.112 (0.059) | 0.046 (0.067) |
| | Final | −0.002 (0.052) | −0.040 (0.065) | −0.079 (0.043) | 0.035 (0.057) | 0.173* (0.068) | 0.151* (0.070) |
| Quartile 2 | Transition | −0.068 (0.036) | −0.067 (0.054) | 0.044 (0.034) | 0.114* (0.049) | 0.122* (0.054) | 0.073 (0.069) |
| | Initial | −0.117 (0.084) | −0.108 (0.068) | 0.093* (0.045) | 0.170** (0.054) | 0.209** (0.066) | 0.129 (0.075) |
| | Final | −0.082* (0.041) | −0.118* (0.051) | 0.012 (0.049) | 0.100 (0.061) | 0.257*** (0.064) | 0.207** (0.079) |
| Quartile 3 | Transition | −0.085 (0.045) | −0.089* (0.045) | 0.067 (0.041) | 0.102* (0.050) | 0.015 (0.054) | −0.036 (0.064) |
| | Initial | −0.144* (0.065) | −0.117 (0.063) | 0.046 (0.040) | 0.128* (0.053) | 0.135** (0.052) | 0.068 (0.063) |
| | Final | −0.110* (0.047) | −0.116* (0.049) | 0.098* (0.044) | 0.184*** (0.055) | 0.230*** (0.058) | 0.171** (0.064) |
| Quartile 4 | Transition | 0.031 (0.043) | 0.024 (0.045) | −0.025 (0.046) | 0.033 (0.049) | 0.008 (0.055) | −0.026 (0.058) |
| | Initial | 0.038 (0.041) | 0.012 (0.055) | 0.040 (0.056) | 0.136* (0.055) | 0.015 (0.057) | −0.021 (0.063) |
| | Final | 0.031 (0.046) | −0.022 (0.047) | 0.066 (0.050) | 0.157** (0.055) | 0.113 (0.058) | 0.056 (0.066) |
| Number of observations | | 3,082 | 3,082 | 3,086 | 3,086 | 3,097 | 3,097 |
| Number of hospitals | | 610 | 610 | 610 | 610 | 610 | 610 |
| $R^2$ | | 0.278 | 0.510 | 0.599 | 0.730 | 0.477 | 0.655 |

*Notes*. Standard errors (in parentheses) beneath the estimates are adjusted for nonindependence of observations within hospitals.
*$p < .05$,
**$p < .01$,
***$p < .001$.
APD, adjusted patient day.

sistent with the results of the regressions for operating margin; California hospitals in quartiles 2 and 3 have higher operating expenses per adjusted patient day and inpatient operating expenses per discharge during the regulation periods as compared to hospitals in the same quartiles in comparison states. For example, coefficient estimates suggest statistically significant increases in operating expenses per adjusted patient day of 12.1 percent ($100 \times (\exp(0.114) - 1)$) and 18.5 percent ($100 \times (\exp(0.170) - 1)$) during the transition and initial regulation periods for hospitals in quartile 2. Statistically significant increases in operating expenses per adjusted patient day of 10.7, 13.7, and 20.2 percent were also found for quartile 3 hospitals in the transition, initial, and final regulation periods, respectively. Although operating margins appeared relatively unchanged, results showed statistically significant increases in operating expenses per adjusted patient day among hospitals in quartile 4 during the initial and final regulation periods. Results with respect to inpatient operating expenses per discharge showed statistically significant increases of 16.3, 23, and 18.6 percent in the final regulation period for hospitals in quartiles 1, 2, and 3, respectively.

## DISCUSSION AND CONCLUSIONS

Consistent with our hypothesis, our analysis suggests that implementation of minimum nurse staffing legislation in California put substantial financial pressure on many hospitals; however, in contrast to what we expected, the financial pressure appeared concentrated among hospitals in the middle two staffing quartiles. The estimated effect on operating margin for quartile 1 hospitals was negative and relatively large in magnitude; however, it was not statistically significant. This lack of precision in the operating margin estimate suggests that there may have been variability in the effect of the regulations on operating margin for hospitals in quartile 1. One possible explanation is the differential ownership distribution across the quartiles. Quartile 1, for both California and the comparison states, has the highest proportion of for-profit hospitals, and the proportion in California is much higher than comparison state hospitals in the same quartile (42 percent of observations versus 25 percent in comparison states).

A second possible explanation is that there were differences in the way hospitals responded to the regulations. Examination of the changes in nurse staffing among California hospitals in the four staffing quartiles revealed that hospitals in quartile 1 increased LVN/LPN staffing more than did hospitals in

quartiles 2 and 3, while hospitals in quartile 4, like hospitals in all quartiles in comparison states, decreased LVN/LPN staffing on average. Use of less costly LVN/LPN staffing may have allowed hospitals in quartile 1 to come into compliance with the staffing ratios while ameliorating the impact on financial performance, although, similar to hospitals in quartiles 2 and 3, findings showed a significant increase in inpatient operating expense per discharge during the final regulation period.

For hospitals in staffing quartiles 2 and 3, operating margins declined significantly during the final regulation period, while operating expenses per day and inpatient operating expenses per discharge increased. Descriptive data on the characteristics of hospitals showed that California quartiles 2 and 3 contained higher proportions of public hospitals relative to quartiles 1 and 4, and the proportion of public hospitals in quartile 3 in California was more than three times higher than in the comparison states. Similarly, California hospitals in quartiles 2 and 3 had substantially lower percentages of days covered by Medicare, and higher percentages of days covered by Medicaid than in comparison states. Fewer financial resources, slightly less favorable government payer mix, and perhaps location in areas with more uninsured patients may have combined to increase the financial pressure created by AB394 for these hospitals.

Limitations of our data prevented us from precisely measuring the actual staffing required for a hospital to come into compliance with the minimum nurse staffing ratios. Staffing quartiles do not precisely measure a hospital's need to increase actual direct-care nurse staffing; therefore, our measure provides an indicator of the relative versus absolute burden of the staffing regulations for different hospitals.

Despite this limitation, results from this study are important. Much emerging evidence has focused on the effects of AB394 on nurse staffing and the nursing labor market, including wages and skill mix (Mark, Harless, and Spetz 2009; McHugh et al. 2011; Munnich 2011). This study adds to the emerging literature by providing the first rigorous, empirical evidence on the financial implications of AB394 for California hospitals. The results are supportive of cost burdens of AB394, but with differential effects depending on pre-regulation staffing levels and responses to the regulation.

Although the effects of legislated minimum nurse staffing ratios may not be common across all hospitals, the significant and relatively large estimated reductions in operating margins for hospitals in quartiles 2 and 3 suggest that such policies may threaten quality in hospitals, even as they strive to improve it. The finding that the cost burden was greatest for hospitals that fell into

quartiles more heavily weighted toward public ownership and with slightly greater reliance on Medicaid deserves note. These hospitals may be financially vulnerable, and at a disadvantage when trying to compensate for increased nurse staffing costs because of less flexibility in shifting services to more profitable activities, and more difficulty increasing prices.

This is not to say that minimum nurse staffing laws should be avoided because they increase costs. If minimum nurse staffing legislation improves quality, patient safety, satisfaction, and nurse working conditions in ways that alternatives cannot, it may be well worth the cost. However, increasing reimbursement to assure adequate staffing to keep patients safe may be required. Policy makers considering such legislation should be aware of the financial implications for hospitals as they weigh the pros and cons of various alternatives.

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## NOTE

1. The 12 comparison states include Arizona, Colorado, Florida, Iowa, Kentucky, Maryland, North Carolina, New Jersey, Utah, Washington, Wisconsin, and West Virginia.

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## SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Appendix SA2: Beta Regression Model Estimates for Proportion of RN and LVN FTEs.

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