

The impact of public hospitals' privatization on nurse staffing

Zo Ramamonjirivelo • Larry Hearld • Robert Weech-Maldonado

Background: Privatization is one of the strategies that public hospitals may adopt to remain competitive. Privatized hospitals may implement nurse staffing cuts as a cost-saving mechanism and to increase financial performance. A better understanding of how privatization may affect nurse staffing is important given its association with patient and organizational outcomes.

Purpose: The aim of this study was to examine the impact of not-for-profit (NFP) and for-profit (FP) privatizations of public hospitals on nurse staffing.

Methodology/Approach: Based on secondary data sets from the American Hospital Association Annual Survey, the Centers for Medicare & Medicaid Services Impact Files, and the Area Health Resources File, this study used a nonexperimental longitudinal design consisting of negative binomial and linear regression models with hospital level and year fixed effects. Our sample consisted of nonfederal and noncritical access, acute care, public hospitals ($n = 492$) followed from 1997 to 2013 (8,335 hospital-year observations). Nurse staffing was measured as full-time equivalents (FTEs) and skill mix. Privatization was defined as conversion from public to either private NFP or private FP status.

Results: FP privatization was associated with greater decreases in registered nurse (RN) staffing FTEs (incidence rate ratio [IRR] = 0.93, $p = .004$) and total nurse staffing FTEs (IRR = 0.93, $p = .001$), compared with NFP privatization: RN staffing FTEs (IRR = 0.95, $p = .003$) and total nurse staffing FTEs (IRR = 0.96, $p = .007$).

Conclusion: Overall, privatization was associated with decreased RN FTEs and total nurse staffing FTEs and no changes in licensed practical nurse FTEs and RN skill mix.

Practice Implications: A close monitoring of nurse staffing level, after privatization, is encouraged to prevent potential deterioration in quality of care.

Key words: for-profit, not-for-profit, nurse staffing, privatization, public hospitals

As safety net providers, government-owned or public hospitals play a major role in the provision of health care services to low-income, underinsured, and uninsured populations (Clark, Roberson, & Ramiah, 2018). In addition, they are expected to provide highly specialized services, as well as medical and allied health education, and engage in research (Clark et al., 2018; Villa & Kane, 2013). However, public hospitals typically operate in a more challenging environment than private hospitals due to diminishing funds from local governments, increased competition, and loss of Medicaid patients to private hospitals (Anderson, Boumbulian, & Pickens, 2004). All these factors have converged to create a financial crisis for many public hospitals (Ramamonjirivelo, Weech-Maldonado, Hearld, & Pradhan, 2014).

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This project was supported by Grant number R03HS024302 from the Agency for Healthcare Research and Quality. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality.

The authors have disclosed that they have no significant relationship with, or financial interest in, any commercial companies pertaining to this article.

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DOI: 10.1097/HMR.0000000000000262

Privatization, defined as “an ownership conversion from public to either private for-profit or private not-for-profit status” (Ramamonjirivelo, Weech-Maldonado, Hearld, Pradhan, & Davlyatov, 2018), p. 2), has been one of the survival strategies adopted by governments that own financially distressed public hospitals and are in need of balancing state budgets (Burns, Shah, Frank, & Powell, 2009; Ramamonjirivelo et al., 2015). Approximately 147 public hospitals privatized between 1997 and 2009; 80% (117 hospitals) privatized to not-for-profit (NFP) status, and 20% (30) to for-profit (FP) status (Ramamonjirivelo et al., 2015).

Prior studies have shown that privatization benefits the hospital in terms of financial performance (Picone, Chou, & Sloan, 2002; Ramamonjirivelo et al., 2018; Shen, 2003) and efficiency (Ramamonjirivelo, Epané, Hearld, McRoy, & Weech-Maldonado, 2016). However, the improved financial performance may come at the expense of reduced access to care (Sloan, 2002; Villa & Kane, 2013) and lower quality of care (Picone et al., 2002; Shen, 2002; Sloan, 2002). For instance, some studies have found that privatization is associated with decreased levels of uncompensated care, which is care delivered to those who cannot afford to pay the hospital (Burns et al., 2009). This decrease in uncompensated care may reflect reduced access to care for those who cannot pay. In addition, one study found that privatization to NFP status resulted in closures of certain services, such as trauma

centers, HIV/AIDS services, dental services, and urgent care centers (Villa & Kane, 2013). Furthermore, some studies have found that quality of care declined after FP conversion (Picone et al., 2002; Sloan, 2002).

One potential explanation for the observed decrease in quality of care may be changes in nurse staffing after privatization (Burns et al., 2009). Nurses are the key workforce needed for the provision of high-quality, safe, efficient, patient-centered, and effective health care (Zhu, Dy, Wenzel, & Wu, 2018). Studies have shown that decreased nurse staffing is associated with increased odds of in-hospital mortality (Kane, Shamliyan, Mueller, Duval, & Wilt, 2007) and increased patient-to-nurse ratio is associated with increased likelihood of dying within 30 days of admission and increased odds of failure to rescue (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002). Furthermore, Picone et al. (2002) found that FP conversion resulted in increased mortality rate among Medicare patients in the short run as a result of a decrease in nurse staffing levels.

On the other hand, increases in nurse staffing are associated with increases in survival rate (Blegen, Goode, Spetz, Vaughn, & Park, 2011; McHugh et al., 2016), increases in hospital patient experience score (Zhu et al., 2018), as well as decreases in nursing-sensitive adverse events (Martsolf et al., 2014), hospital-acquired infection rate (Blegen et al., 2011), and length of stay (Blegen et al., 2011; Martsolf et al., 2014). Yet nurses claim the largest share of hospitals' labor cost (Mark & Harless, 2007; Potter, 2001), and reducing the number of nurses, following privatization, could result in improved financial performance in the short run but negatively affect quality of care in the long run.

Very few studies have assessed the relationship between hospital ownership conversion and staffing. These studies have found that FP conversion resulted in changes in staffing strategies (Picone et al., 2002; Shen, 2003). However, findings from these studies have not clearly shown the impact of privatization on staffing strategies. For example, Picone et al. (2002) and Shen (2003) found that overall staffing and registered nurse (RN) staffing decreased after FP conversion, but they combined public and NFP hospitals in one group to study the impact of FP conversion. In addition, Shen (2003) showed that license practical nurse staffing decreased after NFP conversion; however, they combined public and FP hospitals in one group in examining the impact of NFP conversion. Combining different types of ownership may not be appropriate in examining the impact of ownership conversion, given that they have different structures and may face different operating environments (Burns et al., 2009). Another limitation of this prior research is that it examined data from prior to 2000, and there have been many changes in the health care industry since that time. Given the limitations of prior research and dearth of empirical evidence about the nurse staffing strategies that public hospitals adopt after privatization, the purpose of this study was to examine the relationship between the privatization of public hospitals and nurse staffing patterns.

Conceptual Framework

Burns et al. (2009), in a literature review on hospital ownership conversions, concluded that converted hospitals changed their

strategic content pertaining to values, competitive behavior, financial management, and operations. They found that changes with respect to operations entailed immediate and drastic cut in labor costs, and nursing and ancillary staff underwent the largest reduction. In some instances, nurse staffing became so "dangerously low" that health care providers were alarmed that health care quality could be significantly compromised. Given that ownership conversion is one of the strategies that hospitals use to improve financial performance, immediate cuts in labor costs may provide some immediate financial relief to converted hospitals.

To assess the impact of public hospital privatization, this study uses property rights theory (PRT), which has been used to examine hospital performance after privatization (Ramamonjiravelo et al., 2018). PRT explains managerial behavior based on the organization's ownership type. Property rights are defined as the right of an individual or organization to own an asset, the right to have control over the asset, the right to make a decision regarding the use and exploitation of the asset to generate profit, the right to receive the profit, and the right to sell the asset to a person or organizations (Eggertsson, 1990).

PRT posits that giving managers the right to make decisions regarding the use of an asset as well as the right to own the residual income from the use of that asset is the most effective incentive for managers to make profit-maximizing decisions, which consequently increases managers' financial compensation (Preker & Harding, 2003). In addition, according to PRT, shareholders have the right to sell their shares to other investors, and they will do so if they do not get the highest rate of return on their investments. Therefore, managers will do their best to satisfy investors by maximizing their wealth.

The ownership type of hospitals determines their missions, goals, and objectives. Nonfederal U.S. community hospitals have three ownership types: government-owned or public, private NFP, and private FP ownerships. The overarching mission of all hospitals, regardless of ownership type, is to provide health care to the community (Potter, 2001), and all hospitals are also expected generate adequate profit to stay in business (Horwitz, 2005). However, there are some nuances in hospital mission and the level of commitment to generate the highest possible profit by ownership type.

Public hospitals are owned by the residents of the state, county, or city, which are represented by the state, county, or local government, and they directly or indirectly operate under the control of elected officials (Institute of Medicine [IOM], 1986). Public hospitals generate financial capital from public funding in the form of tax revenues and tax-exempt bonds (IOM, 1986). Because public hospitals receive public funding, the principal purpose of public hospitals is to serve the public by providing care and delivering specialized services to everyone regardless of ability to pay (Clark et al., 2018). Although all hospital types are expected to maintain a viable financial profile, public hospitals are more likely to provide unprofitable services compared with private hospitals (Horwitz, 2005). In addition, the provision of public funding is not based on the hospital's positive financial performance

but on its financial needs and availability of funds. Furthermore, excess revenues over expenses gained by public hospitals are not allowed to be distributed among the managers but are usually deposited in the public treasury (IOM, 1986). As such, managers of public hospitals may not have the same incentives to cut costs and generate large excess revenue over expenses as private FP hospitals.

Private NFP hospitals are owned by religious or private secular entities. They are charitable organizations under the 501(c)(3) classification of the Internal Revenue Code, which qualifies them as tax-exempt organizations. They do not pay state property taxes and federal income taxes (Santos, 2017). Given their status, NFP hospitals are expected to provide high-quality health care, medical education, and research without the intention to build up profit (IOM, 1986). NFP hospitals are also expected to meet the health care needs of the community (Cutler & Horwitz, 2000), including charity care, as long as it does not threaten their financial sustainability (Santos, 2017). NFP hospitals raise their capital from philanthropists' donations and tax-exempt bonds. However, NFP hospitals face a nondistribution constraint; they do not have the right to distribute residual income among the donors, the board of directors, or the managers (Amirkhanyan, 2007). Furthermore, the proceeds from the sale of an NFP hospital are not distributed among philanthropists and managers but rather invested in a foundation to benefit the community (Marsteller, 1998). Therefore, like the managers of public hospitals, the managers of NFP hospitals may not have the incentive to aggressively cut costs to boost profitability as the managers of FP hospitals (Picone et al., 2002; Potter, 2001). For instance, Picone et al. (2002) found that ownership conversion from public or NFP to FP status boosted profitability, in terms of operating margin, and resulted in decreased staffing, in terms of total employment, and total wages and salaries, as well as the ratio of total employment to the number of adjusted patient days and the ratio of total wages and salaries to the number of adjusted patient days. However, conversion from FP to public or NFP ownership resulted in an increased ratio of total employment to the number of adjusted patient days (Picone et al., 2002).

FP hospitals are owned by shareholders. The managers of FP hospitals are expected to generate profits and increase shareholders' wealth (Potter, 2001; Rosenau & Linder, 2003). FP hospitals must pay property, sales, and income taxes, and they are not required by law to provide care to everyone regardless of ability to pay. However, unlike public and NFP hospitals, FP hospitals' shareholders have the right to own and distribute residual income among themselves and the managers (IOM, 1986; Marsteller, 1998). In addition, shareholders have the right to provide financial incentives to the managers of FP hospitals in terms of annual bonuses and stock ownership as incentives to boost profit.

Based on PRT, because the managers of FP hospitals have the right to be owners of the organization and consequently receive residual income, they will make the best managerial decisions to increase profit. One way to improve profitability is to cut costs by reducing workforce (Burns et al., 2009; Picone et al., 2002; Shen, 2003). Therefore, we expect FP

privatization to be associated with a greater decrease in nurse staffing compared to NFP privatization. Shen (2003) found that conversion from public or NFP to FP was associated with a significant decrease in total staff per bed and total RN per bed compared with a nonsignificant decrease for NFP conversion. Although conversion from public or FP to NFP status was associated with a significant decrease in licensed practical nurses (LPNs) per bed (Shen, 2003).

Given that nurses are expensive to employ, especially RNs, one of the ways to boost profit is to cut costs by reducing nurse staffing. FP hospitals may reduce the RN skill mix by substituting RNs with less-skilled LPNs. With differences regarding the missions and pressures to increase profitability among public, NFP, and FP ownerships, it seems plausible that public hospitals that privatize may incur some reduction in their nurse staffing as a means to restore their financial health. According to PRT, public hospitals privatizing to FP status, in particular, may experience the greatest reduction in nurse staffing compared with public hospitals privatizing to NFP status (Potter, 2001). Some studies have indicated that FP hospitals have lower nurse staffing level than NFP and public hospitals, and they have lower nursing salary costs than NFP hospitals (Mark & Harless, 2007). Therefore, it is hypothesized that:

Hypothesis 1a: Public hospitals privatizing to FP status will have a greater decrease in their nurse staffing full-time equivalents (FTEs) compared to hospitals privatizing to NFP status.

Hypothesis 1b: Public hospitals privatizing to FP status will have a greater decrease in their RN skill mix compared to hospitals privatizing to NFP status

Method Data

Our study combined three data sources: the American Hospital Association (AHA) Annual Survey, the Centers for Medicare & Medicaid Services Impact Files, and the Area Health Resources File. The AHA data file consists of hospital profile variables such as ownership status, number of hospital beds, teaching status, system affiliation, and information with respect to the number of clinical and nonclinical staff. The Impact Files contain the Case Mix Index of each individual hospital. The Area Health Resources File contains demographic, health care workforce, and economic data on counties where public hospitals are located.

Sample

Our sample consisted of all government-owned, nonfederal, acute care, general, and surgical hospitals in the United States in 1997. These hospitals were followed from year to year until 2013. Our original sample comprised 669 noncritical access public hospitals. Critical access hospitals are small rural hospitals with no more than 25 beds; they have different payment systems from noncritical access hospitals (Centers for Medicare & Medicaid Services, 2017). Therefore, critical access hospitals need to be studied separately from noncritical access hospitals. We applied several exclusion criteria to construct our analytic sample. First, hospitals that diversified to a skilled nursing facility ($n = 4$) or an ambulatory care facility

($n = 1$) were excluded. Second, we excluded hospitals that were acquired or merged ($n = 8$) during the study period, as these hospitals do not fill out the AHA survey as the same entity before the merger or acquisition. They become new entities after the merger, and the acquirer becomes the entity filling out the AHA survey. Third, hospitals without complete data, for unknown reason, throughout the study period were excluded ($n = 85$). Fourth, following Shen (2003), hospitals that underwent multiple ownership conversions ($n = 32$) during the study period were excluded. These hospitals were excluded because multiple conversions consist of conversions from public to NFP or FP, then from NFP to FP or public status, or from FP to NFP or public status. Conversions from NFP to FP or from NFP or FP to public status are not considered privatization strategies. Our study focuses on privatization; privatization strategies are conversions from public status to either NFP or FP status. Therefore, including these hospitals in our sample may bias our findings. In addition, hospitals that underwent multiple conversions may have some organizational instability, making it difficult to track changes over time. Fifth, we removed 47 hospitals that closed during the study period. Ultimately, our analytic sample comprised 492 public hospitals (8,335 hospital-year observations). Nursing assistive personnel (NAP) data were not available in the AHA Annual Survey before 2003. Therefore, we constructed a secondary sample (2003–2013) containing (4,582 hospital-year observations) to incorporate NAP staffing FTEs as part of our dependent variable measures.

Measures

Dependent variables. Nurse staffing consisted of two types of measures: *nurse staffing FTEs* and *RN skill mix*. For our 1997–2013 sample, “nurse staffing FTEs” was measured using total number of FTE RNs (RN staffing FTEs), total number of full-time LPNs (LPN staffing FTEs), and total nurse staffing FTEs (RN-FTEs + LPN-FTEs). For our 2003–2013 sample, we used the total number of FTE NAP (NAP staffing FTEs) and total nurse staffing FTEs (RN-FTEs + LPN-FTEs + NAP-FTEs) as additional measures of nurse staffing FTEs. We constructed two measures of “RN skill mix.” The first measure consisted of the proportion of RN-FTEs relative to the sum of RN-FTEs and LPN-FTEs for our 1997–2013 sample. The second measure consisted of the proportion of RN-FTEs relative to the sum of RN-FTEs, LPN-FTEs, and NAP-FTEs for our 2003–2013 sample. RN skill mix provides information about the utilization of highly skilled nurses (RNs) compared with the utilization of LPNs and NAPs who are supervised by RNs.

Independent variables. We constructed two dummy variables. The first dummy variable, *privatization to FP status*, was coded as “1” if the hospital privatized to FP status (the year of privatization and subsequent years were coded as “1”) and “0” if the hospital remained public. The second dummy variable, *privatization to NFP status*, was coded as “1” if the hospital privatized to NFP status (the year of privatization and subsequent years were coded as “1”) and “0” if the hospital remained public (Pradhan, Weech-Maldonado, Harman, & Hyer, 2014).

Control variables. We controlled for organizational and market variables that may be associated with nurse staffing (Serratt, Spetz, & Harrington, 2012). The operational definitions of the variables are shown in Table 1. Organizational variables consisted of system membership, teaching status, percentage of Medicare inpatient days, percentage of Medicaid inpatient days, occupancy rate, case mix index, Saidin index, adjusted patient days, and hospital size. Membership of a system may affect the use of nurse staffing level; hospitals affiliated with systems tend to maintain a lower nurse staffing level compared with their stand-alone counterparts (Seago, Spetz, & Mitchell, 2004). Teaching status, severity of disease measured by case-mix index, and the use of high-technology services measured by the Saidin index (Spetz & Maiuro, 2004), which have been used in previous studies as measures of organization complexity, have been found to be positively associated with RN utilization (Blegen, Vaughn, & Vojir, 2008; Seago et al., 2004). Similarly, the share of Medicare inpatient days and the share of Medicaid inpatient days may increase nurse staffing level, given that older adults and low-income populations tend to have multiple morbidities and more advanced diseases. In addition, occupancy rate and adjusted patient days that reflect efficient utilization of hospital services may be associated with nurse staffing strategy (Seago et al., 2004). In this study, we used adjusted patient days to take into account nurse staffing in both inpatient and outpatient settings. We also controlled for hospital size given the expected positive correlation between size and nurse staffing patterns.

Market variables consisted of per capita income, excess capacity, Herfindahl–Hirschman index (HHI), and Medicare Advantage (MA) penetration. Hospitals located in counties with a higher income level may be able to generate more revenue that will allow them to hire more RNs compared with hospitals located in counties with a lower income level. In this study, we used two measures of market competition: excess capacity and HHI. Excess capacity reflects the number of empty beds in the county. Increased excess capacity implies higher competition among hospitals to fill the empty beds. Because there are empty beds, which means fewer patients, hospitals may reduce their nurse staffing level. The HHI, a measure of market concentration, may be also associated with nurse staffing strategies. As competition intensifies through a lower HHI, hospitals may lower their nurse staffing level to cut costs and remain competitive. One study found that California hospitals located in more competitive markets were more likely to have nurse per patient ratios below the mandated minimum ratios (Conway, Konezka, Zhu, Volpp, & Sochalski, 2008). Finally, an increase in MA penetration may negatively affect hospitals’ nurse staffing strategy due to MA’s focus on cost containment strategies.

Analysis

Our study used a nonexperimental longitudinal design. Univariate descriptive statistics, cross-tabulations, and analyses of variance were used to describe the data. Multivariable regressions were used to model the relationships between nurse staffing and privatization. First, given the overdispersed count

TABLE 1: List of variables and operational definitions

Measures	Operational definitions	Data sources
Dependent variables		
RN staffing FTEs ^a	Total number of FTE RNs (RN-FTEs)	AHA
LPN staffing FTEs ^a	Total number of FTE LPNs (LPN-FTEs)	AHA
NAP staffing FTEs ^b	Total number of FTE NAP (NAP-FTEs)	AHA
Total nurse staffing FTEs ^a	RN-FTEs + LPN-FTEs	AHA
Total nurse staffing FTEs ^a	RN-FTEs + LPN-FTEs + NAP-FTEs	AHA
RN skill mix ^a	RN-FTEs / (RN-FTEs + LPN-FTEs)	AHA
RN skill mix ^b	RN-FTEs / (RN-FTEs + LPN-FTEs + NAP-FTEs)	AHA
Independent variables		
Privatization from public to either private for-profit or private not-for-profit status	Hypotheses 1a and 1b	AHA
	Dichotomous: Privatization to FP = 1	
	No privatization to FP = 0	
	Dichotomous: Privatization to NFP = 1	
	No privatization to NFP = 0	
Control variables—organizational factors		
System membership	Dichotomous: System member hospital = 1	AHA
	Stand-alone hospital = 0	
Teaching status	Dichotomous: Having teaching activities = 1	AHA
	No teaching activities = 0	
Hospital size	Total number of beds in the hospital	AHA
Percentage of Medicare inpatient days	Medicare inpatient days / Total inpatient days	AHA
Percentage of Medicaid inpatient days	Medicaid inpatient days / Total inpatient days	AHA
Occupancy rate	Total inpatient days / (#beds * 365 days)	AHA
Case mix index	Measures intensity of hospital services according to disease severity	CMS IF
Saidin index	Weighted sum of high-technology services accounting for rareness	AHA
Adjusted patient days	Inpatient days + (Inpatient days * (Inpatient revenue / Outpatient revenue))	AHA
Control variables—market factors		
Per capita income	Total income in county / Total number of residents	AHRF
Excess capacity	Total number of unoccupied beds in the county/Total number of hospitals in the county	AHRF
Herfindahl–Hirschman index	Herfindahl Index = Σ squared market share of all the hospitals in the health service area.	AHRF- AHA
	Market share for each hospital is measured in term of total acute care patient days for individual hospitals / The total acute care patient days in the Health service area	
Medicare Advantage penetration	(Medicare managed care enrollees / Total Medicare eligible) * 100	AHRF
<p>Note. RN = registered nurse; FTEs = full-time equivalents; AHA = American Hospital Association Annual Survey; LPN = licensed practical nurse; NAP = nursing assistive personnel; CMS IF = Centers for Medicare & Medicaid Services Impact Files; AHRF = Area Health Resources File.</p> <p>^a1997–2013 sample.</p> <p>^b2003–2013 sample.</p>		

data of the nurse staffing FTE variables, negative binomial regressions were used to model the relationships between the nurse staffing FTE dependent variables and privatization, with hospital level and year fixed effects. We used standard errors based on the observed information matrix, defined as “the inverse of the negative of the matrix of second derivatives,” which is the default standard error for longitudinal negative binomial regression in STATA. Second, the relationships between the RN skill mix dependent variables and privatization were modeled using linear regressions with hospital level and year fixed effects and the Huber–White sandwich estimator (robust standard error clustering for hospitals).

A fixed effects model is the appropriate model to use when there are unobservable variables that do not change over time but are thought to be correlated with the independent variables. Fixed effects model controls for these time-invariant unobservable factors that may account for between-hospitals differences. Failing to do so can lead to biased results due to omitted variables (Wooldridge, 2012). Therefore, a fixed effects model focuses on within-hospital variations in nurse staffing patterns. We also used joint tests to test the null hypothesis that the nurse staffing patterns after NFP and FP privatizations are the same (Abel, 2013).

To assess the appropriateness of the control variables, stepwise regressions were used: In the first step, we included only the privatization variables, and hospital and year fixed effects; in the second step, we added the organizational variables to the predictors in the first step; and in the third step, we added the market variables to the predictors in the second step. Given that coefficients remained stable as we added control variables, we report only the results of the full model.

To ensure approximately normal distribution for RN skill mix dependent variable, observations with values of five standard deviations above or below the mean were deleted until skewness was close to 0 and kurtosis was close to 3 (Weech-Maldonado et al., 2012). As a result, three hospital-year observations were deleted for the 1997–2013 sample; no hospital-year observations were deleted from the secondary sample 2003–2013. SAS Version 9.2 was used for data cleaning, and STATA Version 14 was used for data analysis.

Results

Among the 492 public hospitals in our (1997–2013) sample, 104 hospitals (21%) privatized. Among the privatized hospitals, 75 hospitals (72%) privatized to NFP status, and 29 hospitals (28%) privatized to FP status. Hospitals excluded from this study, due to missing data ($n = 85$), had lower median number of nurse staffing FTEs compared with hospitals included in this study: RN-FTEs (56 vs. 130) and LPN-FTEs (14 vs. 23). However, they had higher median number of NAP-FTEs (49) compared with the median number of NAP-FTEs for hospitals included in this study (43). Furthermore, hospitals excluded from this study had higher median number of total nurse staffing FTEs including RNs, LPNs, and NAPs (323) compared with hospitals included in this study (224). In terms of organizational characteristics, 34% of excluded hospitals were members of systems versus 28%

for hospitals included in the study. Eighteen percent of the excluded hospitals were teaching hospitals versus 26% for the hospitals included in the study. Compared with the included hospitals, the excluded hospitals were smaller in terms of average number of beds (163 vs. 194, $p < .01$), had fewer percentage of Medicare inpatient days (40% vs. 46%, $p < .001$), and were located counties with lower per capita income (\$28,100 vs. \$29,632, $p < .01$). Occupancy rate (56.33% vs. 56.29%, $p = .97$) and percentage of Medicaid inpatient days (25% vs. 24%, $p = .10$) are the same for the excluded and included hospitals.

Table 2 shows the results of the descriptive statistics. We report the medians of the nurse staffing FTE variables because the distributions were highly skewed. With respect to our 1997–2013 sample, hospitals that privatized experienced an increase in RN staffing FTEs; NFP privatization had the highest increase in median RN staffing FTEs (64% increase), compared with FP privatization (11% increase). On the other hand, hospitals that privatized experienced a decrease in LPN staffing FTEs, with FP privatization resulting in the greatest decrease in median LPN staffing FTEs (29% decrease), compared to NFP privatization (16% decrease). Although median total nurse staffing FTEs increased after NFP privatization (56% increase), it decreased after FP privatization (3% decrease). Finally, RN skill mix increased after privatization, with NFP privatization resulting in the highest increase (10% increase) compared to FP privatization (5% increase).

Taking into account the number of beds, we also calculated the change in nurse staffing per bed before and after privatization (table not shown). Similar to the distributions of our dependent variables, the distributions of the nurse staffing per bed variables were also skewed; we report the medians. With regard to our 1997–2013 sample, hospitals that privatized experienced an increase in median RN staffing FTEs per bed; NFP privatization had the highest increase (26% increase), compared with FP privatization (16% increase). On the other hand, hospitals that privatized experienced a decrease in median LPN staffing FTEs per bed, with NFP privatization resulting in the greatest decrease (36% decrease), compared with FP privatization (22% decrease). The median total nurse staffing FTEs per bed increased after both NFP privatization (17% increase) and FP privatization (13% increase).

Table 3 shows the results of the regression models for our 1997–2013 sample. Hypothesis 1a was partially supported; FP privatization was associated with a greater decrease (7%) in RN staffing FTEs (incidence rate ratio [IRR] = 0.93, $p = .004$), compared with a relatively smaller decrease (5%) for NFP privatization (IRR = 0.95, $p = .003$). FP privatization was also associated with a greater decrease (7%) in total nurse staffing FTEs (IRR = 0.93, $p = .001$), compared with a relatively smaller decrease (4%) for NFP privatization (IRR = 0.96, $p < .007$). The joint tests assessing the differences in IRR between NFP and FP privatizations regarding RN staffing FTEs and total nurse staffing FTEs were both statistically significant ($p < .001$). However, privatization to either NFP or FP was not significantly associated with a change in

TABLE 2: Descriptive statistics: Univariate analysis, cross-tabulations, and analysis of variance, 1997–2013 (n = 8,335)

Mean (median) Frequency (%)	Remained public	Before FP privatization	After FP privatization	Before NFP privatization	After NFP privatization	p*
Dependent variables						
RN staffing FTEs	351 (137)	126 (76)	138 (84)	196 (90)	392 (148)	
LPN staffing FTEs	38 (24)	28 (21)	19 (15)	29 (19)	26 (16)	
NAP staffing FTEs ^a	96 (46)	54 (37)	33 (27)	59 (33)	93 (40)	
Total nurse staffing FTEs	389 (166)	154 (106)	157 (103)	225 (112)	418 (175)	
Total nurse staffing FTEs ^a	555 (241)	260 (166)	204 (150)	308 (163)	550 (229)	
RN skill mix	0.81	0.77	0.81	0.79	0.87	<.001
RN skill mix ^a	0.67	0.66	0.67	0.64	0.72	<.001
Control variables—organizational factors	Remained Public	Public →FP		Public → NFP		p
System membership						
Yes	1,802 (24.20)	176 (71.26)		363 (56.63)		<.001
No	5,645 (75.80)	71 (28.74)		278 (43.37)		
Teaching status						
Yes	1,932 (24.94)	31 (12.55)		168 (26.21)		<.001
No	5,515 (74.06)	216 (87.45)		473 (73.79)		
Hospital size	197	107		199		<.001
Percentage of Medicare inpatient days	0.45	0.56		0.51		<.001
Percentage of Medicaid inpatient days	0.24	0.18		0.20		<.001
Occupancy rate	0.57	0.49		0.56		<.001
Case mix index	1.27	1.17		1.34		<.001
Saidin index	9.16	6.00		11.19		<.001
Adjusted patient days	85,396	37,854		87,475		<.001
Control variables—market factors						
Per capita income	29,243	31,362		33,446		<.001
Excess capacity	60	54		59		.009
Herfindahl–Hirschman index	0.79	0.82		0.80		.82
Medicare Advantage penetration (%)	12.07	12.77		16.38		<.001
<p>Note. Sample size and frequencies are expressed in hospital-year observations. FP = for-profit; NFP = not-for-profit; RN = registered nurse; FTEs = full-time equivalents; LPN = licensed practical nurse; NAP = nursing assistive personnel.</p> <p>^aOnly for 2003–2013 sample.</p> <p>*p < .05.</p>						

TABLE 3: Fixed effects regression models using 1997–2013 sample (n = 8,335)^a

	Either From Public to NFP or From Public to FP			
	RN staffing FTEs	LPN staffing FTEs	Total nurse staffing FTEs ^b	RN skill mix ^c
	IRR ^d	IRR	IRR	β
	(ρ)	(ρ)	(ρ)	(ρ)
Independent variables				
Privatization from public to NFP	0.95**	0.95	0.96**	0.01
	(.003)	(.10)	(.007)	(.34)
Privatization from public to FP	0.93**	0.96	0.93***	0.01
	(.004)	(.40)	(.001)	(.28)
Control variables—organizational factors				
System membership	0.99	0.95**	0.99	0.01
	(.56)	(.002)	(.17)	(.07)
Teaching status	1.01	0.92***	0.99	0.006
	(.41)	(.001)	(.56)	(.25)
Hospital size	1.00***	1.00**	1.00***	0.0001
	(<.001)	(.007)	(<.001)	(.054)
Percentage of Medicare inpatient days	1.06	0.98	1.08**	−0.01
	(.08)	(.70)	(.012)	(.46)
Percentage of Medicaid inpatient days	0.74***	1.60***	0.87***	−0.11***
	(<.001)	(<.001)	(<.001)	(<.001)
Occupancy rate	1.23***	1.03	1.26***	−0.01
	(<.001)	(.58)	(<.001)	(.64)
Case mix index	1.10***	0.79***	1.23***	−0.02
	(<.001)	(<.001)	(<.001)	(.18)
Saidin index	1.00	1.00***	1.00***	−0.001***
	(.06)	(<.001)	(<.001)	(<.001)
Adjusted patient days	1.00***	1.00***	1.00***	−9.92e−08
	(<.001)	(<.001)	(<.001)	(.14)
Control variables—environmental factors				
Per capita income	1.00***	1.00***	1.00***	2.09e−08
	(<.001)	(<.001)	(<.001)	(.96)
Herfindahl–Hirschman index	1.29***	1.11*	1.26***	0.03*
	(<.001)	(.04)	(<.001)	(.031)
Excess capacity	1.00**	1.00*	1.00**	7.25e−06
	(.003)	(.05)	(.004)	(.90)

(continues)

TABLE 3: Fixed effects regression models using 1997–2013 sample ($n = 8,335$)^a, Continued

	Either From Public to NFP or From Public to FP			
	RN staffing FTEs	LPN staffing FTEs	Total nurse staffing FTEs ^b	RN skill mix ^c
	IRR ^d	IRR	IRR	β
	(p)	(p)	(p)	(p)
Medicare Advantage penetration	1.00*** ($<.001$)	0.99*** ($<.001$)	1.00*** ($<.001$)	0.0001 (.65)
Wald chi-square test or overall F test ^e	60,656*** ($<.001$)	1,538*** ($<.001$)	53,232*** ($<.001$)	53.79*** ($<.001$)

Note. NFP = not-for-profit; FP = for-profit; RN = registered nurse; FTEs = full-time equivalents; LPN = licensed practical nurse.

^aSample size is expressed in hospital-year observations.

^bFixed effects negative binomial regression; Total nurse staffing FTEs = RN FTEs + LPN FTEs.

^cFixed effects linear regression; RN skill mix = RN FTEs / (RN FTEs + LPN FTEs).

^dIncidence rate ratio.

^eOverall F test.

* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

LPN staffing FTEs. Hypothesis 1b was not supported. Privatization to either NFP or FP was not associated with a significant decrease in RN skill mix.

Table 4 shows the results of the regression models from our 2003–2013 secondary sample. NFP privatization was associated with 14% decrease in NAP staffing FTEs (IRR = 0.86, $p = .002$) compared with a nonsignificant decrease for FP privatization. In addition, NFP privatization was associated with 9% decrease in total nurse staffing FTEs (IRR = 0.91, $p = .001$), compared with 8.6% decrease (IRR = 0.914, $p = .02$) for FP privatization. The joint tests assessing these differences were significant at $p = .004$ for NAP staffing FTEs and at $p < .001$ for total nurse staffing FTEs. Both NFP and FP privatizations were not significantly associated with changes in RN skill mix.

Discussion

This study examined the associations between NFP and FP privatizations and nurse staffing strategies. Our findings show that both FP and NFP privatization resulted in a reduction in the number of more educated nurses (RNs). Because RNs hold the largest portion of hospitals' labor cost, reducing the number of RNs may be one of the strategies that privatized hospitals adopt to cut expenditures and improve profitability. Our findings support a prior study that suggests that FP and NFP privatizations were associated with a decrease in the number of FTE employees to improve efficiency (Ramamonjariavelo et al., 2016).

However, FP privatization was associated with a larger reduction in RNs compared to NFP privatization. On the other hand, FP privatization was not associated with a change in the number of NAPs, compared to a significant decrease in NAPs for NFP privatization. The observed differences in staffing strategies between FP and NFP privatizations may be explained by differences in hospitals' missions and goals. The goal of FP hospitals is to generate profit that increases investor's wealth,

whereas the goal of NFP hospitals is to provide care to everyone, as long as it does not threaten their financial viability. Since FP hospitals have a greater emphasis on profits than NFP hospitals, hospitals privatizing to FP may be more willing to make larger cuts in the more expensive RNs, while keeping unchanged the number of the less expensive LPNs and NAPs. Because NFP hospitals have less emphasis on profit making than FP hospitals, they may not implement as large cuts in RNs. The smaller reduction in RNs coupled with a reduction in NAPs may be a strategy of NFP privatized hospitals to improve profitability while maintaining nurse staffing skill mix (by reducing the less educated NAPs). As such, NFP privatized hospitals are able to maintain a higher RN skill mix compared to FP privatized hospitals (Table 2). This suggests a greater emphasis of NFP privatized hospitals on quality compared to FP privatized hospitals.

Limitations and Future Research

The study has several limitations. First, data limitations precluded us from controlling for the percentage of privately insured and uninsured patients in the study. Having a higher proportion of uninsured patients may financially strain hospitals and prevent them from hiring more educated nurses. Second, the years of data used in this study (1997–2013) did not allow us to control for the impact of the Affordable Care Act, as full implementation did not occur until 2014. Additional research is needed to assess the potential effect of the Affordable Care Act on privatization of public hospitals. Third, given the large number of years in our study (17 years), some events, such as the 2007–2009 financial crisis and Great Recession, may have influenced the impact of privatization on nurse staffing. However, the use of year fixed effects controls for changes occurring each year that affect all hospitals.

Fourth, the NAP variable was not available from 1997 to 2002; thus, we were not able to include this variable throughout

TABLE 4: Fixed effects regression models using 2003–2013 sample ($n = 4,582$)^a

	Either From Public to NFP or From Public to FP		
	NAP staffing FTEs	Total nurse staffing FTEs ^b	RN skill mix ^c
	IRR ^d	IRR	β
	(p)	(p)	(p)
Independent variables			
Privatization from public to NFP	0.86*** (.002)	0.91*** ($<.001$)	-0.004 (.78)
Privatization from public to FP	0.91 (.19)	0.914** (.02)	0.03 (.15)
Control variables—organizational factors			
System membership	0.99 (.68)	1.00 (.98)	0.005 (.56)
Teaching status	0.95 (.19)	1.02 (.41)	-0.004 (.69)
Hospital size	1.00 (.66)	1.00*** ($<.001$)	0.0001 (.29)
Percentage of Medicare inpatient days	0.90 (.23)	0.98 (.67)	0.001 (.96)
Percentage of Medicaid inpatient days	0.87 (.09)	0.92 (.07)	-0.13*** ($<.001$)
Occupancy rate	1.06 (.44)	1.13** (.004)	0.003 (.91)
Case mix index	1.37*** ($<.001$)	1.16*** ($<.001$)	-0.04* (.01)
Saidin index	1.00 (.34)	1.00*** ($<.001$)	-0.001 (.06)
Adjusted patient days	1.00** (.02)	1.00*** ($<.001$)	-2.62e-07* (.03)
Control variables—environmental factors			
Per capita income	1.00*** ($<.001$)	1.00*** ($<.001$)	9.18e-07 (.17)
Herfindahl–Hirschman index	1.32*** ($<.001$)	1.26*** ($<.001$)	0.03* (.05)
Excess capacity	1.00 (.14)	1.00** (.003)	-0.00001 (.85)

(continues)

TABLE 4: Fixed effects regression models using 2003–2013 sample (n = 4,582)^a, Continued

	Either From Public to NFP or From Public to FP		
	NAP staffing FTEs	Total nurse staffing FTEs ^b	RN skill mix ^c
	IRR ^d	IRR	β
	(p)	(p)	(p)
Medicare Advantage penetration	1.00**	1.00***	0.001
	(.002)	(<.001)	(.13)
Wald chi-square test or overall F test ^e	150.59***	25,360.07**	124.02***
	(<.001)	(<.001)	(<.001)

Note. NFP = not-for-profit; FP = for-profit; NAP = nursing assistive personnel; FTEs = full-time equivalents; RN = registered nurse.

^aSample size is expressed in hospital-year observations.

^bFixed effects negative binomial regression; Total nurse staffing FTEs = RN FTEs + LPN FTEs + NAP FTEs.

^cFixed effects linear regression; RN skill mix = RN-FTEs / (RN-FTEs + LPN-FTEs + NAP-FTEs).

^dIncidence rate ratio.

^eOverall F test.

*p ≤ .05. **p ≤ .01. ***p ≤ .001.

the study years (1997–2013). However, we used a secondary sample (2003–2013) and incorporated NAP in separate regressions. Fifth, due to data limitations, we were not able to differentiate between nursing hours dedicated to patient care versus other activities. Future studies on the impact of privatization on nurse staffing should use these variables to shed more light on nurse staffing strategies after privatization. Sixth, our study design did not allow us to conclude that there are some causal relationships between FP and NFP privatizations and nurse staffing strategies.

Seventh, some selection bias may have been introduced in the study when we excluded hospitals that did not have complete data throughout the study years. Compared with the hospitals included in this study, excluded hospitals had a higher proportion of system hospitals, but a lower proportion of teaching hospitals. Excluded hospitals were also smaller and had a smaller share of Medicare inpatient days but were similar to the hospitals included in the study in terms of occupancy rate and share of Medicaid inpatient days.

Eighth, given that the purpose of our study was to assess the relationship between public hospital privatization and nurse staffing, we did not seek to investigate the factors associated with the closures of the 47 hospitals as well as the factors associated with the multiple conversions of the 32 hospitals during the study period. Additional studies are needed to identify the factors associated with public hospitals' closures and their multiple conversions.

Ninth, we were not able to assess whether the reduction in nurse staffing, after privatization, was the result of the closures of some service lines (Villa & Kane, 2013) and/or the result of some process improvement initiatives to improve efficiency (Ramamonjivarivelo et al., 2016).

Finally, although this study assessed the relationships between NFP and FP privatizations and nurse staffing, it did not attempt to assess the optimal nurse staffing level, and the findings did not imply that public hospitals provide better

care because they have a higher nurse staffing level than NFP and FP hospitals.

Implications for Management/Application to Management Practice

Privatization may enable hospitals to adopt strategies to improve efficiency by implementing new nurse staffing patterns. Privatized hospitals tend to emphasize reductions in the number of nursing FTEs (nurse staffing intensity) more so than shifting the proportion of RNs (RN skill mix). Specifically, they tend to target RNs, although some differences emerge for FP versus NFP privatization, with hospitals privatizing to FP making more drastic cuts in the number of RNs compared with hospitals privatizing to NFP. Given that NFP and FP hospitals may have different goals and objectives, privatized hospitals may adopt the nurse staffing strategy that may facilitate the achievement of those goals and objectives. Regardless, managers need to keep in mind the importance of maintaining an adequate nurse staffing strategy to ensure that quality of care is not compromised. In the environment of value-based purchasing, hospitals reducing RNs may incur financial penalties as a result of lower quality of care, such as hospital-acquired infections and readmissions. The adoption of minimum nurse-to-patient staffing requirements for hospitals, such as the nurse staffing mandate implemented in California, could be a way to ensure nurse staffing level does not drop below levels that may negatively affect patient outcomes after privatization (Aiken et al., 2010).

Conclusion

Overall, this study found that privatization was associated with decreases in the number of RNs, NAPs, and total nurse staffing. Hospitals that privatized to FP decreased the number of more educated nurses (RNs) but did not change the number of less educated nurses (LPNs and NAPs), whereas hospitals

that privatized to NFP reduced both the number of more educated nurses (RNs) and least educated nurses (NAPs) but did not change the number of LPNs. Although prior studies found that privatization was associated with a decrease in quality of care, that decrease may be attributable to the change in nurse staffing strategies after privatization. A close monitoring of nurse staffing levels, after privatization, may be needed to prevent potential declines in quality of care. Additional studies are needed to explore potential changes in access and quality of care as a result of public hospital privatization.

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