HOW DO HOSPITAL NURSE STAFFING STRATEGIES AFFECT PATIENT SATISFACTION?

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In this article, the authors evaluate the role of the nurse staffing mix on hospital patient satisfaction. Using three years (2009 to 2011) of hospital patient satisfaction data linked to data on the productive staffing hours of registered nurses, licensed vocational nurses, nurse's aides, and contract nurses for 311 California hospitals, the authors analyze how nurse staffing levels affect 10 dimensions of patient satisfaction. The findings indicate that a higher level of registered nurses per bed appears to increase overall patient satisfaction. Conversely, hospitals with a higher proportion of nursing hours provided by contract nurses have significantly lower levels of patient satisfaction on scores related to overall patient satisfaction and nurses' communication with the patient. The results have implications for RN staffing strategies and inform the broader literature on worker skill mix and employment arrangements.

Recognition has been growing that focusing on the frontline hospital staff (i.e., nursing staff), rather than strict hierarchal structures of authority within the hospital organization in the provision of care, has positive impacts on organizational performance. For example, Kane and colleagues (2007) showed that hospital nurse staffing is positively related to patient outcomes. Other evidence has suggested that patient-centered approaches to human resource management can improve safety, in part through maintaining a culture that leads to reduced turnover (Avgar, Givan, and Liu 2011). In fact, the recognition of the importance of nursing for better patient care led California to legislate mandatory nurse staffing levels for its acute-care hospitals in 1999 (Mark, Harless, and Spetz 2009; Donaldson and Shapiro 2010; KC and Terwiesch 2011), with several states subsequently following California's initiative (Aiken et al. 2011).

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In addition to patient outcomes, evidence has been presented that the work environment and workloads for nurses affect patient satisfaction (Kutney-Lee et al. 2009). Although the literature on the impact of the overall registered nurse (RN) staffing level and related work environment on outcomes is well developed, the research literature on the optimal skill mix of the nursing staff is thin (Buchan and Dal Poz 2002). Furthermore, this research, like much of the related literature on nurse staffing, has limited the inferences we can draw concerning the optimal nurse staffing level and nursing skill mix because of limited sample sizes, selection bias in the survey responses, and differences in the measures of the staffing levels (Flynn and McKeown 2009).

In this study we have two primary objectives. Using three years of data from 311 California acute-care hospitals, we first seek to identify the impacts that hospital nursing services have on customer (i.e., patient) satisfaction. Specifically, we employ publicly available data using well-established measures to examine the extent to which the nursing-skill mix, defined as the relative mix of productive hours provided by the hospital nursing staffs of different credentialing levels, is associated with patient satisfaction as measured by validated surveys administered nationally that are used in hospital-reimbursement schemes in the United States. Second, our research extends the literature on the effects of core (directly employed) workers compared to contingent (contract) workers on productivity in the health care sector by examining whether patient satisfaction differs in hospitals with higher proportions of productive hours supplied by contract rather than directly employed RNs.

Background and Theory

The Impact of Nurse Staffing Levels and Nursing-Skill Mix on Patient Care

The division of labor in the typical nurse workforce in a hospital consists of three credentialing layers: (1) RNs, (2) licensed vocational nurses (LVNs), and (3) nurses' aides (NAs). Strong evidence exists that higher levels of hospital nurse staffing are associated with less adverse patient outcomes (Aiken et al. 2002, 2011) and that higher proportions of staffing with RNs relative to LVNs or NAs have an even greater positive impact on patient outcomes and quality of care (Stanton and Rutherford 2004). This existing literature showing better health outcomes resulting from increased RN staffing would reasonably be expected to translate into increased patient satisfaction as well (Kutney-Lee et al. 2009), and this motivates our first hypothesis:

Hypothesis 1: Hospitals with higher levels of RNs per bed will have higher average patient satisfaction.

Although hospitals can increase the proportion of RN staffing, the optimal staffing mix must still be considered because matching tasks and talents is important to performance and efficiency. Attracting and maintaining

nursing staff is not easily accomplished in the hospital industry, which faces incessant cost pressures (Preuss and Frost 2003). A shortage of nurses has persisted in the United States for more than a decade, and the shortage of RNs, LVNs, and NAs has been projected to persist (Janiszewski Goodin 2003).[1] Consequently, hospitals, especially in competitive markets, have had to adjust the skill mix of their nursing staff based on the availability of nurses and also have had to employ contract RNs.

RNs, LVNs, and NAs all provide direct patient care to the patient, but both RNs and LVNs are licensed by the state in which they are employed. RNs assess patient needs, develop patient care plans, and administer medications and treatments; LVNs carry out specified nursing duties under the direction of an RN or physician. NAs typically carry out nonspecialized duties and personal-care activities. In addition, RNs, LVNs, and NAs have different educational requirements. For RNs, three types of educational programs that are sufficient for licensing: three-year diploma programs, two-year associate degree programs, and four-year baccalaureate degree programs. LVNs must go through 12- to 18-month training programs that emphasize technical nursing tasks, such as venipuncture and the removal of uncomplicated sutures to be licensed. NAs are not licensed, but many acquire certified nurse aide/nursing assistant (CNA) status after proving they have certain skills related to the requirements of particular positions. They can do this through formal education programs at technical colleges and community colleges or through hospital-based training.

Buchan and Dal Poz (2002) reviewed the literature on the impact of nurse staffing mix on system performance. They noted that the existing research covers a wide array of skill-mix interventions and expansions of the scope of practice of the existing nurse types. From this literature they concluded that the use of less-trained staff is not always appropriate. When we apply this thought process to patient satisfaction, different staffing mixes are likely to affect different domains of patient satisfaction and hospitals can probably choose a skill mix that achieves high patient satisfaction. For instance, higher proportions of RNs will probably be associated with higher patient satisfaction with the health care aspects of the patients' hospitalization because much of the health care that patients require is provided by RNs. In contrast, satisfaction with the "hoteling" aspects of hospitalization, which include room cleanliness, quiet, and general responsiveness to patient needs, may suffer if hospitals overinvest in highly skilled nurses (RNs) at the expense of lower skilled nurse staff (LVNs and NAs). This leads to the following hypotheses:

Hypothesis 2a: Hospitals with more non-RN nursing hours as a proportion of total nursing hours will have lower average patient satisfaction on nursing-related measures.

[1]The Bureau of Labor Statistics (2013) reported the 30 occupations with the largest projected employment growth between 2010 and 2020, and all three nurse groups were among those occupations listed, with RNs estimated to experience the largest growth. The projections are RNs, 712,000 new jobs (26% increase); LVNs, 169,000 new jobs (22% increase); and NAs, 302,000 new jobs (20% increase).

Hypothesis 2b: Hospitals with more non-RN nursing hours as a proportion of total nursing hours will have greater patient satisfaction on non-nursing and amenity ("hoteling") measures.

The Impact of Contract Nursing on Patient Care

The widespread use of contract nurses in hospitals underscores the importance of the conceptual and empirical research on the impact of standard compared to nonstandard work arrangements on organizational performance (Broschak and Davis-Blake 2006). *Core* workers are those who are directly employed by firms and who would legally be considered employees of the firm, whereas *contingent* workers are those who work under contract, either independently or through a sourcing firm (Brosnan and Walsh 1996; Nardone, Veum, and Yates 1997; Befort 2003).

The benefits and costs of having core and contingent workers doing the same work and the effects of having these two groups working alongside one another are the subject of an ongoing debate. In the context of our study, contract nurses are contingent workers who are engaged in the same work as the core workers; however, the two groups may or may not work directly together in a hospital. Thus, the previous literature has provided a framework for conceptualizing the potential impacts and underlying mechanisms of hospitals' employing contract RNs.

For many organizations, optimal human resource management could involve integrating contingent workers into an organization's work structure (Olsten Corporation 1997; Matusik and Hill 1998; Lepak and Snell 1999). Broschak and Davis-Blake (2006) noted that such well-organized arrangements allow managers to respond to fluctuations and competition in their markets by providing the managers access to specific skill sets of workers who are needed only occasionally. They observed that staffing strategies that include both core and contingent workers can have benefits for both groups. Core workers benefit from enhanced job security and mobility, whereas contingent workers benefit from flexible work arrangements and employment opportunities. This has led some researchers to suggest that having both types of employees is essential for good human resource management (Smith 2001).

Broschak and Davis-Blake (2006) noted that mixing core and contingent workers in the same work group compels employment relationships among employees whose work agreements with the employer can vary dramatically in work tasks, hours, and work-related opportunities and training. This can affect morale because core and contingent employees can be working side by side on the same job but under different compensation and benefits terms. This, in turn, will affect their performance level (Bourhis and Wils 2001). Harley (1994) found that, regardless of size, sector, or industry, an association exists between contingent (which he calls peripheral) workers and negative conditions. These negative conditions for contingent workers include lower wage rates, less job security, worse patterns of gender equality,

less access to training and career-advancement opportunities, and less worker autonomy compared to core workers. Harley found this pattern to be the rule rather than the exception.

More recent evidence has suggested that training and advancement opportunities are important for worker commitment and thus for productivity. Contingent workers are marginal to an organization, and as such, firms allocate fewer resources to training and socializing them than to training and socializing core employees (Valverde, Tregaskis, and Brewster 2000; Wiens-Tuers and Hill 2002; Connelly and Gallagher 2004). This restricted investment on the part of client firms reinforces feelings of second-class citizenship among contingent employees and has the further effect of limiting both their involvement in and identification with the organization. As a result, contingent workers may exhibit lower levels of continuance commitment toward the client firm than do core employees (Millward and Hopkins 1998; Felfe, Schmook, Schyns, and Six 2008; McInnis, Meyer, and Feldman 2009).

In addition, contingent workers face other work-related stress that negatively affects their job performance (De Cuyper et al. 2008). Contract workers face a lack of support from coworkers, supervisors, and even the union (De Witte and Näswall 2003). This may be a result of organizations' lack of investment in the integration of contingent workers into the existing workforce (Breaugh 2008). As such, contingent workers are seen as temporary and viewed as having limited autonomy and fewer possibilities for deciding how to do their work, to use specific skills, and to make other kind of decisions at work (De Witte and Näswall 2003). They also face the liability of newness, having to assimilate new procedures and aspects of the organization, and this may also contribute another potential source of contingent-worker stress (Stinchcombe 1965; De Cuyper et al. 2008). This arises in part because the coordination of work activities between core and contingent workers can create tension and conflict because the latter lack firm-specific skills, that is, the tacit knowledge needed to perform work effectively in the organization (Broschak and Davis-Blake 2006).

The negative findings about the influence of contingent workers on organizational performance are not universal. Regarding job commitment, Martin and Hafer (1995) and De Witte and Näswall (2003) found no significant difference between short-term (contingent) and permanent (core) employees; De Witte and Näswall found similar results regarding job satisfaction. Engellandt and Riphahn (2005) observed an even higher level of employee effort in contingent workers that in core workers. These authors argued that contingent workers are more likely to work harder, although this pattern is more commonly found among employees who have a possibility of moving up in the organization.

These issues are salient in the case of contract RNs, although to what extent they might negatively affect the organization on dimensions of patient satisfaction is unclear. Contract nurses, like other contingent workers, face the same concerns about the organization's lack of commitment to their career development. Further, they may lack hospital-specific knowledge

about the processes of care. As such, their organizational commitment, ability to make autonomous decisions, and ability to coordinate necessary organizational resources to deliver the most effective care in a timely manner could be restricted. This would translate into reduced patient satisfaction. Thus, our third hypothesis is:

Hypothesis 3: Hospitals with more contract RN nursing hours as a proportion of total nursing hours will have lower average patient satisfaction.

Methods

Data

Our database of California hospitals comprises linked data from five databases for the years 2009 to 2011. We start with the Hospital Consumer Assessment of Healthcare Providers and Hospital System Survey (HCAHPS) because this national survey captures the hospital information we need on patient satisfaction. The data from the core HCAHPS were available for 311 of the 325 California hospitals (96%) over the study period.

To capture the differences in patient characteristics that might influence the patient satisfaction scores for hospitals, we aggregated patient-level discharge data from the Agency for Healthcare Research and Quality's (AHRQ's) Healthcare Cost and Utilization Project–State Inpatient Database (HCUP-SID) for each hospital in California by year (Agency for Healthcare Research and Quality [AHRQ] 2013) and linked this to the HCAHPS data for each of the three years. The California HCUP-SID is a 100% discharge-abstract data system, which allowed us to create aggregate annual data for each hospital on key clinical and nonclinical variables: patient demographics, average patient age, percentage female, percentage of patients covered by different payers (Medicare; Medicaid; private, including health maintenance organization; self-pay; no charge; and other), percentage hospital racial composition (white, black, Hispanic, Asian, and other), average number of diagnoses and procedures for each treatment, hospital charges, average length of stay, and percentage of patients who died during their inpatient stay (AHRQ 2013).

To capture organizational information about the hospitals, we also linked the American Hospital Association (AHA) Annual Survey Database for California hospitals to the HCAHPS and HCUP data. These data contain demographic information, organizational structure, facilities and services, use data, community-orientation indicators, physician arrangements, managed-care relationships, expenses, and staffing. We supplemented this database with data from the California Office of Statewide Planning and Development (OSHPD), which annually collects detailed financial and use data, including the hours worked by different job classes in all state hospitals (State of California 2013). Finally, we used the area resource file (ARF) data (Health Resource and Services Administration [HRSA] 2013) to control for market-level level characteristics that could influence overall patient satisfaction scores.

Dependent Variables: Patient Satisfaction

Beginning in 2002, the Centers for Medicare and Medicaid Services partnered with AHRQ, another agency in the federal Department of Health and Human Services, to develop and test HCAHPS, which ultimately became the first publicly available, standardized survey designed to gather information from adult inpatients about the their inpatient care experiences. HCAHPS is a survey consisting of 27 questions and taking 7 to 10 minutes to complete. Of the first 22 questions, 18 are substantive and 4 are screening questions. The aggregate responses to the 18 questions are publicly reported on the HCAHPS website. Of these, 14 have data used to construct composite measures regarding communication with nurses and doctors, responsiveness of staff, pain management, communication about medicines, and discharge information (the typical response options for these questions are "never," "sometimes," "usually," and "always," with a few exceptions; for the discharge questions, the options are "yes" and "no"). Two individual questions pertain to the cleanliness and quietness of the hospital environment, and two overall measures are included: a 0- to 10-point rating of the hospital and a measure of the respondent's willingness to recommend the hospital (the response options are "definitely no," "probably no," "probably yes," and "definitely yes").[2]

The 10 resulting composite HCAHPS questions developed using this methodology are used as our dependent variables reflecting the percentage of patients at each hospital with a positive response to the question.[3] These are 1) overall rating of the hospital; 2) willingness to recommend the hospital to family and friends; and eight ratings of key patient issues related to their hospital stay: 3) communication with doctors, 4) communication with nurses, 5) responsiveness of hospital staff, 6) pain management, 7) communication about medicines, 8) discharge information, 9) cleanliness of the hospital environment, and 10) quietness of the hospital environment (HCAHPS 2013).

Independent Variables: Nurse Staffing Structure

Our key independent variables of interest are related to nursing, including RNs per bed; nursing-skill mix, as measured by LVN hours as a proportion of total nursing hours and NA hours as a proportion of total nursing hours; and contract RN hours as a proportion of total nursing hours for each hospital.

For each hospital, productive working hours are reported in the OSHPD data for all nursing staff combined and separately for core (directly employed) RNs, LVNs, NAs, and contract RNs. Productive hours are the total hours actually worked, including paid time spent attending meetings

[2]Further details of the methodology and survey instrument construction can be found at the HCAHPS website (Hospital Consumer Assessment of Healthcare Providers and Systems [HCAHPS] 2013).

[3]Although testing whether some combination of these questions would yield stronger effects on domains of satisfaction would be of interest, the HCAHPS individual data are not available to test and construct these.

and educational activities at or away from the hospital. Total productive hours include operating and nonoperating cost centers and also the hours for workers who do not receive a paycheck from the hospital's payroll system, such as registry nursing personnel and other temporary personnel. Total productive hours exclude on-call hours.

We calculated the variable RNs per bed by dividing the total numbers of RNs at the hospital by the total number of hospital beds. To construct each hospital's nursing-skill mix and contract RN variables, we divided the productive hours for each group of nurses—core RNs, LVNs, NAs, and contract RNs—by the total productive hours at the hospital all nurses, with core RN hours as a proportion of total nursing work hours as the omitted category.

Control Variables: Hospital Environment, Structure, and Process; Patient Characteristics and Outcomes

Other variables included in our model have been extensively explored in previous management and economic analyses and are modeled to reflect a causal pathway: hospital's environment/market > structure and process > patient experiences > quality performance (Donabedian 1966). An extensive empirical literature exists that has examined the effects of hospital competition on the costs of, access to, patient satisfaction with, and quality of hospital services. These studies typically found statistically significant effects (Wong, Zhan, and Mutter 2005). We used the Herfindahl–Hirschman index (HHI), calculated as the sum of the squared market shares for all hospitals in the local market, as our market-competition measure. The hospital's referral region (HRR), which reflects patient flow (patients' origin), is used to create a hospital market for each hospital and reflects the area from which the hospital draws the vast majority of its patients. The measure Hospital HHI in HRR reflects the hospital's level of competition, and the variable % Minority in HRR measures the concentration of minorities in the hospital's area.

Ownership/control definitions for short-term community hospitals are defined to be consistent with AHA definitions. We differentiate five groups of hospitals: 1) for-profit; 2) private, not-for-profit, nongovernment; 3) private, not-for-profit, religious but not Catholic-affiliated; 4) private, not-for-profit, Catholic-affiliated; and 5) government-controlled. We differentiated among the private, not-for-profit hospitals based on their religious affiliation to reflect differences in their missions and goals and how they might view their worker relationships (Nelson 2001). Government hospitals are the excluded reference category.

We also include three dummy variables for hospitals that are sole community providers (Morrisey, Alexander, Burns, and Johnson 1996), critical-care hospitals (Thomas, Sexton, and Helmreich 2003), and rural referral-center hospitals (Hogan 1988). Each of the designations potentially captures aspects of the hospital's organization, processes, and environment.

Hospital teaching status is determined from AHA data and described by three binary variables: 1) hospitals that had at least one approved residency

program but no medical school affiliation; 2) hospitals that had a medical school but were not a member of the Council of Teaching Hospitals; and 3) hospitals that were members of the Council of Teaching Hospitals. This construction expresses teaching in terms of the level of teaching commitment and has been used extensively and effectively in our past research (Sloan and Becker 1981). No teaching is the excluded reference category. Hospital size, measured by the number of beds, was categorized into four quartiles to capture differences in hospital scale and in the importance and complexity of size; this permits a nonlinear size effect on the dependent variables (ibid.).

Typically, organizational studies have differentiated hospitals based on their complexity and the degree to which they differentiate various products. The AHA lists approximately 90 services staffed and supported by a hospital, including obstetrical care, cardiac intensive care, burn care, rehabilitation care, pediatric cardiac surgery, chiropractic services, dental services, and geriatric services, For each hospital, we include a broad range of measures to capture the service mix and intensity. These include the mean number of chronic conditions, diagnoses, and medical procedures per patient. Shifts among nurse staffing in the treatment areas may be critical to different aspects of patient satisfaction. Because the HCAHPS measures are collected following the patient's stay, we also included the mean costs of the stay in the hospital and the length of stay (LOS). The electronic health record (EHR) variable is a dummy variable indicating the extent of EHR-system implementation at the hospital. We identify hospitals with either a full or partially implemented EHR systems.

Staffing decisions and patient-care levels may vary by hospital payer, racial/ethnic composition, age, and/or gender and, consequently, may influence patient satisfaction (Hall et al. 2003; Spencer, Gaskin, and Roberts 2013). To reflect the payer mix for the hospital, we include in the models the percentage of patients who were insured by Medicare, Medicaid, private insurance, and other (self-pay, no insurance, and other insurers); private insurance is the reference category. Five racial/ethnicity distinctions were included: white, black, Hispanic, Asian or Pacific Islander, and other. The percentage of female inpatients is included, as is the mean age of the patient; age is a continuous variable in the HCUP-SID files.[4]

The uses of International Classification of Diseases, Ninth Revision (ICD-9) coding in the HCUP files permits the identification of a wide range of comorbid conditions. We used a wide variety of these in our past HCUP–Nationwide Inpatient Sample (NIS) investigations, and we include 29 of these major comorbidities in our California data.[5] Inpatients who had major

[4]Some may be concerned that, by adjusting for patient factors that are already used to standardize the HCAHPs scores, we are double-adjusting or introducing endogeneity. Because we are using the aggregate scores and aggregate measures of the sociodemographic and clinical profile of the patient, this is not as great a concern. We did estimate models that excluded these characteristics, and the results were largely similar, and in some cases larger in magnitude, for the significant factors we report here. The estimates of these models without these controls are available from the authors upon request.

[5]See Table 2 later in the article for the list.

risk factors—obesity, alcohol dependence, smoking history, diabetes (insulin-dependent and non-insulin-dependent diabetics), or hypertension—may require higher levels of attention and also heighten the level of patient needs. Many of these variables are described in greater detail in the HCUP-SID documentation (AHRQ 2013).

Statistical Analysis

To assess the impact of hospitals' nursing characteristics (frontline staff) on patient-satisfaction outcomes, we estimate regressions of the following form:

$$\begin{aligned}\%\ \text{Patient high satisfaction}_{k,t} = {} & \beta_0 + \beta_1\ \text{RNs per bed} + \beta_2\ \text{Total nursing hours}_{k,t} \\ & + \beta_3\ \text{Nursing-skill mix}_{k,t} + \beta_4\ \text{Contract RN hours}_{k,t} \\ & + \beta_5\ \text{Hospital characteristics}_{k,t} \\ & + \beta_6\ \text{Patient characteristics}_{k,t} \\ & + \beta_7\ \text{Market characteristics}_{k,t} + \tau_t + \delta_k + \varepsilon_{k,t}\end{aligned}$$

As the dependent variable, we focus on the percentage of patients treated at hospital k in year t who reported high satisfaction. The HCAHPS data are not available at the individual patient level; therefore, we use the aggregate hospital data. We also include year effects, τ_t, to control for secular trends in patient satisfaction. We also include δ_k, which is a hospital-specific effect (discussed next), and $\varepsilon_{k,t}$, represents the error term.

One of the main concerns in a study such as this is that the estimates of effects of nursing characteristics are inconsistent (econometrically speaking) because of unobserved heterogeneity in hospitals that may be driving patient satisfaction. To deal with this, we include δ_k in our estimations, which is a hospital-specific effect. For each satisfaction outcome we perform two estimations: one in which δ_k is included as a hospital random effect and one in which δ_k is included as a hospital fixed effect. The difference between the two is that the random-effects estimate is more efficient statistically but produces consistent coefficient estimates only under the assumption that the unobserved hospital characteristics are uncorrelated with the observed characteristics. In contrast, the fixed-effects estimate is less efficient but makes no such assumption about the correlation between the observed and unobserved factors.

We use the Hausman test (Hausman 1978) to assess whether the hospital random-effects estimates are consistent relative to the hospital fixed-effects estimates. Even in cases in which the Hausman test indicates the random-effects estimates are inconsistent, we considered both the random- and fixed-effects estimates of the impact of the nursing characteristics. We did this for two reasons. First, this allows us to assess the degree of bias on the coefficients of interest, namely β_1 and β_2, that arises from unobserved factors. Second the Hausman test may indicate that the random-effects estimates are inconsistent, not because of the relationship between our covariates of interest and the unobserved characteristics but because the estimated coefficients on other control variables are inconsistent. As such,

the random-effects estimates of the impact of nursing may be informative because they are more efficient.

We also perform a second set of robustness checks on whether unobserved factors are biasing the estimates of the nursing effects. We predict that nursing should influence overall satisfaction and the subcomponents of satisfaction directly related to frontline-staff performance. In addition, we also have access to measures of satisfaction on dimensions that are not likely to be dependent on nursing performance. We estimate regressions of the same form in which our outcomes are the dimensions of patient satisfaction that should not be influenced by nursing or in which the influence should be much smaller. If the impact of nursing on patient satisfaction is being driven by other, unobserved hospital characteristics, then we expect that nursing will be predictive of better performance on these dimensions of satisfaction. If not, this indicates that our main estimates represent the plausibly causal impact of nursing on patient satisfaction.

The last issue in estimations of this type is a concern about the correlation of standard errors in hospitals over time that might bias our standard errors and lead to incorrect inferences. In all our estimations the standard errors are clustered at the hospital level to deal with this concern.

Results

The summary statistics for the patient-satisfaction outcomes, total supply of RNs, nursing-skill mix, and contract RNs are reported in Table 1A. The correlation matrix for the various aspects of patient satisfaction and the nurse staffing arrangements are in Table 1B. The means and standard deviations for other control variables are listed in Table 2.

The estimated effects of nurse staffing levels and nursing-skill mix on overall patient satisfaction and on nursing-communication-related satisfaction are reported in Tables 3 and 4, respectively. We find no evidence that the nurse staffing mix has an impact on amenity-related satisfaction or on communication with physicians (not shown).[6] Hypothesis 1, which predicts that higher levels of RN staffing (RNs per bed) improves patient satisfaction, is partially supported by our results, as shown in Table 3. Although all the coefficients for RNs per bed are positive, the effect is marginally significant for the overall satisfaction measures in the hospital fixed-effects models in Table 3. The coefficient estimates on RNs per bed increase when we move from random- to fixed-effects models, indicating that unobserved, time-invariant hospital factors are biasing the impact of RN staffing toward 0.

Weaker support appears for Hypotheses 2a and 2b, on the impacts of nurse staffing mix on patient satisfaction. The random-effects results in Table 4 indicate that a greater proportion of LVN productive hours may negatively affect nursing-related satisfaction. Nevertheless, these effects are

[6]These results are available from the authors upon request.

Table 1A. Summary Statistics for Patient-Satisfaction Measures and Nursing-Service Characteristics

	Mean	*SD*
A. Dependent variables for patient satisfaction		
Overall satisfaction		
% Rating hospital satisfaction as high overall	64.2	9.7
% Would definitely recommend hospital to family/friends	67.4	10.9
Satisfaction with staffing and care		
% Reporting nurses always communicated well	70.9	6.6
% Reporting staff always explained about medicines	56.8	6.5
% Reporting being given information about what to do during recovery at home	79.6	5.1
% Reporting pain was always well controlled	66.3	6.3
% Reporting doctor always communicated well	76.2	5.3
% Reporting they always received help quickly	57.7	8.7
Satisfaction with stay experience and room adequacy		
% Reporting area around room always kept quiet at night	47.7	8.8
% Reporting rooms always kept clean	68.1	7.1
B. Variables for nursing characteristics		
Mean total productive nursing hours	880,441	901,083
RNs per bed	1.24	0.73
Nurse workload share		
% Core RN hours (reference group)	68.65	
% LVN hours	7.16	7.69
% NA hours	20.01	11.07
% Contract RN hours	4.18	4.44

Notes: LVN, licensed vocational nurse; NA, nurse's assistant; RN, registered nurse; SD, standard deviation.

probably biased by unobserved hospital characteristics because the point estimates move toward 0 or become small and positive when estimated in the fixed-effects models.[7]

Hypothesis 3 predicts that the higher relative use of contract RNs will negatively affect overall patient satisfaction and nursing-communication-related satisfaction, and this hypothesis is well supported by our data. As shown in Table 3, the share of contract RN hours in a hospital is a significant predictor of low patient satisfaction. An increase of 1 percentage point in contract RN hours as a proportion of overall nursing hours reduces the patients who reported high overall satisfaction by 0.17 percentage point in the hospital random-effects model and by 0.22 percentage point in the fixed-effects model. Similarly an increase of 1 percentage point in contract RN hours as a proportion of overall nursing hours reduces the patients who reported they would definitely recommend the hospital to family and friends by 0.21 percentage point in the hospital random-effects model and

[7]We performed additional analyses to examine whether combining LVNs and NAs into a single category yielded different results. Two explanations for why this might yield different insights are that 1) it would provide more statistical power to detect effects and 2) conceptually, it could show that RNs as opposed to all other types of nurses is what matters when assessing nursing-skill mix. But these results did not yield any additional insights and are therefore not reported here.

Table 1B. Correlation Matrix

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. % Rating hospital satisfaction as high overall	1.00									
2. % Would definitely recommend hospital to family/friends	0.93	1.00								
3. % Reporting nurses always communicated well	0.84	0.79	1.00							
4. % Reporting staff always explained about medicines	0.73	0.65	0.83	1.00						
5. % Reporting being given information about what to do during recovery at home	0.65	0.65	0.69	0.72	1.00					
6. Mean total productive nursing hours	0.09	0.14	–0.01	0.00	0.05	1.00				
7. RNs per bed	0.13	0.15	0.10	0.12	0.16	0.32	1.00			
8. % LVN hours	–0.14	–0.22	–0.11	–0.07	–0.19	–0.30	–0.30	1.00		
9. % NA hours	0.00	–0.03	0.03	0.02	–0.02	–0.15	–0.18	0.56	1.00	
10. % Contract RN hours	–0.09	–0.09	–0.08	–0.07	–0.08	–0.05	–0.04	–0.02	0.02	1.00

Table 2. Summary Statistics for All Other Control Variables

Variable	*Mean*	*SD*
Market and hospital characteristics		
Hospital HHI in HRR	1302.62	1260.57
% Minority in HRR	41.84	11.79
Sole community hospital (%)	3.55	18.50
Critical-care hospital (%)	7.92	27.03
Rural referral hospital (%)	1.88	13.58
Hospital ownership (%)		
Government hospital (reference group)	21.38	
Not-for-profit, nongovernmental hospital	38.79	48.75
For-profit hospital	19.60	39.72
Catholic not-for-profit hospital	15.43	36.15
Non-Catholic but religious not-for-profit hospital	4.80	21.38
Teaching status (%)		
No teaching (reference group)	73.93	
Internship program	1.25	11.12
Medical school–affiliated hospital	19.08	39.32
Council of Teaching Hospital	5.74	23.26
Highly centralized health system (%)	4.38	20.47
Moderately centralized health system (%)	20.23	40.19
Hospital has electronic health records (%)	39.94	49.00
Hospital performance characteristics		
% In-hospital deaths	2.28	2.06
Mean LOS in hospital (days)	4.73	4.51
Mean total costs in hospital	$11,389	$4,808
Mean number of chronic conditions per patient	3.7	1.13
Mean number of procedures per patients	1.53	0.7
Mean number of diagnoses per patients	7.98	2.02
Hospital patient characteristics		
Mean patient age	49.66	10.39
% Female	58.86	6.61
Race/ethnicity		
% Black	6.84	9.97
% Hispanic	27.77	23.31
% Asian	6.52	10.25
% Other race	1.96	2.94
%White (reference group)	56.91	
Payer		
% Medicare	37.39	14.26
% Medicaid	25.55	17.74
% Private insurance (reference group)	27.80	
% Other sources	9.26	8.43
Patients with major comorbidities (%)		
Acquired immune deficiency syndrome	0.17	0.29
Alcohol abuse	4.14	2.64
Deficiency anemias	15.82	6.29
Rheumatoid arthritis/collagen vascular diseases	1.89	0.97
Chronic blood loss anemia	2.11	1.37
Congestive heart failure	7.00	3.69
Chronic pulmonary disease	14.39	5.59
Coagulopathy	3.41	1.74

(continued)

Table 2. Continued

Variable	*Mean*	*SD*
AHRQ comorbidity measure: Depression	6.95	3.76
Diabetes	14.11	5.10
Diabetes with chronic complications	4.48	3.39
Drug abuse	3.69	3.57
Hypertension (combine uncomplicated and complicated)	37.71	10.72
Hypothyroidism	8.65	3.39
Liver disease	2.97	1.62
Lymphoma	0.52	0.32
Fluid and electrolyte disorders	17.88	7.85
Metastatic cancer	1.52	0.88
Other neurological disorders	6.22	2.91
Obesity	8.71	4.31
Paralysis	2.40	1.31
Peripheral vascular disorders	4.11	2.80
Psychoses	4.15	3.19
Pulmonary circulation disorders	1.28	0.83
Renal failure	9.19	4.64
Solid tumor without metastasis	1.53	0.78
Peptic ulcer disease excluding bleeding	0.04	0.07
Valvular disease	2.55	1.65
Weight loss	4.24	4.51

Notes: AHRQ, Agency for Healthcare Research and Quality; HHI, Herfindahl-Hirschman index; HRR, hospital's referral region; LOS, length of stay; SD, standard deviation.

by 0.28 percentage point in the hospital fixed-effects model. A higher proportion of LVN hours also reduces the percentage of patients who said they would definitely recommend the hospital in the hospital random-effects model, but this estimate is substantially smaller and insignificant in the hospital fixed-effects model.

The results in Table 4 show that an increase of 1 percentage point in contract RN hours as a proportion of overall nursing hours reduces the patients who reported that nurses always communicated well by 0.11 percentage point in the random-effects model and by 0.16 percentage point in the fixed-effects model. Similarly an increase of 1 percentage point in contract RN hours as a proportion of overall nursing hours reduces the patients who reported that staff always explained about medicines by 0.09 percentage point in the hospital random-effects model and by 0.10 percentage point in the fixed-effects model. The fixed-effects estimates are not statistically precise, but as discussed earlier, the random-effects estimates are more statistically efficient, and in cases in which the estimates of the two effects are similar for the covariates of interest, we can reasonably consider the random-effects estimates.

Interestingly, little evidence is present of an effect of nursing-skill mix or of the proportion of contract RNs productive hours on patients who reported being given information about what to do during recovery at home. We speculative that this is attributable to discharge planning's having

Table 3. Impact of Nurse Staffing Strategies on Overall Patient Satisfaction

	Rating hospital satisfaction as high overall (%)		*Would definitely recommend hospital to family and friends (%)*	
	(1)	*(2)*	*(3)*	*(4)*
Mean total productive nursing hours	0.00	–0.00	0.00	–0.00
	(0.00)	(0.00)	(0.00)	(0.00)
RNs per bed	0.66	1.27^{+}	0.54	1.33^{+}
	(0.52)	(0.74)	(0.56)	(0.77)
% LVN hours[a]	–0.06	0.06	–0.13*	0.06
	(0.06)	(0.22)	(0.05)	(0.24)
% NA hours[a]	0.02	0.00	0.02	0.01
	(0.02)	(0.03)	(0.02)	(0.03)
% Contract RN hours[a]	–0.17*	–0.22^{+}	–0.21**	–0.28*
	(0.07)	(0.12)	(0.08)	(0.13)
Hospital random effects	Yes	No	Yes	No
Hospital fixed effects	No	Yes	No	Yes
Number of observations	847	847	847	847
R^2		0.241		0.237

Notes: All models include the control variables listed in Table 2, the hospital-size quartile as measured by number of beds, and the year fixed effects. Standard errors clustered at the hospital level are in parentheses.

[a]Proportion of hours is calculated by taking the total number of productive hours of the given type of nurse and dividing by the overall total nursing productive hours.

$^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$.

become an area of focus for quality improvement across health care in the United States in recent years and its having been largely standardized as a result.

Our control variables have effects that are in the direction that we expected from the previous literature. For example, not-for-profit hospitals have positive and sometimes large impacts on patient satisfaction, whereas sole community providers have lower levels of patient satisfaction.[8]

Discussion

In this article, we examine the effects of hospital nurse staffing strategies on patient satisfaction. The nursing-skill mix and staffing levels of nursing are widely considered to be critical elements in a high-performing hospital, and we test several hypotheses about the relationship between nursing-service characteristics and patient satisfaction. Our findings indicate that the front-line staffing level and the proportion of core RNs to contract RNs are important factors driving patient satisfaction.

These findings on core and contract nursing arrangements in California hospitals and their impact on patient satisfaction extends the literature on

[8]Full results are available from the authors upon request.

Table 4. Impact of Nurse Staffing Strategies on Nursing-Communication-Centric Patient Satisfaction

	% Reporting nurses always communicated well		*% Reporting staff always explained about medicines*		*% Reporting being given information about what to do during recovery at home*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Mean total productive nursing hours	0.00	–0.00	0.00	0.00	0.00	–0.00^{+}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
RNs per bed	0.14	0.54	0.19	0.84	0.11	0.40
	(0.34)	(0.54)	(0.35)	(0.61)	(0.23)	(0.36)
% LVN hours[a]	–0.05	–0.10	–0.02	–0.21	–0.01	0.05
	(0.03)	(0.15)	(0.04)	(0.16)	(0.03)	(0.11)
% NA hours[a]	0.02	–0.01	0.01	–0.02	0.02^{+}	–0.00
	(0.01)	(0.02)	(0.02)	(0.03)	(0.01)	(0.01)
% Contract RN hours[a]	–0.11*	–0.16*	–0.09*	–0.10	–0.05^{+}	–0.01
	(0.05)	(0.08)	(0.05)	(0.08)	(0.03)	(0.05)
Hospital random effects	Yes	No	Yes	No	Yes	No
Hospital fixed effects	No	Yes	No	Yes	No	Yes
Number of observations	847	847	847	847	847	847
R^2		0.259		0.208		0.259

Notes: All models include the control variables listed in Table 2, the hospital-size quartile as measured by number of beds, and the year fixed effects. Standard errors clustered at the hospital level are in parentheses.

[a]Proportion of hours is calculated by taking the total number of productive hours of the given type of nurse and dividing by the overall total nursing productive hours.

$^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$.

organizational demography in several important ways. Previous research indicated that higher levels of hospital nurse staffing are associated with higher hospital performance in terms of patient outcomes (Aiken, Clarke, and Sloane 2002; Aiken et al. 2008; Stanton and Rutherford 2004). Our results suggest that increasing the RNs per bed increases overall patient satisfaction, although this finding is only marginally statistically significant. The level of significance may be because of the context of our study. California has a mandated nurse-staffing minimum, which probably reduces variation, at least in the left tail of the distribution.

We also find no evidence that the nursing-skill mix has a discernible impact on patient satisfaction. The California policy affects LVNs as well as RNs, but even if these findings were statistically significant, they are still relatively small in magnitude. One explanation for this is that the quality, rather than the skill mix, of the nursing staff has more influence on patient satisfaction. This would imply that the ability to attract more competent, high quality nurses at all levels of nursing explains some of the differences in patient satisfaction between hospitals. Unfortunately, we do not have measures of individual nurse competence available in this study.

What we do find is that the increased use of contract RNs in hospitals has a negative effect on patient satisfaction. These effects are large and statistically

significant. For context, consider an illustration. The mean proportion of nursing hours worked by contract RNs is 4.17% of the total productive nursing hours. Our results imply that, if a hospital employing the mean proportion of contract RNs reduced its use of contract RNs to 0 (i.e., replacing their hours with core RN hours), the proportion of patients reporting they were highly satisfied would increase by 0.92 percentage point and the proportion of patients reporting they would definitely recommend the hospital would increase by 1.17 percentage points. To compare, if we take the marginally significant estimates of the impact of RNs per bed on patient satisfaction as given, this suggests that the average hospital would have to increase its RNs per bed by 58% to increase overall satisfaction by the same amount (0.92 percentage point) as replacing the contract RN hours. Similarly, the hospital would have to increase its RNs per bed by 71% to increase the proportion of patients who would definitely recommend the hospital to family and friends by the same amount (1.17 percentage points) as simply replacing the contract RN hours with core RN hours.

We did hypothesize that contract RNs would have a negative impact on patient satisfaction (Hypothesis 3), but these effects are quite large. Prior to these findings, we could have reasonably assumed that the similarities in training, backgrounds, and work tasks between core and contingent RNs would facilitate better and more positive nonwork social relations and exchanges linked to non-task-related interactions. And we could have hypothesized that this similarity in professional preparation and work would reduce tensions between the two groups and result in a better hospital experience for patients. This does not appear to be the case. Unfortunately, our data do not allow us to probe which of the possible underlying reasons noted in the previous literature on contingent workers and poorer firm performance in other work settings are at play among RNs.

Given the importance of the RN in patient outcomes and satisfaction, this is an important area for future research. Much of this effect appears to come through the impact of contract RNs on patients' satisfaction with nursing communication. Therefore, examining differences in nursing communication between core RNs and contract RNs is a logical starting point for future investigations. More broadly, higher-level nursing credentials allow a nurse to perform more clinical tasks, but they do not necessarily relate directly to customer service. As previously mentioned, it is possible that some hospitals are able to systematically attract more competent nurses.

Of course, hospitals that have more RNs per bed and higher proportions of core RNs may have other human resource practices that are also related to overall organizational performance. Nevertheless, our results of the estimated impacts of RNs per bed and proportion of contract RNs comparing models with hospital random effects and fixed effects indicate that this is unlikely to be the factor completely driving our findings. Although the results for the two models are similar, the fixed-effects estimates are in fact larger in magnitude than the random-effects estimates, suggesting that any failure to properly account for unobserved hospital factors that are related

to differences in RN staffing potentially understate the importance of nursing in patient satisfaction.

Conclusion

Using three years of data from California hospitals to analyze the relational aspects of the impacts of nurse staffing level, nursing-skill mix, and proportions of contingent and core RNs, we find that hospital use of contract RNs reduces patient satisfaction.

Our findings have immediate and direct implications for hospitals. As hospitals move away from employing staffs composed of core RNs and toward employing higher shares of contract RNs, they have fewer patients who are highly satisfied. Specifically, higher proportions of contract RNs have significantly negative impacts on overall patient satisfaction and on patient satisfaction with nurses' communication. Although not always statistically significant, the impact of a higher proportion of contract RNs is almost always negative on satisfaction measures in other domains of service, facility amenities, and non-nursing-related aspects of patient care. Further research is needed to explore whether the relatively high use of contract RNs in hospitals affects other aspects of patient outcomes negatively and whether organizational mechanisms exist that may mitigate these negative impacts.

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