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Abstract

Aims: To identify and describe profiles of nursing resources and compare nurse and patient outcomes among the identified nursing resource profiles.

Background: Research linking nurse education, staffing, and the work environment treats these nursing resources as separate variables. Individual hospitals exhibit distinct profiles of these resources.

Methods: This cross-sectional secondary analysis used 2006 data from 692 hospitals in four states. Latent class mixture modeling was used to identify resource profiles. Regression models estimated the associations among the profiles and outcomes.

Results: Three profiles were identified (better, mixed, and poor) according to their nursing resource levels. Hospitals with poor profiles were disproportionately mid-sized, not-for-profit, non-teaching, urban, and had lower technology capability. Nurse job outcomes, patient mortality and care experiences were significantly improved in hospitals with better resource profiles.

Conclusions: Hospitals exhibit distinct profiles of nursing resources that reflect investments into nursing. Nurse and patient outcomes and patients' experiences are improved in hospitals with better nursing resource profiles. This finding is consistent with the literature that has examined these resources independently.

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Implications for Nursing Management: Nurse managers can identify their nursing resource profile and the associated outcomes. Our results show the advantages of improving one's hospital nursing resource profile, motivating managers to make an informed decision regarding investments in nursing resources.

Keywords

Hospitals; Workforce; Patient Care; Nurse Administrators; Nursing Staff; Hospital

INTRODUCTION

Hospital nursing services are a major component of United States' healthcare delivery system. Nurses provide around-the-clock care, including surveillance of and response to patient's health status, supervision of other nursing personnel, and coordination of the health care team's efforts. Hospital managers seek evidence to guide hospital nursing resource decisions, including those surrounding nurse educational preparation and nurse staffing levels. Also, within the manager's purview is the nurse work environment, which supports or limits each registered nurse's ability to practice to the scope of their knowledge and skill (Lake, 2002).

Evidence suggests that hospital quality of care and patient safety are related to nursing resources, yet evidence has not been presented in the most meaningful way for managers and executives to understand the effectiveness of their resources relative to common alternatives. Previously, nursing resources have been treated as separate independent variables in outcomes research (Sloane, Smith, McHugh, & Aiken, 2018). Patterns of these resources, however, are exhibited by individual hospitals. This research advances the literature beyond the traditional analytic approach that treats these resources as independent by empirically identifying common profiles of nursing resources in a representative sample of hospitals from four large states and the outcomes associated with the resultant profiles.

BACKGROUND

For over two decades, researchers have theorized a conceptual framework where nursing resources are linked to hospital quality, safety, and outcomes (Aiken, Sochalski, & Lake, 1997). Plentiful empirical evidence has emerged demonstrating a "more is better" relationship: a greater proportion of nurses educated at the baccalaureate level, more nurses-per-patient, and a more supportive work environment are associated with favorable patient and nurse outcomes, such as lower patient fall rates, mortality, and higher satisfaction (L. H. Aiken et al., 2011; Jarrar et al., 2021; Kutney-Lee et al., 2009; Lake, Shang, Klaus, & Dunton, 2010; Rahman & Mu'taman Jarrar, 2015). The "more-is-better" view, however, comes with practical and financial limitations.

Missing from science is evidence of actual nursing resource profiles that emerge naturally and their implications for patient and nurse outcomes. One study demonstrated that high nurse-to-patient ratios and highly professional work environments occurred together (Lake & Friese, 2006). In a sample of 156 hospitals from Pennsylvania using nurse survey and administrative data from 1999, hospitals with highly professional work environments also

had nurse-to-patient ratios one standard deviation higher than hospitals with mixed and poor work environments. Similarly, Magnet hospitals have served as an exemplar of an enhanced nursing resource profile with more supportive work environments and higher proportions of nurses with bachelor's degrees than non-Magnet hospitals (McHugh et al., 2013). This gap in the evidence prompted us to take a holistic approach to studying nursing resources and their associations with outcomes.

We hypothesized that there would be two theoretical extremes (all resources are "high," all resources are "low") and a center hospital profile, in which resource allocation and practice environments are merely average. Furthermore, we expected these different profiles to yield different patient outcomes. As our approach was the first to explore distinct hospital resource profiles, we also were open to identifying additional non-gradient profiles comprised of higher levels of certain resources and lower levels of others (e.g., higher levels of staffing with less educated nurses).

The goal of this study was to provide more useful evidence than earlier studies for hospital executives to guide decision making and resource allocation. Our aims were to identify the most common profiles of three nursing resources (education, staffing, and the work environment) that historically have been either the sole resource studied (Kutney-Lee, Sloane, & Aiken, 2013; Lake et al., 2019; Shekelle, 2013) or modelled together as separate independent variables in analyses (Aiken et al., 2014; Sloane et al., 2018). Our second aim was to examine associations between these hospital nurse resource profiles and nurse job outcomes, patient outcomes, and patient care experiences. The unique contribution of the paper is the consideration of the nursing resources together rather than independently, because each nursing resource does not exist in isolation. Each hospital's nursing resource profile is unique and may be attributed to various market factors and management decisions. This paper contributes to the literature by considering the implications of these profiles for patient and nurse outcomes.

METHODS

Study Design

This cross-sectional study used four secondary data sources: 1) patient discharge data, 2) the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey data, 3) a four-state nurse survey, and 4) the American Hospital Association (AHA) Annual Survey. We utilized data from 2006 to 2008, described below, to permit comparisons to results of studies published from these data. The nurse survey data were obtained through R01NR014855 (Aiken, PI), who granted access for this study. We identified the nurse resource profiles using latent class mixture modeling (LCMM) and estimated their relationship to nurse job outcomes, patient outcomes, and patient care experiences across adult acute care hospitals in four states (California, Pennsylvania, Florida, and New Jersey). These four states are the nation's largest states and account for more than 20% of annual hospitalizations. We replicated three earlier studies to compare results (L. H. Aiken et al., 2011; Linda H. Aiken et al., 2011; Kutney-Lee et al., 2009). All data sources were linked using a common hospital identifier.

Data Sources and Samples

Patients——Patient discharge data were obtained from the respective state agencies between 2006 and 2007 (L. H. Aiken et al., 2011). The patient sample were ages 19 to 89 with a diagnosis-related group classification of general, orthopedic, or vascular surgery. We selected these patients to replicate the inclusion criteria of the original study (L. H. Aiken et al., 2011).

Hospitals——Hospital data in this study included HCAHPS data and AHA Annual Survey of Hospitals. AHA Annual Survey of Hospitals was obtained from AHA during 2005. HCAHPS data were obtained from the Centers for Medicare & Medicaid during the first public release period (October 2006-June 2007). The inclusion criteria for the hospital sample included all non-federal, acute care, general hospitals in the four states that responded to AHA Annual Survey of Hospitals. Hospitals were not sampled directly. Hospitals were identified from lists included in the nurse survey.

Nurses——The nurse survey data were collected in California, Pennsylvania, and New Jersey between September 2005 and August 2006 and in Florida between November 2007 and April 2008. More information about the nurse survey methodology is available elsewhere (L. H. Aiken et al., 2011). The survey included items that assessed nurse education, workloads, the work environment, demographics, burnout, and job dissatisfaction. The inclusion criterion for the sample included being an inpatient staff nurse.

Measures

Nursing Resources——Nurses' educational composition was the percentage of staff nurses in each hospital holding baccalaureate degrees in nursing or higher. Hospital nurse staffing was calculated from nurse survey data by dividing the average number of patients reported by nurses on their units on their last shift by the average number of nurses on the unit. The nurse work environment was measured using the Practice Environment Scale-Nurse Work Index (PES-NWI), a validated tool recommended by the National Quality Forum to measure the nurse work environment (Lake, 2002). The 31-item Likert-type scale indicates the degree (1 = strongly disagree to 4 = strongly agree) to which various organizational features are present in the practice setting. The five subscales are nurse participation in hospital affairs; nursing foundations for quality care; nurse manager ability, leadership, and support of nurses; staffing/resource adequacy; and nurse-physician collegial relationship. Subscale and overall composite values were calculated for each hospital by averaging nurse-level subscale values.

Nurse Job Outcomes——Nurse job outcomes included burnout and job dissatisfaction. To measure burnout, we used the emotional exhaustion subscale of the Maslach Burnout Inventory Human Services Survey (MBI-HSS) (Maslach, 1986). Respondents scoring greater than 27 on were classified as having "high" burnout. To measure job satisfaction, we used a single item with four categories to classify nurses as satisfied (moderately or very) or dissatisfied (a little or very).

Patient Outcomes——The two patient outcomes of interest were 30-day surgical mortality and failure-to-rescue (FTR), i.e., deaths involving patients who had developed at least 1 of a set of 39 potentially preventable complications (Silber et al., 2007). Demographic, diagnostic, and clinical data were used to control for risk and type of surgery consistent with earlier work (L. H. Aiken et al., 2011).

Patient Care Experience——HCAHPS survey provided publicly available national, standardized reports of patients' hospital experiences (Centers for Medicare & Medicaid Services (CMS), 2021). HCAHPS is reported as a set of ten measures related to communication with nurses and doctors, responsiveness of hospital staff, pain management, communication about medicines, discharge information, cleanliness, quietness of the hospital, overall rating of the hospital, and willingness to recommend the hospital to friends and family. Per CMS (2021), data are aggregated following risk adjustment for patient mix and mode of administration.

Hospital Variables——Hospital structural characteristics were derived from 2005 and 2007 AHA Annual Survey of Hospitals. Teaching status distinguished major teaching hospitals (≥ 5 medical trainees per bed) from minor teaching hospitals (0–4 medical trainees per bed) and nonteaching hospitals (no medical trainees). Bed size classified hospitals into three categories (≤100 beds, 101–250 beds, and ≥250 beds). High-technology hospitals designated facilities that provided services for open-heart surgery, organ transplantation, or both. For-profit hospitals were distinguished from non-profit hospitals. Urban and rural status was defined by core based statistical area definitions. Metropolitan areas had over 50,000 inhabitants. Micropolitan areas had 10,000 to 50,000 inhabitants. Areas with fewer than 10,000 inhabitants were considered rural.

Analysis

To identify hospital nursing resource profiles, individual nurse survey data were aggregated to the hospital level. Latent class mixture modeling (LCMM) was used to identify common profiles of hospital nursing resources. Patient-to-nurse ratio was modeled as quintiles because of significant positive skewing; all other resource metrics were normally distributed at the hospital-level and kept as continuous variables. Our approach to LCMM model specification was based on procedures detailed elsewhere (Lee, Faulkner, & Thompson, 2020; Ram & Grimm, 2009). Several metrics were used to support the number of profiles; 2–10 configurations were tested. The Lo-Mendell-Rubin adjusted likelihood ratio test (LMRT), Bayesian Information Criterion (BIC), convergence (i.e. entropy near 1.0), the proportion of sample in each configuration (not less than 5%), and classification probabilities (average probability of belonging in "most likely" configuration near 1.0) were used to compare alternative models (e.g. *k* vs. *k*-1 configurations) (Lee et al., 2020; Ram & Grimm, 2009). Differences among identified configurations were quantified using ANOVA, with Bonferroni corrections for multiple measures, or χ^2 analysis where appropriate.

Although there are approaches in LCMM to address missing data, such approaches were unnecessary as hospital-level estimates were based on non-missing values. To balance data loss with sample adequacy, hospitals with greater five or more non-missing and evaluable

respondents were included to calculate hospital-level means. LCMM was performed using Mplus Version 6.12 (Los Angeles, CA); remaining analyses were performed using Stata/MP Version 17 (College Station, TX).

The hospital nursing resource profiles were used as independent categorical variables in clustered regression models to predict the three sets of outcomes. Logistic regression models of nurse job outcomes were estimated at the nurse level. These models controlled for nurse characteristics including age, sex, full-time status, and unit type consistent with prior work (Linda H. Aiken et al., 2011). Logistic regression models of 30-day mortality and failure-to-rescue were estimated at the patient-level. These models controlled for demographic and clinical characteristics, as well as hospital bed size, teaching status, technology status, and state (L. H. Aiken et al., 2011). Linear regression models of patient care experience variables were estimated at the hospital-level. These models controlled for hospital structural characteristics, HCAHPS response rate, and state (Kutney-Lee et al., 2009).

RESULTS

The hospital sample comprised 692 hospitals (Table 1). Most institutions in the sample were mid-sized, not-for-profit, non-teaching medical centers in metro areas. The nurse sample comprised 27,499 staff nurses. Most nurse respondents were female (93%), non-bachelor-educated (59%) with 16.8 years of experience. The patient sample was 1,286,049 patients. The average patient was 61 years of age and female (57%).

Observed Hospital Nursing Resource Profiles

Model fit for three profiles dominated over alternative models of more or fewer, with adjusted BIC of 397.69, entropy of 0.86, average classification probabilities of 93.4%, 93.8%, and 94.7%, and LMRT of 656.96 (p=0.001). Based on observed characteristics, the three profiles of hospital nursing resources were labeled as the “worst” (27.46% of hospitals), the “middle” (51.59% of hospitals) and the “best” (20.95% of hospitals) profile (Supplemental Figure 1).

The profiles of hospital nursing resources differed by all hospital characteristics, except core based statistical area and teaching status (Table 1). Hospitals classified as better were larger, not for profit, with disproportionately higher technology capabilities. Hospitals classified as worst were disproportionately for-profit, classified as mid-size, and low technology.

Differences in Hospital Nursing Resources by Profile

Table 2 displays the hospital nursing resource descriptive statistics by hospital profile. Whereas overall there were 4.74 patients per nurse, this differed across profiles from 5.34 in the worst profile to 4.05 in the best profile, equivalent to one standard deviation (SD). The fraction of BSN-educated nurses was 37.16 percent overall; this differed across profiles from 32.47% in the worst profile to 41.93% in the best profile, equivalent to 0.65 SD. The overall PES-NWI composite value was 2.69; this differed across profiles from 2.41 in the worst profile to 3.01 in the best profile, equivalent to 2.6 SDs. This pattern of scores was replicated across the subscales.

Table 3 displays coefficients from logistic regression models of burnout and job dissatisfaction. Nurses working in the best hospital profile were 67.8% less likely to express job dissatisfaction versus those nurses working in the worst hospital profile. Additionally, nurses working in best profile hospitals were 53.4% less likely to be classified as high burnout relative to the worst nursing resource profile. In sum, nurse job outcomes were significantly improved in hospitals with the best and middle nursing resource profiles.

Table 4 displays coefficients from logistic regression models of 30-day mortality and failure to rescue. Patients in the best hospital profile were 17.7% less likely to die within 30 days of discharge and those in the middle hospital profile were 7.2% less likely to die within 30 days versus those patients hospitalized in the worst hospital profile. Additionally, patients cared for in the best hospital profile were 19.7% less likely to die following a complication, and those in the middle hospital profile were 9.5% less likely to die following a complication versus those patients hospitalized in the worst hospital profile.

Table 5 displays coefficients from linear regression models of the patient care experience variables. For the two HCAPHS global measures, 9.1% more patients gave a rating of 9 or 10 and 9.8% more patients would definitely recommend the hospital in hospitals with best profile as compared to worst profile. In mixed profile hospitals as compared to worst profile hospitals, 3.4% more patients gave a rating of 9 or 10 and 3.5% more patients would definitely recommend the hospital. Among the eight remaining HCAPHS composite measures, the percent of patients who agreed with the item was on average 3.3% more patients (range: 1.5–4.5) in the best profile versus worst profile hospitals, and 1.1% (range: 0.3 to 1.9) in the mixed profile versus the worst profile hospitals. Only four of the eight comparisons between the mixed hospital profile and the worst hospital resource profile, however, were statistically significant.

DISCUSSION

Our objective was to identify and analyze the associations of hospital nursing resource profiles to health, satisfaction, and job outcomes in a large, representative U.S. hospital sample. Although we focus on a U.S. sample, nurse-to-patient ratios and work environments are relevant internationally, with documented associations to improved outcomes in many countries, increasing the utility of the current work. We theorized that specific “naturally occurring” combinations, or profiles, of hospital nursing resources exist that may be effective in achieving improved patient outcomes and nurse job outcomes. Modifiable resources that are the target of hospital management include the educational preparation of the registered nurse staff, nurse staffing, and the nurse work environment. We aimed to take a more comprehensive approach than the traditional approach, which considers the effects of nursing resources independently. By providing actual commonly occurring profiles, this approach generates more practical evidence for hospital executive decision-making and resource allocation.

Three profiles emerged among 692 U.S. hospitals, consistent with higher, middle, and lower proportions of registered nurses with bachelor’s degrees, ratios of nurses-to-patients, and ratings of the professional nursing environment. Half of the sample hospitals (52%) were

classified as having the mixed profile. The fewest hospitals (21%) had best profile; the remaining 27% had the worst profile. The best resource profile was found disproportionately in large, not-for-profit, high technology hospitals. The worst resource profile occurred disproportionately in mid-sized, for-profit, low technology hospitals. Similar evidence has been reported about hospitals with Magnet designation, i.e., they are disproportionately high technology, larger in size, major teaching hospitals with nonprofit status (McHugh et al., 2013). Nursing resources exhibited consistent patterns across the three hospital profiles. Based on the size of differences observed, the profiles from worst to best are most differentiated by their work environments (SD: 2.6), then by staffing (SD: 1.0), and least by nurses' education (SD: 0.65).

Nurse job outcomes and quality ratings, surgical patient mortality and patients' assessments of care experiences were considerably and statistically significantly improved in hospitals with the best nursing resource profile. That is, considering the resources separately informs managers about the potential changes they may achieve when changing one nursing resource, such as the educational preparation of their workforce. Considering them as a profile of all three resources permits managers to identify their profile and anticipate the related outcomes across nurse job, patient health, and satisfaction areas.

We compared our results to prior, seminal publications on these same outcomes, which were replicated here. Aiken, Sloane, et al. (2011) presented nurse job outcomes in relation to work environments in nine countries including the U.S. data utilized here; they excluded staffing and nurse educational preparation, making this comparison not equivalent. They found reduced odds of high burnout in the hospitals classified as having mixed versus poor work environments (OR = 0.75) and for better versus poor (OR=0.56) (Linda H. Aiken et al., 2011). The current study had similar but slightly larger effect sizes (OR = 0.73) for the mixed profile versus the worst profile and best profile versus worst profile (OR = 0.47). Similar comparative results were found for job dissatisfaction.

The L. H. Aiken et al. (2011) paper examined the association between hospital nursing resources (i.e., nurse education, nurse staffing, and the nurse work environment) and patient outcomes (i.e., 30-day inpatient mortality and failure-to-rescue) in 665 study hospitals in the four states. Higher patient-to-nurse ratios increased the odds of patient deaths (OR=1.039), while more supportive work environments (OR=0.926) and higher percentages of nurses educated at the baccalaureate level (OR=0.958) decreased the odds. Similar results were observed for failure-to-rescue. In our paper, these relationships were far more pronounced where best profile versus worst profile was associated with lower odds of 30-day mortality (OR=0.82) and failure to rescue (OR=0.80). These reductions in odds offered by the profiles almost doubles that of the nursing resources modeled separately.

The Kutney-Lee et al. (2009) paper studied the relationship between nurse staffing, the nurse work environment, and patient satisfaction; nurse education was not examined. The nurse work environment was significantly related to all the HCAHPS measures with an average effect size of 3.8 for the global measures and 1.5 for the composite measures, representing the change in estimate for the effect of better versus mixed work environments as well as mixed versus poor (total: 7.6). Nurse staffing was significantly associated with

patients' ratings and recommendation of the hospital to others with an average effect of 1.2% fewer patients giving high ratings or definitely recommending for each additional patient-per-nurse. Additionally, one of the composite measures (satisfaction with receipt of discharge information) was significantly associated with nurse staffing with about one less patient being satisfied with the receipt of discharge information for each additional, patient-per-nurse. The summed effects for work environment and staffing were 8.82 percent of patients. In the current study, the effect sizes were larger for all ten HCAHPS measures. The average effect size for the global measures was 9.45% more patients giving high ratings or definitely recommending the hospital to others (worst profile versus best profile), equivalent to a 1.85% larger effect than when the nursing resources were modelled separately, although the comparison paper excluded nurse's educational preparation.

In addition to several decades of cross-sectional studies documenting significant associations between nursing resources and multiple job and health outcomes and care processes, recent longitudinal studies have augmented this literature by demonstrating that when nursing resources improved over a decade, care processes, patient safety, and quality also improved (Lake, Riman, & Sloane, 2020; Sloane et al., 2018). Sloane et al. (2018) analyzed nursing resources separately, in contrast to our approach of using existing profiles. A key finding of Sloane et al. (2018) was that longitudinal results mimicked the results obtained in earlier cross-sectional designs, suggesting that cross-sectional results are reasonable approximations for effects obtained when resources are changed. Therefore, it is likely that when hospitals shift from a less to more resourced profile, the changes we have identified are reasonable for managers to anticipate in these outcomes of interest. The longitudinal evidence from Sloane et al. (2018) and Lake et al. (2020), which supports causal inference regarding the effects of nursing resources on these important outcomes, gives managers a stronger basis to argue for improved nursing resources in their institutions. It is likely that when hospitals shift towards improved environments, staffing, and workforce educational preparation, that they shift from one profile to another as we have identified. Future research could link hospitals' former and latter profiles in a panel design to document similar causal links over a five- or ten-year period.

Regarding more contemporary evidence about hospital resource profiles, Lasater et al. (2021) evaluated hospital nursing resources in a cohort from 2013 to 2015, which illustrates how hospitals have improved their nursing resources in the decade since our data were generated. Lasater and colleagues (2021) classified 512 hospitals using coherence ranking into better or worse nursing resources based on four dimensions (i.e., staffing, skill mix, education, and work environment). This procedure compares each hospital to all others and scores it better or worse based on these four dimensions. The top ranked 15% and bottom ranked 45% were compared. In the top resourced hospitals, there were 4.30 patients per nurse, 68% nurses educated at the baccalaureate level or higher, and a work environment rated at 3.01. In poorly resourced hospitals, there were 5.79 patients per nurse, 43% nurses with a baccalaureate degree or higher, and a work environment rated at 2.68. For comparison, our best and worst profiles had similar staffing levels to Lasater and colleagues (2021) with our best profile having 4.6 patients-per-nurse, 42% baccalaureate educated nurses, and a work environment rated at 3.01. The worst profile had 6.1 patients-per-nurse with 33% baccalaureate educated nurses, and a work environment rated at 2.41. These

comparisons reveal that staffing and the work environment have remained at consistent levels over this decade in the top resourced hospitals, and the fraction of baccalaureate educated nurses has risen dramatically, as noted elsewhere (Lasater, Sloane, McHugh, Porat-Dahlerbruch, & L.H., 2021). In contrast, nurse staffing was stagnant in the poorly resourced hospitals while improvements in the work environment were equivalent to a more than one SD improvement. In addition to improved outcomes, care in hospitals with better resource profiles also has equivalent or less costs (Lasater, Sloane, McHugh, Porat-Dahlerbruch, & Aiken, 2021).

Limitations

The use of cross-sectional data prevents causal inference. However, the nurse survey provided three major real-world resource factors that managers wrestle with. Moreover, there is utility in considering multiple nursing resources, not just overall staffing, to improve both nurse and patient outcome. The hospitals were from only four states. However, these states reflect geographic diversity, provide a large fraction of hospitalizations nationally, and the sample approximates a census of hospitals in these states. We did not account for hospital financial resources or physician characteristics, which may explain why hospitals with stronger nursing resources achieve improved patient outcomes and warrant investigation in future studies. The age of the data is a limitation. Although the data stem from 2006 to 2008 and have been utilized in prior studies, the new contribution from these data is profiles that have not been presented before and the novelty for managers of accessing existing profiles that are directly relevant to their institutions. In addition, the relationships among the study variables are unlikely to be affected by time (Jarrar et al., 2021). It is important managers to learn from the historical relationships between these nursing resource profiles and nurse and patient outcomes, and that this information should inform their current decisions. If managers compiled current data about their resource profile, the historical evidence we present would be useful for them to estimate various nurse and patient outcomes of interest.

CONCLUSIONS

A taxonomy of “real world” nursing resource profiles from a census of general hospitals in four states in 2006 has been developed to address limitations in the literature. Existing studies either consider one resource only or all resources independently, when neither is the real-world scenario that managers face. This taxonomy details the composition of baccalaureate educated nurses, dominant staffing level, and the rating of the work environment. The results indicate that hospitals provide nursing resources in consistent patterns, which are associated with outcomes and quality. These three patterns (better, mixed, and poor) reflect greater or lesser investments in the nursing workforce. That is, the more professional work environments, lower patient-to-nurse ratios, and higher proportions of nurses educated at the BSN level or higher reflect greater investments in nursing by hospitals classified as having a better resource profile. Conversely, less professional work environments, higher patient-to-nurse ratios, and less educated nurses reflect lower investments in nursing by hospitals classified as having a poor resource profile. This study identified the three most common profiles and how shifting from one profile to another

has implications for outcomes and quality. This evidence could assist the manager with a mixed or poor resource profile to argue for investments in nursing resources by hospital administrators. Further, improving nursing resources in smaller and for-profit hospitals that predominately present with poorer nursing resource profiles, may enhance their outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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IMPLICATIONS FOR NURSE MANAGEMENT

Nurse managers are in an ideal position to identify their respective hospital resource profile and to examine how investments into these nursing resources may translate into improved nurse job outcomes, patient outcomes, and the patient experience. This study provides information for the nurse manager to make an evidence-based decision to improve one's nursing resource profile. Improved nurse job outcomes will not only allow nurse managers to recruit and retain nurses, but it will also result in a happier and healthier nurse workforce. Improved patient outcomes and experiences translate into higher hospital ratings and cost-saving through various P4P metrics. Although the cost of improving one's nursing resource profile may deter nurse managers from taking action, research finds that care in hospitals with better resource profiles has equivalent or less costs (Karen B Lasater, Douglas M Sloane, et al., 2021).

Table 1.

Percent Distribution of Hospital Characteristics by Hospital Nursing Resource Profile

Characteristics	All (n=692)	Worst (n=190)	Middle (n=357)	Best (n=145)	P-value
	N (%)				
State					<0.001
California	284 (41.04)	42 (22.11)	144 (40.34)	98 (67.59)	
New Jersey	75 (10.84)	19 (10.00)	48 (13.45)	8 (5.52)	
Pennsylvania	160 (23.12)	68 (35.79)	75 (21.01)	17 (11.72)	
Florida	173 (25.00)	61 (32.11)	90 (25.21)	22 (15.17)	
CBSA					0.128
Metro	593 (88.91)	155 (84.70)	311 (90.94)	127 (89.44)	
Micro	58 (8.70)	24 (13.11)	24 (7.02)	10 (7.04)	
Rural	16 (2.40)	4 (2.19)	7 (2.05)	5 (3.52)	
Beds					<0.001
<100 Beds	111 (16.09)	34 (17.89)	45 (12.68)	32 (22.07)	
101–250	311 (45.07)	107 (56.32)	152 (42.82)	52 (35.86)	
251–1500	268 (38.84)	49 (25.79)	158 (44.51)	61 (42.07)	
Ownership					<0.001
Govt/Non-federal	66 (9.78)	11 (5.95)	39 (11.21)	16 (11.27)	
Not-for-profit	474 (70.22)	110 (59.46)	251 (72.13)	113 (79.58)	
For-profit	135 (20.00)	64 (34.59)	58 (16.67)	13 (9.15)	
Teaching Status					0.067
None	368 (53.18)	100 (52.63)	181 (50.70)	87 (60.00)	
Minor	277 (40.03)	83 (43.68)	148 (41.46)	46 (31.72)	
Major	47 (6.79)	7 (3.68)	28 (7.84)	12 (8.28)	
High Technology Status					0.001
No	422 (60.98)	137 (72.11)	205 (57.42)	80 (55.17)	
Yes	270 (39.02)	53 (27.89)	152 (42.58)	65 (44.83)	

Notes. CBSA, Core Based Statistical Area

Table 2.

Descriptive Statistics by Hospital Nursing Resource Profile

Resource	All (N=692)	Worst (N=190)	Middle (N=357)	Best (N=145)
	Mean (SD)			
Nurse Staffing (Patients/Nurse)	4.74 (1.26)	5.34 (1.22)	4.71 (1.22)	4.05 (0.97)
Nurse Education (% BSN)	37.16 (14.58)	32.47 (15.45)	37.72 (13.22)	41.93 (14.90)
Nurse Work Environment (PES-NWI)	2.69 (0.23)	2.41 (0.11)	2.70 (0.09)	3.01 (0.12)
Collegial Nurse-Physician Relations	2.90 (0.23)	2.70 (0.21)	2.91 (0.16)	3.13 (0.18)
Nurse Manager Ability, Leadership, and Support of Nurses	2.58 (0.29)	2.30 (0.19)	2.59 (0.18)	2.93 (0.20)
Staffing and Resource Adequacy	2.50 (0.33)	2.19 (0.23)	2.50 (0.21)	2.89 (0.24)
Nurse Participation in Hospital Affairs	2.53 (0.29)	2.21 (0.17)	2.55 (0.16)	2.91 (0.17)
Nursing Foundations for Quality of Care	2.92 (0.23)	2.66 (0.14)	2.94 (0.10)	3.21 (0.13)

Notes. N=Number, SD=Standard Deviation, BSN=Bachelor of Science in Nursing, PES-NWI=Practice Environment Scale of the Nursing Work Index.

Table 3.

Regression of Nurse Outcomes on Hospital Nursing Resource Profile

Outcome	Model 1: Unadjusted	P-value	Model 2: Adjusted for Nurse Characteristics	P-value
	OR (95% CI)		OR (95% CI)	
Burnout				
Middle Profile	0.73 (0.67, 0.79)	<0.001	0.73 (0.66, 0.80)	<0.001
Best Profile	0.49 (0.44, 0.54)	<0.001	0.47 (0.41, 0.53)	<0.001
Job Dissatisfaction				
Middle Profile	0.57 (0.53, 0.62)	<0.001	0.56 (0.51, 0.62)	<0.001
Best Profile	0.33 (0.30, 0.37)	<0.001	0.32 (0.29, 0.36)	<0.001

Notes. OR=Odds Ratio, CI=Confidence Interval. Worst profile is the reference category. Odds ratios are from robust logistic regression models. Model 1 is unadjusted, and Model 2 adjusts for nurse characteristics and the clustering of nurses within hospitals.

Table 4.

Regression of Patient Outcomes on Hospital Nurse Resource Profile

Patient Outcome	Model 1: Unadjusted OR (95% CI)	P-value	Model 2: Adjusted for Patient and Hospital Characteristics OR (95% CI)	P-value
30-day Mortality				
Middle Profile	0.87 (0.81, 0.94)	<0.001	0.93 (0.87, 0.99)	0.015
Best Profile	0.75 (0.69, 0.82)	<0.001	0.82 (0.76, 0.89)	<0.001
Failure to Rescue				
Middle Profile	0.87 (0.81, 0.94)	<0.001	0.90 (0.85, 0.97)	0.003
Best Profile	0.76 (0.69, 0.84)	<0.001	0.80 (0.74, 0.88)	<0.001

Notes. OR=Odds Ratio, CI=Confidence Interval. Worst profile is the reference category. Odds ratios are from robust logistic regression models adjusted for patient and hospital characteristics and the clustering of patients within hospitals.

Table 5.

Regression of Hospital-Level Patient Assessment of Quality on Hospital Nurse Resource Profile

Patient Assessment	Model 1: Unadjusted	P-value	Model 2: Adjusted for Patient and Hospital Characteristics	P-value
	Beta (95% CI)		Beta (95% CI)	
Patient gave a rating of 9 or 10 (High)				
Middle Profile	4.52 (2.63, 6.41)	<0.001	3.35 (1.53, 5.18)	<0.001
Best Profile	11.10 (8.87, 13.32)	<0.001	9.11 (6.87, 11.36)	<0.001
Patient would definitely recommend the hospital				
Middle Profile	5.26 (3.17, 7.35)	<0.001	3.55 (1.53, 5.56)	0.001
Best Profile	12.70 (10.24, 15.17)	<0.001	9.77 (7.30, 12.24)	<0.001
Nurses always communicated well				
Middle profile	1.95 (0.35, 3.55)	0.017	1.87 (0.51, 3.22)	0.007
Best Profile	4.17 (2.29, 6.06)	<0.001	4.49 (2.82, 6.15)	<0.001
Patients always received help as soon as they wanted				
Middle profile	1.08 (−0.71, 2.88)	0.237	1.60 (0.3, 3.17)	0.045
Best Profile	2.96 (0.85, 5.08)	<0.006	4.01 (2.09, 5.93)	<0.001
Always quiet at night				
Middle profile	−0.69 (−2.43, 1.04)	0.431	0.41 (−1.27, 2.08)	0.634
Best Profile	0.95 (−1.09, 2.99)	0.359	2.85 (0.80, 4.91)	0.007
Doctor always communicated well				
Middle Profile	0.78 (−0.33, 1.89)	0.169	0.34 (−0.70, 1.38)	0.517
Best Profile	2.30 (0.99, 3.62)	0.001	1.54 (2.66, 2.82)	0.018
Room was always clean				
Middle Profile	0.69 (−0.95, 2.34)	0.408	0.45 (−1.11, 2.00)	0.572
Best Profile	3.36 (1.42, 5.29)	0.001	3.19 (1.28, 5.10)	0.001
Staff gave patients discharge information				
Middle profile	1.45 (0.39, 2.50)	0.007	1.50 (0.56, 2.44)	0.002
Best profile	3.10 (1.86, 4.35)	<0.001	3.41 (2.25, 4.56)	<0.001
Pain was always well controlled				
Middle profile	1.47 (0.11, 2.82)	<0.001	1.06 (−0.20, 2.31)	0.098
Best profile	3.37 (1.78, 4.96)	<0.001	2.82 (1.28, 4.36)	<0.001
Staff always explained medications				
Middle Profile	1.92 (0.52, 3.31)	0.007	1.37 (0.10, 2.63)	0.034
Best Profile	4.80 (3.15, 6.44)	<0.001	3.89 (2.34, 5.44)	<0.001

Notes. CI= Confidence Interval. Beta coefficients are from linear regression models adjusted for hospital characteristics.