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Variations in nursing baccalaureate education and 30-day inpatient surgical mortality

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Abstract

Background: In 2010, the IOM recommended an increase in the proportion of bachelor's-prepared (BSN) nurses to 80% by 2020. This goal was largely based on evidence linking hospitals with higher proportions of BSN nurses to better patient outcomes. Though, evidence is lacking on whether outcomes differ by a hospital's composition of initial BSN and transitional RN-to-BSN nurses.

Purpose: The purpose of this study is to determine whether risk-adjusted odds of surgical mortality are associated with a hospital's proportion of initial BSN and transitional RN-to-BSN nurses.

Methods: Logistic regression models were used to analyze cross-sectional data of general surgical patients, nurses, and hospitals in four large states in 2015 to 2016.

Findings: Higher hospital proportions of BSN nurses, regardless of educational pathway, are associated with lower odds of 30-day inpatient surgical mortality. *Discussion:* Findings support promoting multiple BSN educational pathways to reach the IOM's recommendation of at least an 80% BSN workforce.

Keywords

Education; Health service research; Nursing; Outcomes research; Healthcare workforce

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Author Contribution

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In 2010, the National Academy of Medicine (NAM), formerly the Institute of Medicine, published *The Future of Nursing: Leading Change, Advancing Health* report, which called for an increase in the proportion of nurses in the United States educated at the baccalaureate level to at least 80% by 2020 (IOM, 2011). Beginning in 2003 and continuing to the present, a number of empirical studies in the U.S. and internationally have demonstrated the link between hospitals with higher proportions of BSN nurses and decreased odds of surgical mortality and failure to rescue (Aiken et al., 2014; Aiken et al., 2003; Haegdorens et al., 2019; Harrison et al., 2019; White et al., 2018; Lasater et al., 2021). Studies have also estimated financial gains for hospitals with a greater proportion of BSNs. A single institution study measuring the proportion of BSN nursing hours individual patients received estimated that reaching an 80% BSN workforce could result in $6 million in annual cost savings per hospital resulting from decreased length of stay and fewer readmissions (Yakusheva et al., 2014). More recently, a large longitudinal panel study of 519 hospitals determined that hospitals that increased their proportion of BSN nurses over a decade experienced significant reductions in 30-day general surgical inpatient mortality, length of stay, and readmissions compared to hospitals that did not employ a greater proportion of BSNs over the period, contributing to a business case for investments in BSNs (Lasater et al., 2021).

Hospital employers have responded to this building evidence base by preferentially hiring BSN nurses (AACN, 2019b). The proportion of BSN-prepared nurses in the nation's workforce increased from 46% to 64% between 2010 and 2018 (AACN, 2019d; HRSA, 2018; IOM, 2015), although not enough to reach the 80% target in 2020. To meet the 80% BSN goal by 2025, workforce economists project a need for an immediate increase in the proportion of nurses whose initial pre-licensure qualification is a BSN (initial BSN nurses) from the current 46% to 70% and a 100,000 annual increase in the number of transitional BSN nurses—RNs advancing from a diploma or associate degree to a bachelor's degree via baccalaureate completion programs (Spetz, 2018). Sustaining timely progress toward a predominately BSN nurse workforce will require continuation of multiple pathways to the BSN.

The NAM's 80% BSN workforce recommendation was largely based on research linking higher proportions of hospital BSN nurses to better general surgical patient outcomes using data from 1999 (Aiken et al., 2003) when most nurses with BSNs obtained their degrees from traditional 4-year college programs. Now 48% of newly conferred BSN degrees are earned through RN to BSN completion programs (Spetz, 2018). No empirical research, however, has distinguished whether patient outcomes differ based on the educational pathway by which hospital nurses earn their BSN.

Despite this lack of evidence, many stakeholders support increasing the BSN workforce via both initial and transitional BSN nurses. The Tri-Council (American Association of Colleges of Nursing (AACN), American Nurses Association, and American Organization of Nurse Executives) has supported education advancement via all pathways (AACN, 2019a, 2019b, 2019c). The National Council of the State Boards of Nursing has encouraged state regulators to promote baccalaureate completion since BSNs help the nursing discipline meet future healthcare workforce needs, function in an increasingly complex health care environment, and address the ongoing nurse faculty shortage (NCSBN, 2010). The National Advisory

Council on Nursing Education and Practice's 18th Annual Report to Congress supported articulation agreements to ease further educational attainment (NACNEP, 2010). More-over, different educational pathways to the BSN are seen as a mechanism for promoting greater diversity among nurses and enhancing access to baccalaureate nursing education (IOM, 2015; Odahowski et al., 2020), which is important since greater workforce diversity may play an important role in mitigating health disparities (National Academies of Sciences, 2021; RWJF, 2020; Williams et al., 2014).

National nurse workforce policy should be guided by empirical evidence. Though, there is little evidence of whether or not a substantially changing composition of the hospital BSN workforce by type of educational pathway is associated with better patient outcomes. If differences in contribution to patient outcomes exist between initial and transitional BSN nurses, the current means of transitioning to an 80% BSN workforce may not yield expected patient and financial results. This study addresses this gap by determining whether varying proportions of transitional and initial BSNs at hospitals have equivalent benefits on 30-day general surgical patient mortality.

Methods

Design

This is a cross-sectional, observational analysis of patient, nurse, and hospital data from 2015 to 2016. The study evaluates to what extent hospital level differences in proportions of transitional and initial BSN nurses are associated with risk-adjusted inpatient mortality for patients following surgery, after taking account of other hospital characteristics that have been found to be related to mortality, including hospital size, staffing (patient-to-nurse ratios), and work environments. To address this aim, we link nurse survey data, aggregated to the hospital level, with detailed clinical patient outcomes data, and data on the characteristics of hospitals from four states—Pennsylvania, New Jersey, Florida, and California. Hospitals in these four states are roughly similar to hospitals nationally—they are diverse with respect to balance of urban and rural hospitals and account for 25% of hospital discharges annually.

Sources of Data

Nurses—The RN4CAST-US study included surveys of nurses in Pennsylvania, New Jersey, Florida, and California (Lasater et al., 2019; Sloane, Smith, McHugh, & Aiken, 2018). The sampling frame was constructed from state licensure lists and consisted of roughly 231,000 registered nurses—a 30% random sample of all registered nurses licensed to practice in the four states. Nurses were surveyed in 2015—16 using questionnaires sent to their home addresses and to personal email addresses where available. Nurses served as informants about their practice sites and provided detailed information about the quality of their work environments, staffing levels, and quality of care. Nurse informants also provided personal information including their education and the identity of their employing organization. For this study, we selected only nurses whose primary position involved practicing in hospitals, yielding an analytic sample of 20,268 registered nurses. A survey of nonrespondents found no evidence of nonresponse bias (Lasater et al., 2019; Sloane, Smith,

McHugh, & Aiken, 2018). The RN4CAST- US captured data on nursing resources in 97% of the 766 adult acute care hospitals in the four states (Sloane, Smith, McHugh, & Aiken, 2018).

Hospitals—Hospital characteristics were obtained from the 2016 American Hospital Association's (AHA) Annual Survey and from the aforementioned nurse surveys, after aggregating nurse responses to the hospital level. Hospitals were included in the sample if they had at least 10 RNs responding to the RN4CAST survey and were represented in the AHA Annual Survey; though the hospitals included in this study had an average of 40 nurse informants per hospital. Previous publications have demonstrated that 10 nurse informants are adequate to estimate organizational characteristics of hospitals (Aiken et al., 2003; Lasater et al., 2021). Federal hospitals were excluded from the analytic sample since they do not participate in state standardized discharge databases, which contain the patient outcomes data used in this study. These exclusions yielded a final analytic sample of 510 hospitals.

Patients—This study used 2015–16 comprehensive patient administrative data from California's Office of State- wide Health Planning and Development, the New Jersey Department of Health and Senior Services, the Pennsylvania Health Care Cost Containment Council, and Florida's Agency for Healthcare Administration. These administrative databases contain rich clinical detail to provide patient information used in risk- adjustment, while also providing a sufficiently large sample from which to observe variations in mortality across a large number of hospitals. These data include information on name of admitting hospital and individual patient information including patient demo-graphics (i.e., age, sex), comorbidities, admission information (i.e., transfer status), discharge status (alive/dead), discharge destination, and diagnosis related group (DRG) ICD-10 codes. The study sample included patients age 18 through 99, admitted for a general, orthopedic, or vascular surgical procedure. After applying these inclusion criteria, the final analytic sample consisted of 1,705,055 surgical patients.

Measures

Nursing Education Composition—In the RN4CAST-US survey, nurses were asked to report their initial and highest nursing degree type from the following options: diploma, associate, bachelor, master, doctorate. Hospital level BSN composition was determined by calculating the total percentage of nurses at each hospital who indicated that their highest degree in nursing was a bachelor's or higher. Transitional BSN composition at each hospital was determined by calculating the proportion of nurses out of all BSN nurses who indicated that their highest degree was a bachelor's or higher in nursing while their initial nursing education was a diploma or associate degree.

Inpatient Mortality and Patient Risk Adjustment—Inpatient mortality was defined as a death that occurs in the hospital within 30 days of admission. As demonstrated in prior research, 30-day surgical mortality is a nurse-sensitive indicator (Aiken et al., 2002, 2003, 2014; Lasater et al., 2021). We adjusted for patient char acteristics—age, sex, transfer status,

29 Elixhauser comorbidities (Elixhauser et al., 1998), and 58 surgical-based DRGs using ICD-10 codes.

Hospital Covariates

Hospital Characteristics.: Consistent with prior patient outcomes research, this study included measures from the AHA Annual Survey that previous research has shown to be associated with hospital mortality—teaching status, technology status, and bed size (Aiken et al., 2003; Burke et al., 2017; Harrison et al., 2019; Sheetz et al., 2016; Silber et al., 2016; Silber et al., 1992). Non-teaching hospitals had no postgraduate medical residents or fellows. Minor teaching hospitals had fewer than 1:4 trainee to bed ratios and major teaching hospitals had more than a 1:4 trainee to bed ratios. High technology status was defined as hospitals with facilities for open-heart surgery, major organ transplants, or both. Bed size is categorized as large (≥251 beds), medium (101—250 beds), or small (≤100 beds). State was included as a control variable to account for differences in nurses' education and hospital nurse staffing by state.

Nursing Resources.: Better nurse staffing and work environments have been empirically linked to improved patient outcomes (Aiken et al., 2018; Aiken et al., 2002; Aiken et al., 2021; Ball et al., 2018; Haegdorens et al., 2019; Lake et al., 2019; Lasater et al., 2021; Olds et al., 2017). Therefore, controlling for nurse staffing and work environment ratings enabled us to obtain adjusted and unbiased estimates of the effects of a hospital's nurse education composition. As part of the RN4CAST-US, nurses indicated the number of patients assigned to them on their last shift. To create the nurse staffing measure, individual nurse reports were averaged for medical/surgical nurses in each hospital. In addition, nurses completed the PES-NWI work environment survey (Lake, 2002), which is extensively validated in the United States and internationally (Lake et al., 2019). The PES-NWI is a 31-item question-naire that asks nurses about features in their practice setting. For each hospital, we aggregated scores from four subscales: 1) nurse participation in hospital affairs, 2) nursing foundations for quality care, 3) nurse manager ability, leadership, and support of nurses, and 4) collegial nurse-physician relations. The fifth subscale—staffing and resource adequacy —was excluded because it is highly correlated with the nurse staffing measure. We then recategorized the continuous work environment measure into three groups: 1) Good work environment (top quartile); 2) Moderate work environment (second and third quartiles); 3) Poor work environment (bottom quartile).

Data Analysis

We first used simple descriptive statistics to describe nursing education composition, nursing resources, and other characteristics of hospitals. We analyzed, using ANOVA and chi-squared statistics, differences in characteristics across hospitals according to total BSN and transitional BSN composition. Using means and percentages, we described sample patient characteristics.

We evaluated whether odds of general surgical inpatient mortality differed by the hospital composition of specific BSN pathway—initial or transitional BSN—using multivariate logistic regression models. These models estimated: 1) the relationship of a 10% increase in

the proportion of all BSN nurses and odds of inpatient mortality, before and after accounting for hospital characteristics (bed size, teaching status, state, and technology status), hospital nursing resources (medical/surgical patient to nurse ratios, nurse work environment), and patient characteristics (age, sex, transfer status, 29 Elixhauser comorbidities, 58 surgical-based DRGs); and 2) whether the relationship between BSN composition and odds of mortality is distinguishable by BSN pathway type. We controlled for a hospital's transitional BSN composition in the adjusted model estimating the relationship between inpatient mortality and total BSN composition. If, for example, total BSN composition is significantly associated with lower mortality odds and stepping in transitional BSN composition has no effect, it would indicate that the association of BSN composition with inpatient mortality risk is unaffected by the percentage of transitional BSNs included among all BSNs. On the other hand, if the association of BSN composition and inpatient mortality risk is magnified or attenuated when the transitional BSN variable is introduced into the model, then it would indicate that the association of BSN composition and inpatient mortality risk is respectively related to initial BSN or transitional BSN composition. All models accounted for the clustering of patients within hospitals using Huber-White sandwich estimators (Freedman, 2006; White, 1980). Regression results are reported using odds ratios (ORs), 95% confidence intervals (CIs), and *p*-values.

The study was reviewed by the University of Penn-sylvania's Institutional Review Board and found to be exempt.

Findings

As shown in Table 1, the hospital mean proportion of total BSNs among the 510 study hospitals was 56% (SD = 15%; IQR: 46–67%) and ranged from 8% to 95%. Sixty-nine percent of hospitals had greater than or equal to 50% BSN nurses (*N* = 353) and 4% had fewer than 30% BSN nurses (*N* = 18). Just 4 years before the NAM target date of 2020 for 80% BSNs, only 5% (*N* = 25) of hospitals had achieved that benchmark. The hospital mean percentage of transitional BSNs out of all BSNs was 44% (SD = 18%, IQR: 32—56%) and ranged from 0% to 100% of BSNs. Thirty-eight percent (N = 192) of hospitals had more than or equal to 50% of their total BSNs from transitional pathways (RN to BSN completion programs).

Table 2 Panel A shows the characteristics and distribution of all BSNs across hospitals. Hospitals with higher percentages of BSN nurses were larger, had a high technology status, and good work environments. Hospitals with higher proportions of BSN nurses had better nurse staffing ratios with fewer patients per nurse.

Table 2 Panel B describes the study hospitals in terms of their composition of transitional BSNs—a measure of the percentage of transitional BSNs comprising all BSNs at a hospital. The percentage of transitional BSNs were only modestly related (r = 0.36) to the percentage of total BSN in the hospitals. Sensitivity analyses revealed that transitional and total BSN composition variables are not multicollinear. As shown in Table 2 Panel B, higher proportions of transitional BSNs were associated with worse staffing or greater mean numbers of patients per nurse. The relationship between teaching status and transitional

BSN composition was insignificant, though only 5% of hospitals in which transitional BSNs comprised 60% or more of all BSNs were major teaching hospitals specifically. Hospitals with higher proportions of transitional BSNs were less likely to be high technology hospitals.

Characteristics of the patient sample are described in Table 3. Among 1,705,055 adult surgical patients, 51%, 36%, and 14% respectively underwent orthope- dic, general, and vascular surgeries. The majority of patients were female (54.2%) and the average age was 62 years (SD 16.6). About 0.8% of patients died in the hospital within 30 days of their surgical admission. Common comorbidities included hyper-tension (57.5%), obesity (17.1%), diabetes (15.9%), and chronic pulmonary disease (15.9%).

Odds ratios estimating relationships between mortality and hospital percentages of total BSNs and transitional BSNs are shown in Table 4 using various model specifications. Model (1) estimates these relationships separately (i.e., using two different models), before adjusting for covariates. Model (2) includes adjustments for hospital characteristics (i.e, bed size, teaching hospital status, technology status, and state), nursing resources (i.e., work environment and nurse staffing), and patient characteristics (i.e., 29 comorbidities, 58 diagnostic related groups, age, sex, transfer status). Model (3) includes the same covariate adjustments used in Model (2), but estimates the relationships jointly (i.e., in the same model). While the different models produce slightly different estimates, the results are essentially the same. While in Model (3), the percentage of transitional BSNs is of no consequence (OR = 1.008, 95% CI = 0.984—1.032, $p > .05$), the relationship of mortality to the total percentage of BSNs among all nurses is sizabl and significant (OR = 0.948, 95% CI = 0.921—0.977, $p < .001$). Each 10% increase in the proportion of BSN nurses resulted in a 5.5% decrease in the odds of 30-day general surgical inpatient mortality (Model 2; OR: 0.945; 95% CI: 0.910– 0.972). Furthermore, the odds ratios are multiplicative. To compute the odds of mortality in a hospital with 30% total BSN composition and 80% total BSN composition, the odds ratio should be raised to the fifth power, since the difference between 30 and 80 represents five intervals of 10. The risk of inpatient mortality at a hospital with 80% BSNs versus 30% BSNs, therefore, is lower by a factor of $0.945^5 = 0.754$, or 24.6% lower odds. This is a very large difference and a difference, as we have noted, that is unaffected by how many (or what percentage) of transitional BSNs are included among all BSNs.

Discussion

In this large cross-sectional study of 510 hospitals and 1,705,055 adult general surgical patients, we analyzed associations of hospital compositions of transitional and initial BSN nurses with risk-adjusted odds of inpatient mortality. The findings reaffirm prior research (Aiken et al., 2003; Lasater et al., 2021) showing that surgical patients in hospitals with higher proportions of BSN nurses have significantly lower odds of mortality. The findings also validate the recommendations of the National Academy of Medicine (IOM, 2011) that it is in the public's interest for the nation to move to a nurse workforce with 80% of nurses having bachelor's degrees or higher. We show that risk-adjusted mortality in hospitals with 80% BSNs as recommended by the National Academy of Medicine is almost 25% lower

than hospitals with 30% BSNs. These findings are net of patient to nurse staffing ratios and the quality of the nurse work environment.

This study adds new findings to what is known about the relationship between nurses' educational qualifications and patient outcomes by demonstrating that the specific educational pathway that nurses take to earn a BSN is not associated with odds of 30-day general surgical inpatient mortality. In other words, the outcome benefits of BSN qualifications are not contin-gent upon the educational pathway by which the BSN was earned. These findings provide the first empirical evidence to support workforce policies and stake-holder efforts aimed at reaching the 80% National Academy of Medicine goal by a combination of both initial and transitional BSN nurses.

Our research is focused on proportions of nurses with baccalaureate or higher degrees in nursing following earlier research (Aiken et al., 2003, 2014) and the recommendation of the National Academy of Medicine that the nation should move to a largely BSN workforce. We asked RNs to provide their highest degree in nursing creating two groups—those with a BSN or higher degree in nursing and those without it. Thus, RNs with degrees in other fields were placed in our group without BSN or higher degrees in nursing. We have no findings specifically related to RNs with bachelor's or higher degrees in fields other than nursing. The numbers of such nurses in individual hospitals are too small to study their association with patient outcomes.

Despite international differences in baccalaureate nursing education, research in multiple countries consistently finds that patients experience better outcomes at organizations with higher BSN compositions. BSN curricular competencies and length vary across nations. A BSN education in many European countries spans about 3 years versus 4 years in the United States. Countries require varying amounts of didactic versus clinical education. Aiken et al. (2014) in a study published in *The Lancet* found that when using nine European countries' own definitions of a BSN, the effect size of percent BSN on risk adjusted mortality was almost exactly the same as found in U.S. hospital studies. Just as nursing baccalaureate findings are consistent internationally despite differing BSN education definitions, these study results also find that improved patient mortality outcomes are not dependent on a single defined BSN pathway. It is not the pathway by which nurses earn a BSN but rather the attainment of the BSN itself that is important for ensuring favorable patient outcomes.

Reducing excess/avoidable mortality is in the public's interest, as well as hospitals', since mortality statistics are publicly available and affect hospital rankings. Our study findings indicate that hospitals should prioritize attaining high proportions of BSN nurses, which can be achieved via a combination of initial and transitional BSN nurses. There are a number of ways by which hospitals could increase their composition of BSN nurses, including 1) subsidizing baccalaureate completion as an employee benefit via tuition support; and 2) creating partnerships with baccalaureate completion programs to help mitigate issues preventing their nurses from accessing and completing BSN education (Cheshire et al., 2017; Hawkins et al., 2018).

Fostering diversity in the BSN workforce remains essential since greater workforce diversity is thought to mitigate health disparities (AACN, 2017; Sullivan Commission, 2003; National Academies of Sciences, 2021). Baccalaureate completion programs are often thought to enhance access to baccalaureate education and promote diversity among BSN nurses (Cheshire et al., 2017; Hawkins et al., 2018; IOM, 2011; Knowlton & Angel, 2017; NACNEP, 2010). Racial-ethnic minority nurses are less likely to initially obtain a BSN than other nurses—41% of Black, 44% of Hispanic, and 51% of White new nurse graduates entered the work- force with a BSN or higher (RWJF, 2020). Yet, racial-ethnic minority nurses are slightly more likely than other nurses to obtain a BSN or higher at some point in their career (HRSA, 2010; IOM, 2015; Odahowski et al., 2020). This suggests that maintaining multiple pathways to the BSN, besides contributing to the goal of a largely BSN nurse workforce, may also contribute to greater diversity among the BSN-prepared nurse workforce.

Limitations

This study uses cross-sectional data, limiting our ability to make causal inferences. However, longitudinal hospital panel studies using RN4CAST-US nurse survey data from 2006 and 2016 found associations observed in cross-sectional data to be similar to that of longitudinal panel results (Lasater et al., 2021; Sloane, Smith, McHugh, & Aiken, 2018). Patients studied here are limited to those undergoing common surgical procedures—orthopedic, general, and vascular surgery. These patients were selected because almost all hospitals care for patients undergoing these surgeries and risk adjustment procedures are well developed. Despite low mortality (less than 1%) in this group of surgical patients, we find a significant relationship between nursing education composition at hospitals and general surgical inpatient mortality. We expect that the relationships found here would be equally, if not more sizable, among patients admitted for medical conditions for which mortality rates are substantially higher, a needed focus for future research.

Conclusion

This study provides evidence that employment by hospitals of a nurse workforce with bachelor's degrees in nursing (BSN) has value in improving clinical outcomes above and beyond improving nurse staffing and work environments. This is the first research to show that achievement of the BSN is more important for patient outcomes than the educational pathway to the BSN degree. We found that among hospital nurses, the education pathway to obtain a BSN was not associated with 30-day general surgical inpatient mortality beyond the central importance of obtaining the BSN. These findings support recent trends of increases in both initial BSN and baccalaureate completion pathways to achieve a largely BSN nurse workforce nationally. With this new evidence, the once seemingly unachievable goal of a primarily BSN nursing workforce in the United States now seems attainable.

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Table 1 –

Hospital Level Nurse Education Composition by Total BSN and Transitional BSN Pathway (*N* = 510)

	Hospital Mean and Range		Hospital Distribution, *N* (percent)		
	Mean (SD)	**Range**	**<30%**	**≥50%**	**≥80%**
Total BSNs as % of all RNs	56% (15%)	8—95%	18 (4%)	353 (69%)	25 (5%)
Transitional pathway BSNs as % of all BSNs	44% (18%)	0—100%	107 (21%)	192 (38%)	18 (4%)

Note. Hospital distribution categories ≥50% and ≥ 80% are not mutually exclusive such that ≥50% will encompass hospitals with a BSN percentage ≥ 80%.

Table 2 –

Characteristics of Study Hospitals Overall, and by Total BSN Composition (Panel A) and Transitional BSN Composition (Panel B)

Panel A		**Hospitals in Which the Percentage of Total BSN Nurses is -**					
Characteristic	**All Hospitals (*n* = 510)**	**<30% (*n* = 18)**	**30–39% (*n* = 55)**	**40–49% (*n* = 84)**	**50–59% (*n* = 133)**	**≥60% (*n* = 220)**	***p*-value**
Size (No., %)							<.001
Large, or > 250 beds	264 (51.8)	1 (5.6)	12 (21.8)	36 (42.9)	73 (54.9)	142 (64.6)	
Small, or ≤ 250 beds	246 (48.2)	17 (94.4)	43 (78.2)	48 (57.1)	60 (45.1)	78 (35.4)	
Teaching status (No., %)							.582
Teaching	295 (57.9)	8 (44.4)	34(61.8)	49 (58.3)	72 (54.1)	132 (60.0)	
Non-teaching	215 (42.2)	10 (55.6)	21 (38.2)	35 (41.7)	61 (45.9)	88 (40.0)	
Technology status (No., %)							.001
High technology	277 (54.3)	4 (22.2)	20 (36.4)	48 (57.1)	73 (54.9)	132 (60.0)	
Non-high technology	233 (45.7)	14 (77.8)	32 (63.6)	36 (42.9)	60 (45.1)	88 (40.0)	
Nurse work environment (No., %)							<.001
Good environment	127 (24.9)	2(11.1)	7 (12.7)	10 (11.9)	35 (26.3)	73 (33.2)	
Poor or fair environment	383 (75.1)	16 (88.9)	48 (87.3)	74 (88.1)	98 (73.7)	147 (66.8)	
Nurse staffing ratio (Mean, SD)	5.0 (1.4)	6.0 (1.9)	5.5 (2.0)	5.2 (1.5)	4.9 (1.1)	4.7 (1.1)	<.001
Panel B		**Hospitals in Which the Percentage of Transitional BSN Nurses is -**					
Characteristic	**All Hospitals (*n* = 510)**	**<30% (*n* = 107)**	**30–39% (*n* = 107)**	**40–49% (*n* = 104)**	**50–59% (*n* = 87)**	**≥60% (*n* = 105)**	***p*-value**
Size (No., %)							<.001
Large, or > 250 beds	264 (51.8)	57 (53.2)	70 (65.4)	65 (62.5)	37 (42.5)	35 (33.3)	
Small, or ≤ 250 beds	246 (48.2)	50 (46.8)	37 (34.6)	39 (37.5)	50 (57.5)	70 (66.7)	
Teaching status (No., %)							.967
Teaching	295 (57.9)	60 (56.1)	65 (60.7)	59 (56.7)	50 (57.5)	61 (58.1)	
Non-teaching	215 (42.2)	47 (43.9)	42 (39.3)	45 (43.3)	37 (42.5)	44 (41.9)	
High tech status (No., %)							.002
High technology	277 (54.3)	50 (46.7)	60 (56.1)	72 (69.2)	44 (50.6)	43 (41.0)	
Non-high technology	233 (45.7)	57 (53.3)	47 (43.9)	32 (30.8)	43 (49.4)	62 (59.0)	
Good work environment (No., %)							.237
Good environment	127 (24.9)	28 (26.2)	28 (26.2)	33 (31.7)	18 (20.7)	20 (19.1)	

Panel A		Hospitals in Which the Percentage of Total BSN Nurses is -					
Characteristic	**All Hospitals (*n* = 510)**	**<30% (*n* = 18)**	**30–39% (*n* = 55)**	**40–49% (*n* = 84)**	**50–59% (*n* = 133)**	**≥60% (*n* = 220)**	***p*-value**
Poor or fair environment	383 (75.1)	79 (73.8)	79 (73.8)	71 (62.9)	69 (79.3)	85 (80.9)	
Nurse staffing ratio (Mean, SD)	5.0 (1.4)	4.6 (1.3)	4.9 (1.6)	5.0 (1.3)	4.9 (1.0)	5.5 (1.5)	<.001

Note. Transitional BSN composition is the percent of transitional BSN nurses out of all BSN nurses at a hospital. *p*-values were calculated using chi-squared tests except for nurse staffing ratios, which used ANOVA testing. Nurse staffing ratios represent the average number of patients to each medical/surgical nurse at a hospital.

Table 3 –

Patient Characteristics of Study Sample

Total Number of Patients Characteristic (Continuous)	**Mean**	***N* = 1,705,055 SD**
Age	62.0	16.6
Characteristic (Categorical)	No. of Cases	Percent
Female	924,630	54.2%
Transfer	41,129	2.4%
Surgery type		
Orthopedic surgery	870,964	51.1%
General surgery	609,642	35.8%
Vascular surgery	224,449	13.6%
Selected comorbidities		
Hypertension	980,581	57.5%
Obesity	290,746	17.1%
Diabetes w/o chronic complications	271,235	15.9%
Chronic pulmonary disease	270,428	15.9%
Fluid & electrolyte disorders	261,496	15.3%
Deficiency anemias	231,058	13.6%
Hypothyroidism	221,957	13.0%
Depression	181,149	10.6%
Outcome (Categorical)	No. of Cases	Percent
Inpatient deaths	13,309	0.8%

Note. Selected comorbidities are those with 10% or greater preva- lence among sample patients. General surgery includes the follow- ing surgery types: hepatobiliary, skin, subcutaneous and breast tissue, digestive, and endocrine.

Table 4 –

Odds Ratios Estimating the Association of Surgical Inpatient Mortality and Hospital Compositions of Total BSN and Transitional BSN Nurses

	Model 1	Model 2	Model 3
Hospital characteristic	Estimated Separately, and Unadjusted, OR (95 % CI)	Estimated Separately, and Adjusted, OR (95 % CI)	Estimated Jointly, and Adjusted, OR (95 % CI)
Percent total BSN Percent transitional	0.973 [0.948–0.999] *	0.945 [0.919–0.972] ***	0.948 [0.921–0.977] ***
BSN	1.016 [0.993–1.039]	1.023 [0.999–1.047]	1.008 [0.984–1.032]

Note. Adjusted models (Models 2 and 3) control for hospital characteristics (bed size, teaching hospital status, technology status, and state), nursing resources (work environment and nurse staffing), and patient characteristics (29 comorbidities, 58 diagnostic related groups, age, sex, transfer status).

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.

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