OPEN

Is Hospital Nurse Staffing Legislation in the Public's Interest?

An Observational Study in New York State

Karen B. Lasater, PhD, RN,† Linda H. Aiken, PhD, RN, FAAN,*† Douglas M. Sloane, PhD,* Rachel French, BSN, RN,*† Colleen V. Anusiewicz, PhD, RN,*† Brendan Martin, PhD,‡ Kyrani Reneau, MS,‡ Maryann Alexander, PhD, RN, FAAN,‡ and Matthew D. McHugh, PhD, RN, FAAN*†*

Background: The Safe Staffing for Quality Care Act under consideration in the New York (NY) state assembly would require hospitals to staff enough nurses to safely care for patients. The impact of regulated minimum patient-to-nurse staffing ratios in acute care hospitals in NY is unknown.

Objectives: To examine variation in patient-to-nurse staffing in NY hospitals and its association with adverse outcomes (ie, mortality and avoidable costs).

Research Design: Cross-sectional data on nurse staffing in 116 acute care general hospitals in NY are linked with Medicare claims data.

Subjects: A total of 417,861 Medicare medical and surgical patients.

Measures: Patient-to-nurse staffing is the primary predictor variable. Outcomes include in-hospital mortality, length of stay, 30-day readmission, and estimated costs using Medicare-specific cost-to-charge ratios.

Results: Hospital staffing ranged from 4.3 to 10.5 patients per nurse (P/N), and averaged 6.3 P/N. After adjusting for potential confounders each additional patient per nurse, for surgical and medical patients, respectively, was associated with higher odds of in-hospital mortality [odds ratio (OR) = 1.13, $P = 0.0262$; OR = 1.13, $P = 0.0019$], longer lengths of stay (incidence rate ratio = 1.09, $P = 0.0008$; incidence rate ratio = 1.05, $P = 0.0023$), and higher odds of 30-day readmission (OR = 1.08, $P = 0.0002$; OR = 1.06, $P = 0.0003$). Were hospitals staffed at the 4:1 P/N ratio proposed in the legislation, we conservatively estimated 4370 lives saved and $720 million saved over the 2-year study period in shorter lengths of stay and avoided readmissions.

Conclusions: Patient-to-nurse staffing varies substantially across NY hospitals and higher ratios adversely affect patients. Our estimates of potential lives and costs saved substantially underestimate potential benefits of improved hospital nurse staffing.

Key Words: health policy, health services research, hospital staffing, nurse staffing, nursing

(*Med Care* 2021;59: 444–450)

A bipartisan coalition of New York (NY) state assembly members sponsored legislation in 2019, *Safe Staffing for Quality Care Act*, to require hospitals to staff enough nurses to safely care for patients.[1] A July 2020 Harris national public opinion poll found 91% of respondents agreed that hospitals should be required to meet safe staffing standards for nurses.[2] Yet a similar policy requiring hospitals in Massachusetts to meet minimum nurse staffing standards was rejected in 2018 after a contentious debate in which some stakeholders warned of disastrous consequences absent information on whether the legislation was in the public's interest. The current study provides timely and relevant evidence related specifically to nurse staffing in NY hospitals— information necessary to guide the policy decision process that was absent in Massachusetts and other states considering similar policies.

We provide new evidence to inform the public and their elected officials of variability in nurse staffing across hospitals in NY and the consequences and associated costs of high nurse staffing ratios on clinical outcomes among older adults hospitalized with common medical and surgical conditions. This examination provides much needed evidence about the need in NY for mandated safe nurse staffing legislation. While our findings are specific to the circumstances and legislation under consideration in NY, the relationships between staffing ratios,

From the *Center for Health Outcomes and Policy Research, School of Nursing, University of Pennsylvania; †Leonard Davis Institute of Health Economics, University of Pennsylvania, Philadelphia, PA; and ‡National Council of State Boards of Nursing, Chicago, IL.
Funding for this work was provided by the National Council of State Boards of Nursing (NCSBN) (K.B.L., PI), the Leonard Davis Institute of Health Economics (K.B.L., PI), and National Institute of Nursing Research, National Institutes of Health (R01NR014855, L.H.A., PI; T32NR007104, L.H.A., Eileen Lake, M.D.M., MPIs).
The authors declare no conflict of interest.
Correspondence to: Karen B. Lasater, PhD, RN, Center for Health Outcomes and Policy Research, University of Pennsylvania School of Nursing, 418 Curie Boulevard, Fagin Hall, Philadelphia, PA 19104. E-mail: karenbl@nursing.upenn.edu.
Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website, www.lww-medicalcare.com.
Copyright © 2021 The Author(s). Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.
ISSN: 0025-7079/21/5905-0444

patient outcomes, and cost savings may be relevant to other states looking to undertake safe staffing laws.

METHODS

Study Design and Data

This cross-sectional study utilizes data on hospital patient-to-nurse staffing ratios collected between December 16, 2019 and February 24, 2020 from a survey of all actively licensed registered nurses (RNs) in NY. RNs completed an email-based survey and provided the name of their employer and detailed information about their inpatient workloads during their most recent shift worked, including: the type of unit (eg, medical or surgical, intensive care) and how many patients they were assigned to care for at one time. The name of their employing hospital and type of unit that nurses reported being assigned to allowed us to generate hospital-level estimates of staffing ratios from responses of nurses working in the same hospitals.

Hospital staffing data were linked with the American Hospital Association (AHA) Annual Survey which included other hospital information such as size, teaching status, and technology availability. The Medical Provider Analysis and Review File (MEDPAR) was used to identify Medicare patients discharged from each NY hospital, between January 1, 2017 and December 31, 2018, the 2 years for which data most proximate to our survey were available.

Sample

This study included 2 distinct samples of Medicare patients discharged over the 2-year study period: medical and surgical. The sample of medical patients included those admitted for 1 of 5 common medical conditions: acute myocardial infarction, congestive heart failure, pneumonia, stroke, and sepsis (Appendix Table 1, Supplemental Digital Content 1, http://links.lww.com/MLR/C192). These medical conditions account for ∼23.5% of the total Medicare medical admissions in NY. The sample of surgical patients included those admitted for a general, orthopedic, or vascular procedure (Appendix Table 2, Supplemental Digital Content 1, http://links.lww.com/MLR/C192), accounting for ∼15.5% of the total Medicare surgical admissions in the state. Medicare beneficiaries younger than 65 years old and older than 99 years old were excluded. If a patient had more than 1 hospitalization during the study period, the first hospitalization for a medical and surgical condition was selected as the index admission to avoid double counting.

The analytic sample of hospitals included 116 acute care general hospitals in NY. Inclusion in the analysis was determined by whether enough nurse respondents from each hospital had been obtained to reliably estimate measures of patient-to-nurse staffing ratios for medical-surgical nurses. On average, there were 24 direct-care medical-surgical RN survey respondents per hospital, though larger hospitals (ie, those with 500+ beds) averaged more than 50 medical-surgical RN survey respondents per hospital. The 116 hospitals in our sample account for ∼81% of the acute care general hospitals in NY state. Hospitals omitted were smaller hospitals with fewer inpatient admissions.

Variables

The predictor of primary interest is patient-to-nurse staffing ratios. Nurse survey respondents were asked, "How many patients were assigned to you on that [your last] shift?" The response was open-ended. The numbers of patients reported by direct-care medical-surgical staff nurses during their last shift were aggregated within hospitals and divided by the number of medical-surgical nurse respondents to create a hospital-level measure representing average patient-to-nurse staffing. This approach has been widely used and validated.[3,4]

Patient outcomes were derived from Medicare claims data and included in-hospital mortality, length of stay, and 30-day readmission. In-hospital mortality was defined as a death occurring during the first 30 days of the index hospitalization. Length of stay represented the number of days spent in the hospital during the index admission. Readmissions were defined as a hospital admission occurring within 30 days from the index hospital discharge date. Costs were estimated using Medicare-specific cost-to-charge ratios using patient-level charge data from the MEDPAR file and hospital-level cost reports from the Centers for Medicare and Medicaid Services Impact Files.

The Medicare claims data also provided detailed information for risk-adjustment including patients' age, sex, 32 Elixhauser comorbidities, transfer status, and dummy variables for each surgical diagnostic-related group and each medical category. AHA data provided hospital-level variables for risk-adjustment including size, teaching status, and technology status. Hospital size was defined by the number of licensed beds (small ≤ 100 beds; medium 101–250 beds; large >250 beds). Teaching status categories were based on the ratio of medical residents or fellows to hospital beds (nonteaching, no medical trainees; minor teaching, 0–4 per bed; major teaching, ≥ 4 per bed). High technology hospitals performed major organ transplants and/or open-heart surgery. Skill mix was also controlled for. While skill mix did not have a significant effect on the different outcomes, net of the effect of medical-surgical nurse staffing, its inclusion in our models did appear to stabilize our staffing effect estimates across various model specifications.

Statistical Analyses

We use descriptive statistics (percentages, means, medians, SD, and ranges) to show (1) the region, size, teaching status, and technology of the study hospitals; (2) the average hospital medical-surgical staffing derived from the reports of the medical-surgical nurses in the hospitals; (3) the numbers of medical-surgical nurses whose survey responses produced these average hospital staffing measures; and (4) the numbers of medical and surgical patients admitted. We show the characteristics of Medicare patients with medical and surgical conditions and the same study hospitals, including the region of their admitting hospital as well as their age, sex, and comorbidities. We also show, before taking account of any potentially confounding factors, how mortality, readmissions, and lengths of stay vary across groups of hospitals with different staffing levels (eg, <6, 6–7, and >7 patients per nurse).

Ultimately, we use multi-level random effects logistic regression models to estimate the size and significance of the association of hospital nurse staffing with individual patient

Copyright © 2021 The Author(s). Published by Wolters Kluwer Health, Inc.

TABLE 1. Selected Characteristics of the 116 New York Hospitals in the Study Sample, and Medical-Surgical Staffing in Hospitals With Different Characteristics

			Medical-Surgical Staffing (Patients Per Nurse)				
						Range in Staffing	
Hospital Characteristics	Number of Hospitals	Percent of Hospitals	Mean	SD	Median	Minimum	Maximum
Region							
1 Western NY	12	10.3	6.1	0.6	6.2	5.0	7.0
2 Finger Lakes	8	6.9	5.7	0.6	5.5	5.1	6.6
3 Central	14	12.1	5.8	0.7	5.8	4.3	6.9
4 North Eastern	12	10.3	5.4	0.3	5.3	4.9	5.9
5 New York City	35	30.2	6.9	1.0	6.9	5.1	8.7
6 Mid-Hudson	17	14.7	6.2	1.2	6.0	4.7	10.5
7 Nassau-Suffolk	18	15.5	6.5	1.0	6.5	4.9	8.6
Total	116	100.0	6.3	1.0	6.1	4.3	10.5
Hospital size							
≤ 100 beds	12	10.3	5.8	0.5	5.7	5.3	6.9
101–250 beds	36	31.0	6.3	1.2	6.1	4.3	10.5
> 250	68	58.6	6.4	0.9	6.2	4.8	8.7
Total	116	100.0	6.3	1.0	6.1	4.3	10.5
Teaching status							
Nonteaching	31	26.7	5.9	0.7	5.8	4.9	7.5
Minor teaching	43	37.1	6.3	1.1	6.1	4.3	10.5
Major teaching	36	31.0	6.5	1.1	6.5	4.8	8.6
Missing	6	5.2	6.5	1.2	6.2	5.2	8.4
Total	116	100.0	6.3	1.0	6.1	4.3	10.5
Technology							
Non–high technology	62	53.5	6.2	0.9	6.1	4.3	8.5
High technology	32	27.6	6.0	0.8	5.9	4.8	8.3
Missing	22	19.0	6.9	1.4	6.7	4.7	10.5
Total	116	100.0	6.3	1.0	6.1	4.3	10.5

	Patients discharged from 116 study hospitals					
	Number	Mean	SD	Median	Minimum	Maximum
Surgical patients	185,169	1596	1739	887	35	8707
Medical patients	232,692	2,006	1,726	1,416	140	8820

	Nurses completing surveys in 116 study hospitals					
	Number	Mean	SD	Median	Minimum	Maximum
Medical-surgical nurses	2747	23.7	24.3	14.0	5	139

Staffing data are from the nurse survey and other hospital characteristics are from AHA data. Data related to patients are from MEDPAR.

mortality and readmissions. Zero-truncated negative binomial regression models were used to test the association of staffing with length of stay, which is a count variable that ranged in value from 1 to 60 days. We estimated these associations before and after adjusting for other hospital characteristics and potentially confounding characteristics of the patients. We then used the adjusted estimates to approximate how many lives and how much money would have been saved over the 2 years from shorter lengths of stay and the reduced number of readmissions that would be produced by staffing at the proposed policy level (4:1 on medical-surgical units) rather than the current observed levels.

To compute cost savings to hospitals from reductions in length of stay, we first computed the total observed days and charges for patients in each hospital, and then, using regression modeling, estimated the predicted days per hospital if that hospital were to have staffed at a 4:1 patient-to-nurse ratio. The percentage reduction in length of stay between the observed and predicted was then applied to a percentage reduction in charges, and then converted to cost savings using hospital-level Medicare-specific cost-to-charge ratios. Payments avoided from reduced readmissions were calculated by first computing the difference between the observed and predicted readmissions in each hospital, and then applying the percentage reduction in readmissions to the payments from observed readmissions.

RESULTS

The 7 regions into which the hospitals were classified, as well as the number of hospitals in each region are presented in Table 1 and in Figure 1 of the Appendix, Supplemental Digital Content 1 (http://links.lww.com/MLR/C192). Thirty percent of the study hospitals were located in NY City, and another 30% in the 2 contiguous regions consisting of counties along the Mid-Hudson and on Long Island. The remaining hospitals—some 40% of the total—were scattered across the Western, Finger Lakes, Central, and North Eastern regions of the state. Roughly 60% of the hospitals had 250 beds or more, a slightly larger percentage were major or minor teaching hospitals, and more than half (53.5%) of hospitals were characterized as non–high-technology hospitals.

 Copyright © 2021 The Author(s). Published by Wolters Kluwer Health, Inc.

Medical-surgical staffing in these hospitals was estimated using individual workloads from 2747 medical-surgical RNs in the 116 hospitals, or a mean of 24 RNs per hospital. The medical-surgical staffing ratios ranged across hospitals from 4.3 to 10.5 patients per nurse and were somewhat worse (or patients per nurse were somewhat higher) in NY City (P/N = 6.9) than elsewhere (P/N = 6.0).

Eight percent of the 232,692 medical patients and 1.5% of the 185,169 surgical patients died in the hospital within 30 days of admission (Table 2). The average length of stay, excluding patients who died, were transferred, or stayed beyond 60 days, was 6.7 days (median: 5 d) for medical patients and 5.0 days on average for surgical patients (median: 3 d). Of the 206,259 medical patients who were discharged alive and not transferred to another acute care hospital, 15.3% were readmitted within 30 days; while 9.2% of surgical patients were readmitted within 30 days. Roughly one-third of patients were in NY City hospitals, and a similar percentage were in 2 contiguous regions combined. Similar percentages of patients were found in the various age groups, slightly more than half were female, and the most common comorbidities were hypertension, fluid/electrolyte disorders, chronic pulmonary disease, and renal failure.

Table 3 shows that, before adjusting for any potentially confounding factors, the average percentages of deaths and readmissions, as well as the average length of stay were lowest in the group of better-staffed hospitals with fewer than 6 patients per nurse and highest in the worst-staffed hospitals with 7 or more patients per nurse. Table 4 provides odds ratios (for mortality and readmissions) and incident rate ratios (for length of stay) indicating the effects of medical-surgical staffing for outcomes of medical and surgical patients separately. Coefficients after adjusting for different hospital and patient characteristics indicate that each patient added to the average nurse's workload increase the odds of death by a factor of 1.13 (or 13%) for both surgical patients and medical patients. The odds of 30-day readmissions increase by a factor of 1.08 (or 8%) and 1.06 (or 6%) for surgical and medical patients respectively; and the odds of staying a day longer at all intervals increased by a factor of 1.09 (or 9%) and 1.05 (or 5%) for surgical and medical patients, respectively.

We use the adjusted effects to estimate, for the 2-year study period, the number of lives that would have been saved and the amount of money that might have been saved by hospitals from shorter lengths of stay and by payers from avoided readmissions, if medical-surgical staffing had been 4:1 (as prescribed by the legislation) rather than an average of roughly 6:1 (as was observed). As shown in Table 5, for medical patients (who account for roughly one-quarter of the medical hospital stays among Medicare beneficiaries, and considerably fewer among hospitalizations of all payer-types), there would have been 3,821 fewer deaths and nearly $298 million saved from shorter stays over the two years. Avoided payments from reduced readmissions following a medical admission would have been more than $37 million over two years. Among the surgical patients studied, who account for roughly 15% of the total surgical Medicare volume in hospitals, we estimate that if hospitals were to have staffed at the 4:1 ratio, 549 lives would have been saved, $360 million could have been saved by hospitals from shortened stays, and nearly $24 million payments avoided from avoided readmissions.

TABLE 2. Outcomes and Selected Characteristics of the Surgical and Medical Patients in the Study Hospitals

	Numbers (%)			
Patient Outcomes	**Surgical Patients**		**Medical Patients**	
Deaths/cases	2730/185,169 (1.5%)		19,184/232,692 (8.2%)	
30 d readmissions/cases	16,756/182,437 (9.2%)		31,534/206,259 (15.3%)	
	No. of cases	Mean (SD)	No. of cases	Mean (SD)
Length of stay	182,304	5.0 (5.4)	205,855	6.7 (6.1)
Patient characteristics	Number (%)		Number (%)	
Region of their admitting hospital				
1 Western NY	17,794 (9.6)		20,120 (8.7)	
2 Finger Lakes	16,561 (8.9)		17,780 (7.6)	
3 Central	18,852 (10.2)		21,096 (9.1)	
4 North Eastern	18,720 (10.1)		19,840 (8.5)	
5 New York City	57,745 (31.2)		78,543 (33.8)	
6 Mid-Hudson	17,880 (9.7)		27,185 (11.7)	
7 Nassau-Suffolk	37,617 (20.3)		48,128 (20.7)	
Total	185,169 (100.0)		232,692 (100.0)	
Age (y)				
65–69	45,143 (24.4)		37,923 (16.3)	
70–74	44,351 (24.0)		37,484 (16.1)	
75–79	36,664 (19.8)		38,814 (16.7)	
80–84	27,189 (14.7)		39,860 (17.1)	
85–89	19,243 (10.4)		39,000 (16.8)	
90+	12,579 (6.8)		39,611 (17.0)	
Total	185,169 (100.0)		232,692 (100.0)	
Sex				
Female	107,045 (57.8)		121,985 (52.4)	
Male	78,124 (42.2)		110,707 (47.6)	
Total	185,169 (100.0)		232,692 (100.0)	
Transfer status				
Nontransfer	176,992 (95.6)		222,051 (95.4)	
Transfer	8,177 (4.4)		10,641 (4.6)	
Total	185,169 (100.0)		232,692 (100.0)	
Common comorbidities				
Hypertension	133,073 (71.9)		141,560 (60.8)	
Fluid and electrolyte disorders	35,442 (19.1)		103,508 (44.5)	
Chronic pulmonary disease	35,533 (19.2)		67,699 (29.1)	
Obesity	33,907 (18.3)		30,406 (13.1)	
Hypothyroidism	32,300 (17.4)		42,587 (18.3)	
Diabetes without complications	28,780 (15.5)		37,053 (15.9)	
Renal failure	26,775 (14.5)		66,797 (28.7)	
Deficiency anemias	24,307 (13.1)		55,180 (23.7)	
Diabetes with complications	24,409 (13.2)		52,129 (22.4)	
Depression	19,837 (10.7)		26,138 (11.2)	
Peripheral vascular disease	15,225 (8.2)		21,299 (9.2)	
Congestive heart failure	15,612 (8.4)		39,830 (17.1)	
Other neurological disorders	14,294 (7.7)		30,835 (13.3)	
Valvular disease	13,109 (7.1)		18,320 (7.9)	
Weight loss	9365 (5.1)		23,476 (10.1)	
Coagulopathy	6889 (3.7)		19,786 (8.5)	
Paralysis	4022 (2.2)		14,570 (6.3)	

The percentage of deaths are for all surgical cases admitted for general, orthopedic and vascular surgeries, and medical cases with acute myocardial infarction, congestive heart failure, pneumonia, stroke, and sepsis. Readmissions are based on cases that exclude cases that died in the hospital or were transferred to another hospital. Cases used to calculate length of stay exclude cases involving in-hospital deaths, patients transferred to another acute care facility, and lengths of stay longer than 60 days. Comorbidities shown are those that involved at least 5% of the patients in either patient group, ordered according to their prevalence among surgical patients. The percentages of cases with different comorbidities do not sum to 100% due to patients with no comorbidities and multicomorbidities.

Copyright © 2021 The Author(s). Published by Wolters Kluwer Health, Inc.

TABLE 3. Average Deaths, Readmissions and Lengths of Stay (LOS), for Medical and Surgical Patients in 3 Groups of Hospitals With Different Patient/Nurse Ratios

		Medical			Surgical		
Patient/Nurse Ratio	**N**	**Mortality**	**Readmissions**	**LOS**	**Mortality**	**Readmissions**	**LOS**
< 6	52	7.6%	14.4%	6.1	1.4%	8.4%	4.8
6– < 7	39	8.6%	15.6%	6.7	1.9%	9.6%	5.8
7+	25	9.5%	16.5%	7.3	2.4%	12.3%	7.5
Total	116	8.3%	15.3%	6.6	1.8%	9.6%	5.7

Slight discrepancies between some of the percentages reported in this table versus Table 2 result from the fact that numbers and percentages in Table 2 are calculated from individual patients rather than by averaging numbers and percentages across hospitals.

DISCUSSION

We found wide variation in patient-to-nurse staffing across a large representative sample of NY hospitals; with staffing on medical-surgical units ranging from 4.3 to 10.5 patients per nurse and an average of 6.3 patients per nurse. Staffing on intensive care units ranged from 1.8 to 4.3, with an average of 2.5 patients per nurse, which is more than the proposed legislation for ICU staffing of 2:1 (Appendix Table 3, Supplemental Digital Content 1, http://links.lww.com/MLR/C192). While we observed variation in average staffing levels across hospitals, medical-surgical nurses in most study hospitals reported caring for more patients than would be permissible under the 4:1 ratio for medical-surgical nurses in the proposed NY staffing legislation. In fact, medical-surgical nurses in only a few NY hospitals reported workloads of < 5:1, which is the current mandated ratio in California passed 20 years ago—the only US state to have implemented hospital-wide staffing legislation.[5–7]

We demonstrate higher odds of in-hospital mortality and 30-day readmission, and longer lengths of stay for medical and surgical patients in hospitals where nurses care for more patients each. If NY hospitals had staffed medical-surgical nurses at the 4:1 ratio as proposed in the current legislation, we project there would have been 4370 fewer in-hospital deaths in the 2-year period among Medicare patients. With roughly 388,160 fewer hospital days annually, we project $658 million in cost savings to hospitals annually from shortened lengths of stay. Likewise, we estimate 1.5% and 1.1% fewer 30-day readmissions among medical and surgical patients, respectively, with a resultant annual estimated savings of roughly $61.5 million. These estimates are produced by only about 25% of the Medicare hospitalizations in NY, so the actual savings when applied to all inpatients—both Medicare and non-Medicare—would likely be many-fold higher.

Previous research on larger groups of medical and surgical inpatients has demonstrated an association between lower patient-to-nurse staffing ratios and better patient outcomes including lower in-hospital mortality, avoided readmission, and reductions in length of stay[8–15]; as well as the value of patient outcomes relative to costs of investment in hospital nurse staffing.[16–18] Shorter lengths of stay and avoided readmissions are not only favorable outcomes for patients, but have favorable cost implications for hospitals including making available more beds to accept a case-mix consistent with hospitals' strategic priorities.

Strengths and Limitations

This study describes hospital nurse staffing using data collected from nurses employed in NY hospitals during the period that staffing legislation is under consideration. The timeliness of the staffing data is a major strength of this study since it provides current evidence to inform state policy decisions. There is, however, a lag in available patient claims data. While we use hospital staffing data collected during 2019 and 2020, we relied on the most recent available Medicare claims data from 2017 and 2018. While the timing of the patient and hospital data do not overlap, previous research demonstrates that nurse staffing changes modestly over a 10-year period.[4] Thus, it is likely that the staffing data collected in 2019–2020 closely resembles staffing in 2017–2018.

TABLE 4. Effect of Medical Surgical Staffing (Patient-to-Nurse Ratio) on Surgical and Medical Patient Outcomes

		Surgical Patients		Medical Patients	
Patient Outcome	**Coefficient**	**Unadjusted Models**	**Fully Adjusted Models**	**Unadjusted Models**	**Fully Adjusted Models**
In-hospital mortality	Odds ratio	1.18	1.13	1.11	1.13
	95% CI	1.08, 1.30	1.01, 1.26	1.05, 1.18	1.05, 1.22
	$P > \|z\|$	0.0004	0.0262	0.0003	0.0019
30-day readmission	Odds ratio	1.14	1.08	1.05	1.06
	95% CI	1.08, 1.21	1.04, 1.13	1.03, 1.08	1.03, 1.09
	$P > \|z\|$	< 0.0001	0.0002	< 0.0001	0.0003
Length of stay	IRR	1.13	1.09	1.05	1.05
	95% CI	1.05, 1.22	1.04, 1.14	1.01, 1.08	1.02, 1.09
	$P > \|z\|$	0.0022	0.0008	0.0066	0.0023

CI indicates confidence interval; IRR, incidence rate ratio.

Copyright © 2021 The Author(s). Published by Wolters Kluwer Health, Inc.

TABLE 5. Lives Saved and Cost Savings From Reduced Readmissions and Shorter Lengths of Stay With 4:1 Staffing Ratios Over 2 Years (2017–2018)

Variables Used to Estimate Lives Saved and Cost Savings	Surgical Patients Mortality	Surgical Patients 30-Day Readmissions	Surgical Patients Length of Stay	Medical Patients Mortality	Medical Patients 30-Day Readmissions	Medical Patients Length of Stay
Number of patients at risk of experiencing outcomes	185,169	182,437	182,304	232,692	206,259	205,855
Observed number of patients experiencing outcomes	2730	16,756		19,184	31,534	
Expected number of patients experiencing outcomes with 4:1 patient/nurse ratio	2181	14,727		15,363	28,520	
Difference between observed and expected patients experiencing outcomes	549	2029		3821	3014	
Observed total payments		$195,598,928			$381,565,063	
Projected savings in payments		$23,985,739			$37,555,479	
Observed number of patient days			909,555			1,377,496
Expected number of patient days with 4:1 patient/nurse ratio			805,015			1,254,798
Difference between observed and expected patient days			104,540			122,698
Observed total charges			$14,290,847,096			$13,538,143,902
Projected reduction in total charges			$1,353,413,218			$1,166,470,040
Projected cost savings after applying cost-to-charge ratio			$360,155,287			$297,836,798

Our estimates for predicted numbers of lives saved, readmissions avoided, reduced lengths of stay, and resultant cost-savings are conservative estimates of the overall potential impact of improving patient-to-nurse ratios. Our estimates make use of data from Medicare patients with 1 of 5 common medical conditions or a common surgery; a sample which accounts for roughly 25% of the total hospitalizations among Medicare beneficiaries in NY, not accounting for hospitalizations among non-Medicare patients. Previous research has shown that more favorable nurse staffing ratios are associated with better outcomes for all kinds of patients, including adults undergoing surgical procedures,[11,19,20] adults with a range of medical conditions,[3,15,21,22] as well as special populations like very low–birth-weight infants[23] and Black patients.[10] This study examines a limited number of patient outcomes and their cost-implications; however, with the increasing shift towards value-based payments, reductions in other unfavorable outcomes such as hospital-acquired infections which are known to be associated with lower patient-to-nurse staffing[24] might also result in cost-savings to hospitals. We also do not account for nurse outcomes, such as burnout and job turnover, which are known to be associated with higher staffing ratios[19,24,25,26] and negatively impact hospitals financially.

In this study, we demonstrate a need for and the potential implications of implementing mandated hospital nurse staffing ratios on the health of the public and associated cost-savings to hospitals and payers. While we do not study the number of additional nurses needed in NY state to achieve the recommended ratios, previous research suggests there are more than enough nurses to safely staff hospitals. Nursing graduations have doubled over the past 20 years with more than 160,000 newly educated nurses entering the US workforce every year.[27] The nurse to population ratio in NY (18.7 RNs per 1000 population) is higher than in California (11.3 RNs per 1000 population), where ratios have been successfully implemented.[28] The unfunded mandate in California was successfully implemented in safety net hospitals[5] as well as other hospitals, and there was no evidence of hospital closures associated with state-wide staffing requirements. Finally, 34 states, but not NY, have joined the Nurse Licensure Compact, state legislation which permits nurses to practice in any Compact state.[29] Passage of the Compact in NY would facilitate timely recruitment of nurses to the relatively few communities likely to have an actual shortage of nurses. All together, these trends in nurse workforce development suggest that passing the proposed safe nurse staffing legislation will not create a nursing shortage in hospitals or other clinical settings that would disrupt access to or quality of care.

CONCLUSIONS

Our findings demonstrate considerable variation in the patient-to-nurse staffing ratios on adult medical and surgical units in a large, representative sample of NY hospitals. The majority of hospitals do not meet the minimum nurse staffing required by legislation currently under consideration in NY. We find associations between worse nurse staffing and poorer outcomes for NY patients, consistent with a large body of research which shows the clinical benefit to patients of being cared for by a nurse with fewer assigned patients.[8,10–12,19,30] If NY state enacted the *Safe Staffing for Quality Care Act,* our evidence projects many lives would be saved and shorter hospital stays would translate into cost-savings for hospitals.

ACKNOWLEDGMENTS

The authors wish to acknowledge Tim Cheney for his contributions to data management and analysis in April through September of 2020. All meetings were held virtually.

Copyright © 2021 The Author(s). Published by Wolters Kluwer Health, Inc.

REFERENCES

1. New York Senate and Assembly. S.1032/ A.2954—Safe Staffing for Quality Care Act. 2019–2020 Legislative Session.
2. Nurses everywhere. Americans need nurses and demand more access, not less. Physician groups say no. Available at: https://www.nurseseverywhere.com/articles/5-americans-need-nurses-dem. Accessed February 19, 2021.
3. Bettencourt AP, McHugh MD, Sloane DM, et al. Nurse staffing, the clinical work environment, and burn patient mortality. *J Burn Care Res*. 2020;41:796–802.
4. Sloane DM, Smith HL, McHugh MD, et al. Effect of changes in hospital nursing resources on improvements in patient safety and quality of care: a panel study. *Med Care*. 2018;56:1001–1008.
5. McHugh MD, Brooks Carthon JM, Sloane DM, et al. Impact of nurse staffing mandates on safety-net hospitals: lessons from California. *Milbank Q*. 2012;90:160–186.
6. Aiken LH, Sloane DM, Cimiotti JP, et al. Implications of the California nurse staffing mandate for other states. *Health Serv Res*. 2010;45:904–921.
7. Mark BA, Harless DW, Spetz J, et al. California's minimum nurse staffing legislation: results from a natural experiment. *Health Services Res*. 2013;48(pt1):435–454.
8. Aiken LH, Cimiotti JP, Sloane DM, et al. Effects of nurse staffing and nurse education on patient deaths in hospitals with different nurse work environments. *Med Care*. 2011;49:1047–1053.
9. Aiken LH, Sloane DM, Bruyneel L, et al. Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet*. 2014;383:1824–1830.
10. Brooks Carthon JM, Kutney-Lee A, Jarrín O, et al. Nurse staffing and postsurgical outcomes in black adults. *J Am Geriatr Soc*. 2012;60: 1078–1084.
11. Lasater KB, Mchugh MD. Nurse staffing and the work environment linked to readmissions among older adults following elective total hip and knee replacement. *Intl J Qual Health Care*. 2016;28:253–258.
12. McHugh MD, Berez J, Small DS. Hospitals with higher nurse staffing had lower odds of readmissions penalties than hospitals with lower staffing. *Health Aff*. 2013;32:1740–1747.
13. Haegdorens F, Van Bogaert P, De Meester K, et al. The impact of nurse staffing levels and nurse's education on patient mortality in medical and surgical wards: an observational multicentre study. *BMC Health Serv Res*. 2019;19:1–9.
14. Thungjaroenkul P, Cummings GG, Embleton A. The impact of nurse staffing on hospital costs and patient length of stay: a systematic review. *Nurs Econ*. 2007;25:255–265.
15. Lasater KB, Sloane DM, McHugh MD, et al. Evaluation of hospital nurse-to-patient staffing ratios and sepsis bundles on patient outcomes. *Am J Infect Control*. 2020. Available at: https://doi.org/10.1016/j.ajic.2020.12.002.
16. Lasater KB, McHugh M, Rosenbaum PR, et al. Valuing hospital investments in nursing: multistate matched-cohort study of surgical patients. *BMJ Qual Saf*. 2020;30:46–55.
17. Silber JH, Rosenbaum PR, McHugh MD, et al. Comparison of the value of nursing work environments in hospitals across different levels of patient risk. *JAMA Surg*. 2016;151:527–536.
18. Lasater KB, McHugh M, Rosenbaum PR, et al. Evaluating the costs and outcomes of hospital nursing Rresources: a matched cohort study of patients with common medical conditions. *J Gen Intern Med*. 2020; 36:84–91.
19. Aiken LH, Clarke SP, Sloane DM, et al. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*. 2002;288: 1987–1993.
20. Kim Y, Cho S-H, June KJ, et al. Effects of hospital nurse staffing on in-hospital mortality, pneumonia, sepsis, and urinary tract infection in surgical patients. *J Korean Acad Nurs*. 2012;42:719–729.
21. Whitman GR, Kim Y, Davidson LJ, et al. The impact of staffing on patient outcomes across specialty units. *J Nurs Adm*. 2002;32: 633–639.
22. Cho S-H, Hwang JH, Kim J. Nurse staffing and patient mortality in intensive care units. *Nurs Res*. 2008;57:322–330.
23. Callaghan L, Cartwright D, O'Rourke P, et al. Infant to staff ratios and risk of mortality in very low birthweight infants. *Arch Dis Child Fetal Neonatal Ed*. 2003;88:F94–F97.
24. Cimiotti JP, Aiken LH, Sloane DM, et al. Nurse staffing, burnout, and health care–associated infection. *Am J Infect Control*. 2012;40:486–490.
25. McHugh MD, Ma C. Wage, work environment, and staffing: effects on nurse outcomes. *Policy Polit Nurs Pract*. 2014;15:72–80.
26. Lasater KB P, Aiken LH GG, Sloane DM A, et al. Chronic hospital nurse understaffing meets COVID-19: an observational study. *BMJ Qual Saf*. 2020. doi: 10.1136/bmjqs-2020-011512.
27. National Council of State Boards of Nursing. NCLEX Examination Statistics. 2019. Available at: https://www.ncsbn.org/2019_NCLEXExamStats.pdf. Accessed February 19, 2021.
28. United States Census Bureau. State Population Totals and Components of Change: 2010-2019. Suitland, MD. 2019. Available at: https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html. Accessed February 19, 2021.
29. Interstate Commission of Nurse Licensure Compact Administration. NLC Member States. 2020.
30. Needleman J, Buerhaus P, Pankratz VS, et al. Nurse staffing and inpatient hospital mortality. *N Engl J Med*. 2011;364:1037–1045.

Copyright © 2021 The Author(s). Published by Wolters Kluwer Health, Inc.