The Economic Value of Professional Nursing

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Background: Improved understanding of the economic value of registered nurse services can help inform staffing decisions and policies.

Objectives: To quantify the economic value of professional nursing.

Methods: We synthesize findings from the literature on the relationship between registered nurse staffing levels and nursing-sensitive patient outcomes in acute care hospitals. Using hospital discharge data to estimate incidence and cost of these patient outcomes together with productivity measures, we estimate the economic implications of changes in registered nurse staffing levels.

Subjects: Medical and surgical patients in nonfederal acute care hospitals. Data come from a literature review, and hospital discharge data from the 2005 Nationwide Inpatient Sample.

Measures: Patient nosocomial complications, healthcare expenditures, and national productivity.

Results: As nurse staffing levels increase, patient risk of nosocomial complications and hospital length of stay decrease, resulting in medical cost savings, improved national productivity, and lives saved.

Conclusions: Only a portion of the services that professional nurses provide can be quantified in pecuniary terms, but the partial estimates of economic value presented illustrate the economic value to society of improved quality of care achieved through higher staffing levels.

Key Words: nurses, quality of care, workforce issues, health economics

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Professional nursing care is a vital component of the healthcare system. More than 2.4 million registered nurses (RNs) are employed in nursing (56% in hospitals), making registered nursing the largest healthcare profession.[1] As healthcare costs increase, efforts to improve the efficiency and effectiveness of the healthcare system must take into account nurses' contribution to ensuring cost-effective, high-quality care.[2]

The term economic value of professional nursing refers to a monetary assessment of the value of services provided by nurses. In this study, we focus on the economic value of incremental changes in nurse staffing that result in improved quality of patient care. This definition emphasizes the changes in nurse staffing that affect medical costs via the impact on patient outcomes. Improved patient care that prevents nosocomial complications, mitigates complications by more rapid identification and intervention, and leads to more rapid patient recovery, creates medical savings. Reduced length of recovery and mortality have national productivity implications. From an economic perspective, healthcare facilities and other employers of RNs want to achieve a staffing level and mix such that the marginal value of employing one additional RN will equal or exceed the marginal cost.

There have been many studies on the impact of nurse staffing on patient outcomes. A recent meta-analysis found 2858 potentially relevant studies of which 28 studies met inclusion criteria and reported adjusted odds ratios of the association between RN staffing and patient outcomes.[3] The meta-analysis shows an association between higher staffing level and reduced hospital-related mortality, hospital-acquired pneumonia, unplanned extubation, failure to rescue, nosocomial bloodstream infections, and length of stay (LOS). There seems to be little association between RN staffing level and urinary tract infection (UTI) and surgical bleeding.

In our current study, completed before the meta-analysis was published, we identified studies that estimated the impact of nurse staffing and were methodologically sound, recent, and reported findings primarily using multivariate regression analysis. These studies examined the relationship between changes in RN hours per patient day (HPPD) and changes in nurse sensitive patient outcomes (NSOs). We analyzed hospital discharge data from the 2005 Nationwide Inpatient Sample (NIS) to estimate incidence and costs of these patient outcomes. We then applied the RN HPPD findings to the cost data in a model to estimate the economic implications of changes in RN staffing.

METHODS

Nurse Staffing Literature Review

We reviewed the research literature on the relationship between RN staffing level in hospitals and patient risk for UTI, hospital-acquired pneumonia, pressure ulcer, upper

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gastrointestinal bleeding, sepsis, shock/cardiac failure, pulmonary failure, central nervous system complications, deep vein thrombosis, postoperative infection, adverse drug events, and patient falls.[4–16] We also reviewed the impact of nurse staffing levels for in-hospital patient mortality (failure to rescue)[4–6,10,12,14,17,18] and LOS.[6,11,12,14,15,18,19]

Most studies identified an inverse relationship between nurse staffing levels and adverse patient outcomes, but the statistical significance of the findings varies by study and by surgical versus medical patients. Although the studies try to infer causality by controlling for case mix and other confounding factors, the reported relationships are associations. The use of existing data (rather than prospective data collection), the cross-sectional nature of the data, and variation across studies in the strength of the study design also limits the ability to generalize findings to the larger population.

Despite these limitations with the published literature, we combine findings across studies to quantify the size of the relationship for each NSO as an "elasticity." In the context of nurse staffing and patient outcomes, elasticity ($\epsilon_{\text{HPPD,complication}}$) estimates refer to the percent change in patient risk for complication for each 1% increase in HPPD. For example, an elasticity of -0.5 suggests that a 10% rise in HPPD is associated with a 5% decline in patient risk of complication.

The economic value of adding one more RN to a nursing unit depends on current staffing levels. At low staffing levels, the services of each additional RN make a large contribution to patient care and thus have high economic value. As staffing levels improve, the value of services provided by each additional RN is positive, but declining. Because the marginal value of services approach attempts to estimate the value of the services provided by the last RN hired, this approach will underestimate the average economic value of RNs for a given staff level.

To quantify the relationship between patient risk of a particular NSO and HPPD, we projected patient risk for different staffing levels with findings from several studies. From the Needleman et al study, we use the regression equations 1, 2, 9, and 10 because the specification for these equations is most similar to the control variables used in other studies.[10–12] These studies used regression analysis to isolate change in patient risk due to HPPD, controlling for patient acuity and inputs to care. Findings for patients admitted primarily for major surgery (surgery patients) were reviewed separately from patients admitted for all other reasons (medical patients). We averaged the projected risk estimates for a particular NSO for each staffing level to obtain the average risk of that NSO associated with that staffing level. Three staffing levels are of special interest for this analysis: a low staffing level (6.4 HPPD), a median staffing level (7.8 HPPD), and a high staffing level (9.1 HPPD), which are the 25th, 50th, and 75th percentile, respectively, of RN HPPD in a national sample of hospitals as reported by Needleman et al.[10–12] When using findings from studies that controlled for nursing mix, we used LPN HPPD and nurse aid HPPD of 1.2 and 2.4, respectively, reported by Needleman et al as the hospital median.

Hospital Data Analysis

The NIS hospital discharge data for 2005 were analyzed to estimate patients' underlying risk for nosocomial complications. The NIS was linked to the American Hospital Association's Annual Survey of Hospitals to identify nonfederal acute care hospitals, yielding an analysis file with 5.4 million discharges from 610 hospitals. Nosocomial complications among patients were identified by secondary diagnosis codes.[10,20]

We estimate multivariate regressions with NIS data to quantify the change in mortality risk, LOS, and cost per discharge associated with the presence of each NSO. For each analysis (mortality, LOS, cost), we estimated separate regressions for medical and surgical patients. Explanatory variables include patient age (in years), gender, admission type (elective, newborn, trauma center, urgent, emergency, other), expected payer (Medicaid, Medicare, private insurer, self pay, no charge, other), hospital characteristics (ownership/control, bed size, urban/rural, teaching status, region), a risk adjustment using diagnosis-related group (DRG), and a set of indicator variables indicating the presence of each nosocomial complication (1 = present, 0 = not present).

For the mortality analysis, we used logistic regression with in-hospital mortality as the dependent variable. The risk adjustment variable was the average in-hospital mortality rate associated with the DRG. Using the regression findings, for each discharge with a complication we projected mortality risk both in the presence and absence of the complication, with the average difference in mortality risk assumed to be attributed to the complication.

For the LOS analysis, we used Poisson regression with LOS as the dependent variable. The risk adjustment variable was average LOS associated with the DRG. Similar to the mortality analysis, we predicted LOS both in the presence and absence of each complication and attribute the average difference in LOS to the complication.

To estimate the reduction in hospital-related medical costs via prevention of nosocomial complications, we estimated the impact of each complication on hospital cost using ordinary least squares regression. Charges were converted to cost with hospital-specific cost-to-charge ratios. The risk adjustment variable was average cost associated with the DRG. The coefficient for each complication is the increase in hospital costs associated with the complication.

The hospital discharge data used are hierarchical, with patient outcomes influenced by both patient level characteristics and hospital level characteristics. The actual models used in our analysis (Poisson, logistic and ordinary least squares) do not explicitly consider the data hierarchy. Hierarchical models allow one to better understand the impact of explanatory variables at different levels in the hierarchy and to study variation at different levels of the hierarchy. The primary focus of our regression analysis is to estimate the association between presence of nosocomial complications and patient outcomes (mortality, LOS, and cost), with patient and hospital characteristics used as control variables. When we compared the results reported in this article to results using a random-intercepts model, we found differences in the estimates of control variables but minimal differences in the estimates of nosocomial complications predicting mortality, LOS, and cost. Also, analysis with a random-intercepts model suggests that the proportion of total variance that is accounted for at the hospital level is small.

The NIS only contains hospital costs. Costs for professional services provided in the hospital and postdischarge costs for each NSO are based on expert medical opinion regarding patterns of physicians' hospital rounds and the following assumptions: (1) the average hospital visit by a physician or other clinician costs approximately $100; (2) patients who experience a fall receive 1 examination by a clinician; (3) for each additional day in the hospital attributed to the complication, patients are visited by their attending physician and for some complications are also visited by a specialist; and (4) after discharge, some nosocomial complications require one or more follow-up ambulatory visits, medications, and tests.

Economic Benefits per Additional RN

An economic value of nursing model was developed that combines the HPPD elasticity estimates and the NIS regression results. We calculate patient risk of complications at 3 staffing levels: 6.4, 7.8, and 9.1 HPPD. We assume the national average NSO risk is associated with HPPD of 7.8, and then use the findings from each applicable study in the literature to predict NSO risk at 6.4 and 9.1 HPPD. For most NSOs, multiple studies reported findings so we calculate multiple values for NSO risk at each staffing level and take the average. To obtain point estimates of the economic value of an additional RN at each staffing level, we compute the change in NSO risk associated with a 0.01 change in HPPD.

Multiplying NSO risk by patient volume produces an estimate of total adverse patient events during the year for a given staffing level. Comparing the projected number of adverse outcomes for any 2 nurse staffing levels suggests how quality of care changes when nurse staffing changes. Multiplying the number of adverse patient outcomes by cost per case provides an economic estimate of the benefit of reduced incidence of complications, mortality, and LOS.

Productivity Loss

Using Bureau of Labor Statistics data on average earnings and labor force participation rates by age and gender, we estimate the lost productive value to society from premature mortality and increased LOS using the following assumptions: (1) annual earnings is used as a proxy for the value of productivity for people in the labor force; (2) for people not in the labor force the value of their productivity is assumed to be 75% of the annual earnings of their peers in the labor force (to account for the value of services in the home and volunteer work); (3) for a person age "A" in year "Y," their productive value in year "Y+1" is calculated $V_{A,Y+1} = 1.01 \times V_{A+1,Y}$, where the 1.01 accounts for the annual increase in productivity; and (4) a 3% discount rate is used to calculate the net present value of future productivity.

TABLE 1. Estimates of Adverse Outcome Elasticities With Respect to RN Hours Per Patient Day Based on Literature Review

Adverse Events	Medical Patients	Sources	Surgical Patients	Sources
Nosocomial complications				
Urinary tract infection	−0.08	6, 10	−0.12	6, 7, 10
Pneumonia	−0.28	6, 10	−0.26	6, 7, 10
Pressure ulcer	−0.06	6, 10	−0.11	6, 10
Upper gastrointestinal bleeding	−0.15	10	−0.15	10
Sepsis	−0.04	10	0.00	10
Pulmonary failure	NA		−0.06	7, 10
Shock/cardiac failure	−0.15	10	−0.11	10
CNS complications	0.00	10	0.00	10
Deep vein thrombosis	0.00	10	−0.06	7, 10
Postoperative infection	NA		−0.09	6, 10
Accidents				
Adverse drug event	−0.06	6	−0.06	6
Fall	−0.71	15, 16	−0.71	14, 16
Other				
Length of stay	−0.18	12, 15	−0.05	10
Failure to rescue	−0.00	12	−0.19	5, 10

The elasticities presented here are point elasticities evaluated at 7.8 RN HPPD. NA indicates not applicable.

RESULTS

Nurse Staffing Elasticity Estimates

The elasticity point estimates in Table 1 show the percent change in patient risk for each NSO associated with a 1% rise in HPPD evaluated at 7.8 HPPD (median staffing level). The strength of the relationships is:

- Strong (elasticity of −0.1 or below) for patient falls, hospital-acquired pneumonia, upper gastrointestinal bleeding, shock/cardiac failure, pressure ulcer (for surgical patients), and UTI (for surgical patients).
- Modest (elasticity between −0.1 and −0.05) for UTI (for medical patients), pressure ulcer (for medical patients), pulmonary failure, adverse drug events, postoperative infection, and deep vein thromboses (for surgical patients).
- Weak (elasticity between −0.05 and 0) for central nervous system complications, sepsis, and deep vein thromboses (for medical patients).

Nurse Staffing and Mortality Risk

Logistic regression results suggest that presence of nosocomial complications is associated with a rise in risk of in-hospital mortality (Table 2). The regression coefficients for all complications are statistically different from 0 at $P < 0.05$, with the exception of pressure ulcer for medical patients. Unexpectedly, UTI is associated with lower mortality risk so for modeling we assume no mortality associated with UTI.

We compare 2 approaches to estimate the relationship between HPPD and mortality ($\epsilon_{HPPD,mortality}$). One, we combine elasticity estimates from our synthesis of the literature on the relationship between HPPD and nosocomial compli-

TABLE 2. Increased Mortality Risks Attributed to Presence of Nosocomial Complications

	Medical Patients			Surgical Patients		
Effect	**Predicted Mortality Risk for Patient Without Complication (%)**	**Predicted Mortality Risk for Patient With Complication (%)**	**Attributed Mortality Risk (%)**	**Predicted Mortality Risk for Patient Without Complication (%)**	**Predicted Mortality Risk for Patient With Complication (%)**	**Attributed Mortality Risk (%)**
Has urinary tract infection	6.43	5.63	0.00	5.33	4.92	0.00
Has pressure ulcer	7.07	7.09	0.02	5.62	6.32	0.69
Has pneumonia	8.29	14.24	5.95	9.97	11.17	1.20
Has DVT/PE	6.23	9.93	3.70	6.34	10.69	4.35
Has ulcer/gastritis/UGI bleeding	6.11	7.24	1.13	5.84	7.77	1.93
Has central nervous system complications	5.12	7.22	2.09	3.87	5.87	2.00
Has sepsis	10.23	16.98	6.75	12.17	20.71	8.53
Has shock/cardiac arrest	17.97	49.36	31.39	10.61	33.64	23.03
Has surgical wound infection		NA		6.07	6.42	0.35
Has pulmonary failure		NA		6.89	22.01	15.13

Source: Analysis of the 2005 NIS.

TABLE 3. Increased Length of Stay (in Days) Attributed to Presence of Nosocomial Complications

	Medical Patients			Surgical Patients		
Effect	**Predicted LOS for Patient Without Complication**	**Predicted LOS for Patient With Complication**	**Attributed LOS**	**Predicted LOS for Patient Without Complication**	**Predicted LOS for Patient With Complication**	**Attributed LOS**
Has urinary tract infection	5.88	7.56	1.68	9.03	13.60	4.58
Has pressure ulcer	6.54	10.73	4.19	10.51	17.10	6.59
Has pneumonia	6.32	9.10	2.79	12.78	17.26	4.48
Has DVT/PE	6.38	9.48	3.09	11.52	17.17	5.65
Has ulcer/gastritis/UGI bleeding	5.69	7.06	1.37	9.62	12.26	2.64
Has central nervous system complications	5.26	6.06	0.80	7.85	10.84	2.99
Has sepsis	6.89	12.40	5.51	15.93	25.22	9.30
Has shock/cardiac arrest	8.40	8.96	0.56	17.26	18.62	1.36
Has surgical wound infection		NA		11.68	19.82	8.14
Has pulmonary failure		NA		16.13	20.64	4.51

Source: Analysis of the 2005 NIS.
NA indicates not applicable.

cation risk ($\epsilon_{\text{HPPD,NSO}}$) with estimates from our regression analysis of the NIS on the increase in mortality risk associated with having each complication ($\epsilon_{\text{NSO,mortality}}$).

$$\varepsilon_{HPPD,\text{mortality}} = \sum_{\text{NSO}=i} \varepsilon_{\text{HPPD},i} \times \varepsilon_{i,\text{mortality}}$$

Second, we directly calculate ϵ_{HPPD} mortality based on a synthesis of the literature—for mortality, findings from Needleman et al and Aiken et al.[5,10] Compared with the first approach, the second approach produces a weaker relationship between HPPD and mortality risk for medical patients and a stronger relationship for surgical patients. Combining both medical and surgical patients, the 2 approaches produce similar estimates of change in mortality risk associated with increased RN staffing levels. The first approach (which measures lives saved by preventing NSOs) produced estimates that are approximately 87% the size of the estimates produced by the second approach. Although both approaches produce estimates with some level of imprecision, one possible interpretation is that approximately 87% of lives saved by improved RN staffing levels is achieved by preventing nosocomial complications while approximately 13% of lives saved is achieved by early detection and mitigation of complications that still occur. The second approach provides a more complete picture of the impact of RN staffing levels on patient mortality risk, and we use findings from the second approach to compute the economic estimates presented.

Nurse Staffing and Length of Stay

The Poisson regression results estimate the average increase in LOS when each of the nosocomial complications was present (Table 3). As with the mortality analysis, we compare 2 approaches to estimate the relationship between HPPD and LOS. The approaches are identical to those used for the mortality analysis but using the elasticity estimates for LOS ($\epsilon_{NSO,LOS}$) instead of mortality. The second approach produced a more complete (and larger) estimate of nursing's impact on LOS. Although the first approach only models prevention of NSOs, the second approach also includes the impact via mitigation of nosocomial complications that do occur and faster patient discharge unassociated with nosocomial complications. Results from the second approach are used to calculate the total economic value estimates presented.

Patient Medical Costs

The results of the ordinary least squares regression analyses estimating the impact of each nosocomial complication on hospital cost is shown in Table 4. For hospital days that are prevented unassociated with prevention of NSOs, each inpatient day avoided is assumed to generate cost savings of approximately $1522 (the 2005 national average cost per inpatient day in community hospitals).[21]

Estimates of increased mortality risk, LOS and medical cost associated with each NSO are summarized in Table 5. Combining this information with estimates of the number of adverse events in 2005 suggests that these adverse events were associated with 251,000 in-hospital deaths, 22.6 million hospital inpatient days, and $41.8 billion in medical costs.

Productivity Loss

Based on the age distribution of the patients with complications and who died in the hospital, we calculate that the net present value of future productivity would average $222,400 per life saved. The estimate for individual demographic groups ranges from $1,194,000 for men age 15–44, to $13,819 for women age 65 and older. Approximately 63% of the projected deaths averted would occur among the population age 65 and older, 24% would occur among the population age 46–64, 10% would occur among the population age 18–44, and 3% would occur among the population under age 18.

Economic Benefits per Additional RN

Although we quantify the economic value of only a subset of the services that RNs provide, these partial estimates of economic value per additional full time equivalent (FTE) RN range from $58,100 (to add an RN when already at 9.1 HPPD) to $62,500 (to add an RN when already at 6.4 HPPD). That the benefits per additional RN changes relatively little between low HPPD and high HPPD is surprising and likely reflects the many data challenges faced by researchers whose work we synthesized (eg, few hospitals staff at extremely low or high levels so there is only modest variation in staffing levels across hospitals after one controls for patient mix).

At 7.8 HPPD the quantified benefits per FTE RN is $60,000. Annual medical savings per RN include $7400 from preventing nursing sensitive adverse events (91% of which are reduced hospital costs and 9% are reduced costs for professional services and other postdischarge costs); and $38,100 for hospital-related savings and $2500 for professional services savings related to reduced LOS unassociated with preventing adverse events. Productivity benefits to society per additional FTE RN include $10,300 for reduced patient mortality, and $1800 from faster recovery.

The approach used provides an estimate of the value of the next RN hired, for a given staffing level. The value of each additional nurse declines at higher staffing levels, so this marginal value approach underestimates the average value per nurse. Reflecting the nurse staffing measures in studies synthesized, this definition of FTE does not distinguish between additional staff and working longer hours.

Economic Value of Increased Hospital Nurse Staffing at the National Level

Estimates from this study suggest that adding 133,000 FTE RNs to the acute care hospital workforce [the estimated number of RNs needed to increase those hospitals below 9.1 HPPD (75th percentile) up to 9.1 HPPD] would save 5900 lives per year. The productivity value of total deaths averted is equivalent to more than $1.3 billion per year, or about $9900 per additional RN per year.

Adding 133,000 RNs nationally would decrease hospital days by 3.6 million. The value of national productivity when nurses help patients recover more rapidly is conservatively estimated at $231 million (or $1700 per additional RN per year).

Medical savings (before increased nursing labor costs) is estimated at $6.1 billion (or $46,000 per additional RN per year). Combining medical savings with increased productivity, these partial estimates of economic value average $57,700 for each of the additional 133,000 RNs. Although this national scenario highlights the potential impact of improved staffing in acute care hospitals, we acknowledge the challenges faced by the nation to meet the current and growing demand for RNs just to maintain current staffing levels. Also, improved nurse staffing is one of several factors needed to improve quality of care—including the contribution of other clinician specialties, and advances in training, processes, and technology.

DISCUSSION

This study draws heavily on the growing body of literature to quantify the economic value of professional nursing. Our findings are generally consistent with findings published by Kane et al on the relationship between staffing and complication risk, by Needleman et al on the business case for nursing and by Aiken et al on the relationship between nurse staffing level and patient mortality, despite using a different approach and combining findings across multiple studies.[3,5,12] Our findings help to confirm the basic overall findings reported in the literature.

TABLE 4. Increased Hospital Costs Attributed to Presence of Nosocomial Complications (in dollars; 2005)

	Medical Patients			Surgical Patients		
Effect	**Point Estimate**	**Standard Error**	***P***	**Point Estimate**	**Standard Error**	***P***
Intercept	$448	$20	<0.0001	$2583	$59	<0.0001
Age at admission	($1)	$0	0.0523	$6	$1	<0.0001
Female	($42)	$9	<0.0001	($448)	$24	<0.0001
Has urinary tract infection	$1389	$18	<0.0001	$4243	$60	<0.0001
Has pressure ulcer	$4457	$30	<0.0001	$4525	$75	<0.0001
Has pneumonia	$4953	$27	<0.0001	$7289	$69	<0.0001
Has DVT/PE	$4648	$62	<0.0001	$9460	$129	<0.0001
Has ulcer/gastritis/UGI bleeding	$2315	$42	<0.0001	$5114	$138	<0.0001
Has central nervous system complications	$842	$45	<0.0001	$2886	$152	<0.0001
Has sepsis	$9897	$37	<0.0001	$18,278	$90	<0.0001
Has shock/cardiac arrest	$5225	$46	<.0001	$8729	$102	<0.0001
Has surgical wound infection		NA		$12,643	$133	<0.0001
Has pulmonary failure		NA		$14,136	$72	<0.0001
Admission type (emergency omitted)						
Elective	($256)	$14	<0.0001	($1166)	$29	<0.0001
New born	($10)	$18	0.5944	$34,298	$921	<0.0001
Other	$1747	$18	<0.0001	$3739	$49	<0.0001
Trauma center	$1863	$161	<0.0001	$3017	$292	<0.0001
Urgent	($302)	$12	<0.0001	($987)	$36	<0.0001
Expected payer (private omitted)						
Medicaid	$539	$12	<0.0001	$620	$39	<0.0001
Medicare	$60	$14	<0.0001	($52)	$33	0.1223
No charge	($534)	$58	<0.0001	($632)	$185	0.0006
Other	$149	$27	<0.0001	$334	$61	<0.0001
Self	$348	$20	<0.0001	$59	$62	0.3424
Control/ownership of hospital (government/private, collapsed category omitted)						
Government, nonfederal, public	$666	$23	<0.0001	$1525	$66	<0.0001
Private, non-profit, voluntary	$755	$18	<0.0001	$1151	$49	<0.0001
Private, invest-own	$686	$21	<0.0001	$1301	$56	<0.0001
Private,collapsed category	$681	$29	<0.0001	$1378	$89	<0.0001
Bed size of hospital (large omitted)						
Small	($762)	$13	<0.0001	($1242)	$39	<0.0001
Medium	($308)	$10	<0.0001	($853)	$28	<0.0001
Region of hospital (Midwest omitted)						
Northeast	$1659	$13	<0.0001	$919	$34	<0.0001
South	($757)	$16	<0.0001	($1564)	$41	<0.0001
West	($156)	$18	<0.0001	($700)	$48	<0.0001
Location/teaching status of hospital (urban teaching omitted)						
Rural	($1934)	$19	<0.0001	($1886)	$57	<0.0001
Urban nonteaching	($1413)	$13	<0.0001	($1957)	$34	<0.0001
Average cost for DRG	$0.89	$0	<0.0001	$0.80	$0	<0.0001
Sample size (discharges)	3,834,251			1,446,624		
R^2	0.26			0.52		

Source: Analysis of the 2005 NIS.

Not all services that nurses provide can be quantified in pecuniary terms. Although there is a growing body of literature on the impact of nursing care on preventing nosocomial complications, we identified very little research on the impact of nursing on mitigating the severity of complications that still occur.

The average annual cost for hospitals to employ an RN in 2005 was approximately $83,000 (salary of $57,820 and a fringe benefit rate of 30.4%).[22] An expansion in RN supply of RNs to improve staffing levels could cause the cost per RN to rise. The benefits of increased RN staffing included in our analysis find that each additional patient care RN employed

TABLE 5. Average Attributed Increase in Mortality Risk, Length of Stay, and Medical Cost per Case

	Mortality Risk (Percentage Point Increase)		Inpatient Days		Total Medical Cost (in 2005 Dollars)	
Nosocomial Complication	**Medical**	**Surgical**	**Medical**	**Surgical**	**Medical**	**Surgical**
Urinary tract infection	0.00%	0.00%	1.68	4.58	$1628	$4770
Pressure ulcer	0.02%	0.69%	4.19	6.59	$5177	$5484
Pneumonia	5.95%	1.20%	2.79	4.48	$5837	$8511
Deep vein thrombosis	3.71%	4.35%	3.09	5.65	$5281	$10,349
Upper gastrointestinal bleeding	1.13%	1.93%	1.37	2.64	$2809	$5862
CNS complications	2.12%	2.00%	0.80	2.99	$1102	$3584
Sepsis	6.75%	8.53%	5.51	9.30	$11,259	$20,398
Shock/cardiac failure	31.39%	23.03%	0.56	1.36	$5584	$9247
Postoperative infection	NA	0.03%	NA	8.14	NA	$14,571
Pulmonary failure	NA	15.25%	NA	4.51	NA	$15,138
Adverse drug event	1.74%*		3.80†		$7789†	
Fall	Unknown		2.39‡		$7118‡	

*Based on Lazarou et al (2000).[25]
†Based on Suh et al (2000).[26]
‡Extrapolated based on estimated average cost per case reported by Hendrich et al (2003).[27]
Sources: Analysis of the 2005 NIS.

(at 7.8 HPPD) will generate over $60,000 annually in reduced medical costs and improved national productivity (accounting for 72% of labor costs). This is only a partial estimate of the economic value of nursing, omitting the intangible benefits of reduced pain and suffering by patients and family members; the risk for patient rehospitalization; benefits to the hospital such as improved reputation, reduced malpractice claims and payouts, and reduced compliance-related costs; the benefits of increased staffing related to improved work environment (eg, reduced turnover and risk of injury); and the value of administrative activities that patient care nurses perform (eg, functions related to billing and ordering). Omitted areas of economic value reflect gaps in the literature and warrant future research. The approach we used to quantify the economic value of increased staffing levels has several limitations:

One, the estimates omit the value of some services that RNs provide and consequently underestimate their economic value.

Two, a major component of estimated medical savings is reduced patient LOS. Prevention of nosocomial complications explains only a small portion of the total decrease in inpatient days. Additional research is needed to better understand the pathways that lead to reduced LOS.

Three, the approach used may encounter effect modification. If overall healthcare quality improves causing patient risk of nosocomial complications to decline with existing staffing levels, effect modification causes the estimates of economic value per RN to decline (there is less potential for quality improvements).

Four, estimates from the literature on the relationship between RN staffing level and quality of care are based on cross-sectional studies. These studies rely on associations that imply but do not establish causality. Work by Mark et al suggests that failure to adequately control for hospital characteristics can bias the estimated relationship between nurse staffing and quality of care.[23] When we compared the results reported in our paper to results using hierarchical linear models, we found differences in the estimates of control variables but minimal differences in the estimates used in our analysis (ie, the impact of nosocomial complications on predicting mortality, LOS, and cost).

The findings from this study point to 2 related issues with policy implications. First, because healthcare facilities realize only a portion of the economic value of professional nursing, under current reimbursement systems the incentive (and financial reality) is for facilities to staff at levels below where the benefit to society equals the cost to employ an additional nurse. Perception of a market failure or the increased potential for social good often results in calls for political action—as is the case with calls for mandated minimum nurse staffing ratios. A study by Evans and Kim (2006) studied the relationship between hospital staffing levels and adverse patient events in California hospitals to investigate the merit of California's mandated minimum nurse-to-patient ratios.[24]

Second, the economic value of nursing is greater for payers than for individual healthcare facilities. By reducing patient recovery periods and preventing nosocomial complications, nurses reduce the demand for selected physician services. Furthermore, depending on reimbursement method, the healthcare facility might fail to realize estimated financial benefits that accrue from prevention of nosocomial complications and reduced LOS. Regardless, insurers and other payers have a financial incentive to ensure that healthcare facilities have appropriate nurse staffing mix and levels. One potential solution that is gaining acceptance is to pay more for quality, with payers raising reimbursement rates for facilities that provide higher levels of care. More closely linking reimbursement to patient outcomes could help facilities capture more of the benefits from improved staffing, thus strengthening the financial incentive and providing the financial means to improve quality of care.

Our findings reinforce the findings of others, strengthening the economic case for hospital investment in nursing, particularly in low staffed hospitals.

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