Presentation by

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on

SB 284 Patient Safe Staffing Act

to

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My name is Jack Neeedleman. I am the Wasserman Professor and Chair of the Department of Health Policy and Management at the UCLA Fielding School of Public Health, and I will be speaking today on nurse staffing in hospitals. For over 15 years, I have conducted research on nurse staffing and quality of care in hospitals. My research has been used by the Centers for Medicare and Medicaid Services, the National Quality Forum, the Joint Commission, consumer groups such as AARP, and nursing organizations such as the American Nurses Association to establish policy on staffing and endorse nursing-sensitive measures of hospital quality. Three of my first authored papers on nurse staffing and quality of care and the business case for nurse staffing have been designated patient safety classics by the US Agency for Healthcare Research and Quality and my research was awarded the first Health Services Research Impact Award from AcademyHealth, the association of the producers and users of health services research. As a journal reviewer and member of committees for the Institute of Medicine, the National Quality Forum and others, I have reviewed in detail the research of others on staffing and quality.

I am very happy to be here and to discuss the need for and appropriateness of the staffing legislation you are considering, and look forward to your questions and further discussion.

In my formal presentation, I want to discuss 5 key issues related to safe staffing legislation. These are:

1. Nursing is complex, cognitively and managerially challenging work, a fact not appreciated by public or frankly all health care executives
2. Nurse staffing matters: there is extensive evidence that nurse staffing levels influence patient safety and outcomes such as death and hospital acquired complications
3. Patients are entitled to nurse staffing at levels that assure safe and reliable care
4. Higher, safer staffing is affordable
5. The right staffing levels vary from hospital to hospital and unit to unit, and is not one size fits all, so hospital-staff jointly developed staffing models are good approach to assuring right staffing

1. Nursing is complex, cognitively and managerially challenging work, a fact not appreciated by public or frankly all health care executives

The public understands that nurse's work is physically and emotionally demanding, but the public and often too many health care executives do not appreciate that the work of front line nurses is cognitively, intellectually and managerially demanding.

What do I mean by cognitively and intellectually demanding? The stereotype of nurses is that they deliver the care that is ordered, administer drugs, take vital signs, help patients eat or go to the bathroom, and help them bathe. Nurses do this, and it is part of the fundamental work of nurses. But there are other dimensions to the fundamental work of nurses.

When care is ordered, especially medicines, nurses are expected to review the order and assure it is correct. Not just accurate, but appropriate and at the correct dose. If something is ordered that is not delivered, whether it's a medicine or a physical therapy session or a meal, the nurse is responsible for coordinating with the other services so that lapse is corrected and the care is delivered. Nurses are responsible for preventing errors of commission and omission to keep patients safe.

While doing basic care, nurses are also monitoring and assessing patients, determining whether the patient is at risk for adverse events such as falls, pressure ulcers, disorientation and delirium, and other risks to their health while hospitalized. Based on these assessments, they are

expected to identify and implement the appropriate evidence-based nursing intervention to address these risks.

They are also assessing and monitoring whether the patient is progressing as expected and if an intervention by a nurse or physician is needed to prevent a complication or avoidable death and keep the patient safe. They monitor pain and take action to assure it is controlled. They provide targeted education to patients and their families, prepare patients for safe discharge, and provide emotional, psychological and existential support for patients, families and other caregivers. It is common for patients on all types of units to also have behavioral health issues that nurses need to evaluate and manage to keep the patient, the staff and others on the unit safe. Nurses often are the principal coordinators of care across interprofessional teams that include physicians, pharmacists, social workers and other providers.[1] I've included as Exhibit 1 a chart from a recent publication trying to characterize the full scope of a nurse's work with an individual patient.[2] Nurses' work is complex and demanding.

Nurses' work is also managerially demanding. What I described in the paragraph above is the expectations for a nurse with respect to each patient under her or his care. But hospital nurses in medical-surgical areas may have four, five, six or more patients under their charge, each expecting that level of care, each with his or her own list of work to be accomplished during a given shift. These lists are dynamic, changing during a shift as patient conditions change, as new patients are admitted and discharged, and as scheduled care or services by others are disrupted. Nurses have the responsibility to assure that in this dynamic environment all the care required for each patient is delivered, a challenge Patricia Ebright characterized as "managing the stack."[3] Just how complex the work can be is reflected in Exhibit 2, a diagram of one RN's movements on a unit during just 50 minutes of one shift.

2. Nurse staffing matters: there is extensive evidence that nurse staffing levels influence patient safety and outcomes such as death and hospital acquired complications

The preceding discussion underscores the complexity of nurses' work and the cognitive and managerial demands on nurses. There is a substantial body of research that indicates that when hospital units are inadequately staffed, nurses may not have the time, training or

experience to carry out their work in a manner that keeps patients safe and allows for efficient and effective delivery of care. I have recently summarized that research in an editorial for the journal Nursing Economic$.[4]

In its 1996 report on nurse staffing in hospitals and nursing homes, the Institute of Medicine bemoaned the "serious paucity of recent research" on nurse staffing and quality. [5] Since that report, the literature on staffing and quality in hospitals has grown substantially, and documents the association of staffing levels and the mix of RNs and other staff with a wide range of adverse patient outcomes and patient length of stay. The length of stay finding is particularly important because it appears to be the result not only of increased adverse events but delays in care due to nurse staffing and those delays add to hospital costs.

A 2007 meta-analysis of the studies of staffing and outcomes found consistent associations of lower staffing with higher rates of adverse outcomes, including mortality, hospital acquired pneumonia, surgical wound infection, sepsis, the need for cardio-pulmonary resuscitation, and longer lengths of stay. [6,7] I have included a key table from the Kane Medical Care article that summarizes their fundings as Exhibit 3.

Since the Kane 2007 meta-analysis summarizing the research on staffing, there have been more studies confirming these findings and expanding the list of adverse outcomes to include readmissions and lower scores on the CMS HCAHPS survey, both of which can affect hospital payment under value-based payment rules. Similar findings have also been reported from international studies. [8]

Because much of the research on staffing and outcomes comes from studies in which higher staffed hospitals are compared with lower staffed hospitals, some have questioned whether these relationships are causal. These skeptics suggest something else other than staffing is the "real" source of these findings – higher staffed hospitals may have better doctors, or better technology, or more commitment to quality.

There are strong and compelling reasons to believe these associations are causal, that it is the staffing that matters. Causality is most convincingly demonstrated through randomized controlled trials, but we will never have a randomized trial of nurse staffing. In the absence of a

trial, we can still draw inferences of causality from three sources – the quality of the research and other efforts to control for other factors that might contribute to adverse outcomes or longer length of stay, quasi-experiments where the equivalent of randomization is leading to variations in staffing, and demonstrating the causal pathways by which nursing might be expected to affect outcomes. We have all three.

First, these results have been replicated across a wide range of studies with different ways of measuring staffing and different data sources. These studies have controlled for a wide variety of other hospital factors including technology, teaching status (a measure of expertise and physician quality), location (a measure of variations in physician practice), hospital accreditation status, hospital ownership. Patient characteristics that might influence the outcomes being studied are also controlled for with complex, detailed risk adjustment models. The "something else" the skeptics posit as the "real" source have been controlled for and the association of nurse staffing and patient outcomes remains strong.

Second, to directly address the causality question, my colleagues and I conducted a study in a single large high quality and nationally recognized academic medical center. [9] We had data for each patient treated over a five year period, approximately 250,000 admissions. The hospital had data on its staffing target for each unit for each shift based on its staffing model and measures of patient acuity and need for nursing care, and the actual staffing on the unit for that shift. Most of the time, approximately 80%, unit staffing was at or close to the target. Approximately 20% of the time, for reasons beyond the control of hospital and nurse management, RN staffing on a shift was 8 hours or more below the target; that is the unit was down approximately one nurse on that shift. We had data on which unit a patient was assigned for each shift and could count the number of below target shifts a patient was exposed to. Everything else – the technology, the training and experience of the nursing staff, the quality of the doctors and commitment of the hospital to high quality care – was the same. This is, I believe, as close to a randomized control trial as we will see on this issue.

As patients were exposed to more below target shifts, their risk of dying in the hospital increased. The higher risk of mortality was comparable to those observed in the cross-hospital

studies comparing high and low staffed hospitals, reinforcing the conclusion that the cross-hospital studies are measuring causal relationships.

Third, research is demonstrating how nurse staffing levels and mix influences patient outcomes. One of the key pathways, not surprisingly, is through missed care. Nurses on units with lower staffing are more likely to report being unable to complete their work. Levels of missed care are in turn associated with higher risks of adverse outcomes.

There are several well-validated measures of missed care, most completed by nurses, one for patients. [10-12] These instruments cover the full scope of nursing discussed above – assistance with activities of daily living; caring and emotional support; rehabilitation, instruction and education; monitoring and safety; delivery of ordered care and documentation. Exhibit 4 presents the domains of the Basel Extent of Rationing Nursing Care instrument. Exhibit 5 presents the areas covered by the Kalisch Missed Care instrument and the percentage of nurses reporting that the care is missed at least sometimes on their unit.

The research shows that when staffing is low, missed care increases. [13,14] Other research finds adverse outcomes increasing as missed care increases.[15] A growing body of research studies the links between staffing and missed care and missed care and outcomes simultaneously and models the link between staffing, missed care and adverse outcomes. [16-19] Collectively, this research helps us understand how low staffing leads to adverse outcomes.

In summary, the evidence that low staffing and a smaller proportion of RNs in the nursing work force increases adverse patient outcomes and extends length of stay is large and continues to grow. Given the extent of controls in the research comparing hospitals, the single hospital study using uncontrolled variations in staffing and mortality, and research examining how low staffing influences outcomes through missed care, the question of whether the association of staffing and outcomes is causal has been resolved. The association is causal, and policy and management decisions should reflect this.

3. Patients are entitled to nurse staffing at levels that assure safe and reliable care

There is considerable hope that competition among hospitals and public reporting of quality measures will lead to improvement in care, and that with more information patients will direct themselves to higher quality hospitals. We can call this the Consumer Reports model of how to achieve higher quality care.

While I encourage the inclusion of staffing measures such as nurse staffing levels and skill mix, falls rates, and other nursing sensitive measures in public reporting on hospitals in systems like CMS's Hospital Compare, this is not a sufficient response to the need to assure safe staffing. In many cases, such as when they are emergent and have called 911 for an ambulance or because they live in a community served by only one hospital, patients have no choice in the hospital to which they are admitted. Patients that don't have choice deserve safe and reliable care.

Beyond this, nursing is a core service of hospitals. Hospitals exist because their patients need round the clock nursing care. Every other service of the hospital can be and is provided on an outpatient basis. A hospital should only operate if it can provide this core service well. Call this the Underwriter's Laboratory model of quality. Patients do not want to assess how good a hospital's nursing care is; they want to and generally do assume the nursing system will work. Public policy should assure that this assumption is valid.

4. Higher, safer staffing is affordable

One of the issues often raised by opponents of staffing legislation is that the increased staffing is too costly and unaffordable. Research does not support this. Indeed, it finds the cost increases are modest and that there may be no increase in costs associated with a richer RN mix or more nursing hours per patient day.

There are four key studies in the literature on this topic. Three are simulations of the increased cost of nursing and the cost savings associated with shorter lengths of stay and reduced adverse outcomes. I conducted the first published business case analysis in 2006[20] and expanded it to include the cost savings of reduced nurse turnover in 2008.[21] Dall and colleagues expanded

on the range of adverse outcomes in the 2009 study.[22] The team from the University of Minnesota led by Robert Kane who conducted the meta-analysis of nursing studies did its own simulation of the costs and cost savings associated with increased staffing.[23] The results from all of these studies were consistent. The costs of increasing the number of hours of nursing were substantially but not fully offset by the cost savings from reduced length of stay and adverse events, but the net cost increase was small. Increasing the proportion of the nursing staff that are RNs (compared to Licensed Practical Nurses) was cost saving.

The fourth study by a team from the Rand Corporation directly compares costs per admission in higher staffed versus lower staffed hospitals, controlling for other hospital characteristics and patient characteristics that might influence costs of care.[24] As with the simulation studies, a richer mix of RNs was associated with lower costs. What the Rand researchers also found, however, was that the costs per admission in hospitals with higher hours per patient day were not statistically significantly higher than in hospitals with fewer nurses. The precise language from their research reads "Increases in nurse staffing levels were associated with reductions in nursing-sensitive adverse events and length of stay, but did not lead to increases in patient care costs. Changing skill mix by increasing the number of registered nurses, as a proportion of licensed nursing staff, led to reductions in costs.... The study findings provide support for the value of inpatient nurse staffing as it contributes to improvements in inpatient care; increases in staff number and skill mix can lead to improved quality and reduced length of stay at no additional cost."

Looking only at the increased cost of nursing and ignoring the offsetting cost savings from reduced length of stay, reduced readmissions and reduced adverse events provides a misleading picture of the net cost of safe staffing levels. Given the offsetting cost savings, safe staffing levels can be achieved with little or no net cost to the hospital.

For reference, I include the key table from my 2006 article as Exhibit 6 and the key table from the Martsolf 2014 article (the Rand study) as Exhibit 7. I have annotated the Martsolf table to explain what is being displayed.

5. The right staffing levels vary from hospital to hospital and unit to unit, and is not one size fits all, so hospital-staff jointly developed staffing models are a good approach to assuring appropriate staffing

The staffing needed on hospital units will vary depending upon the nature of the unit and its patients, and can vary from day to day and shift to shift as the nursing acuity of patients changes and admissions and discharges bring new patients with different needs to unit. Hospitals respond to the need to adjust staffing in a variety of ways. Some hospitals, typically larger hospitals with complex and changing case mix, have implemented data-driven acuity systems like the QuadraMed AcuityPlus system that require entry of substantial amounts of data on each patient each shift but allow them to adjust staffing to rapidly changing census and patient mix. Other hospitals with less day to day variation in acuity may use a simple grid system, which provides target staffing based on census. Some hospitals start with a grid but provide for formal or informal adjustment to staffing based on the characteristics of the patients and available nurses. The January-February and March-April 2015 issues of Nursing Economic$ present a range of papers looking at the challenges and potential of creating local staffing models.

In one hospital, several colleagues and I are evaluating a system which starts with a grid but in which the unit charge nurse can adjust the staffing to better meet perceived needs. The original plan as implemented was to leave the staffing adjustments to the complete discretion of the charge nurse. The charge nurses, however, decided to collectively establish a set of criteria for adjusting staffing as a way to pool their collective knowledge and assure consistency in staffing approaches. The guidelines, for example, called for an additional RN if two of a series of circumstances existed, such as three or more patients requiring isolation, three or more patients requiring one-to-one feeding, one or more confused patients, six or more admissions or discharges, or more than 50% float staff. The guidelines created similar criteria for an additional patient care assistant (nurses' aide).

I cite this hospital not because its system should be adopted by others but to illustrate that staffing models can be effectively developed with local input from nurse management, unit nurse leadership and unit staff. Indeed other variants on this model of local development of a staffing

model could also be presented. This experience demonstrates the model for developing and maintaining locally established staffing models envisaged by SB 284 is realistic and feasible.

Thank you for this opportunity. I look forward to your questions.

Exhibit 1: The Fundamentals of Care Framework, from Kitson et al, Journal of Nursing Scholarship, 2014

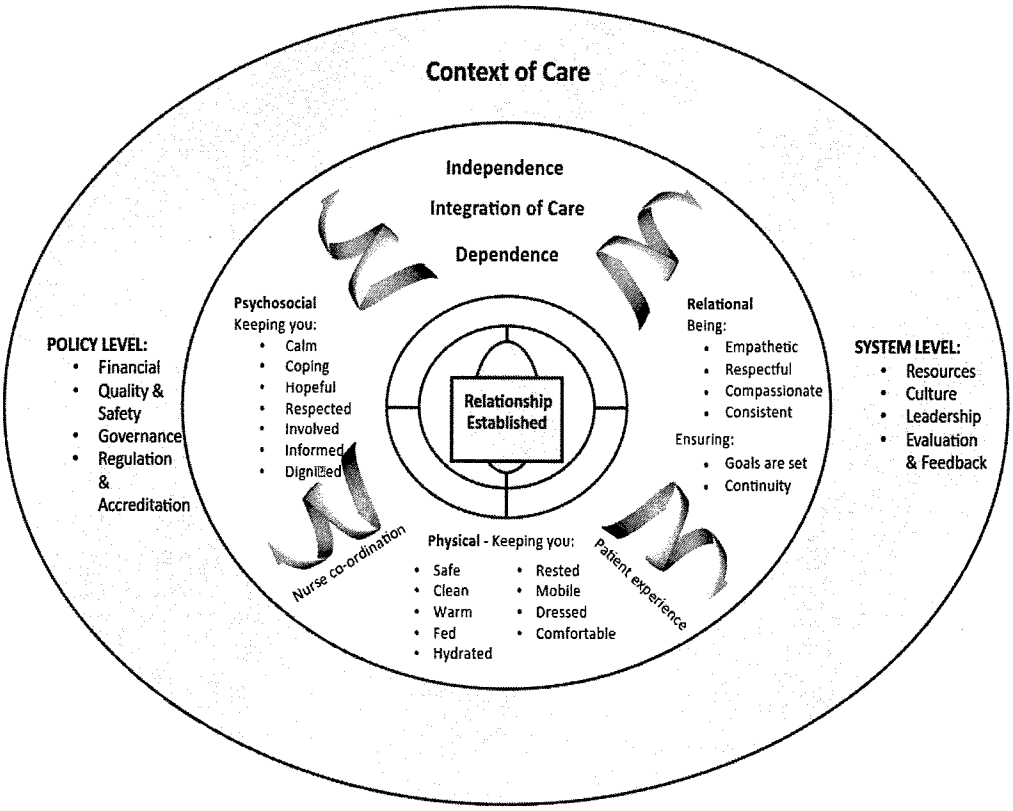
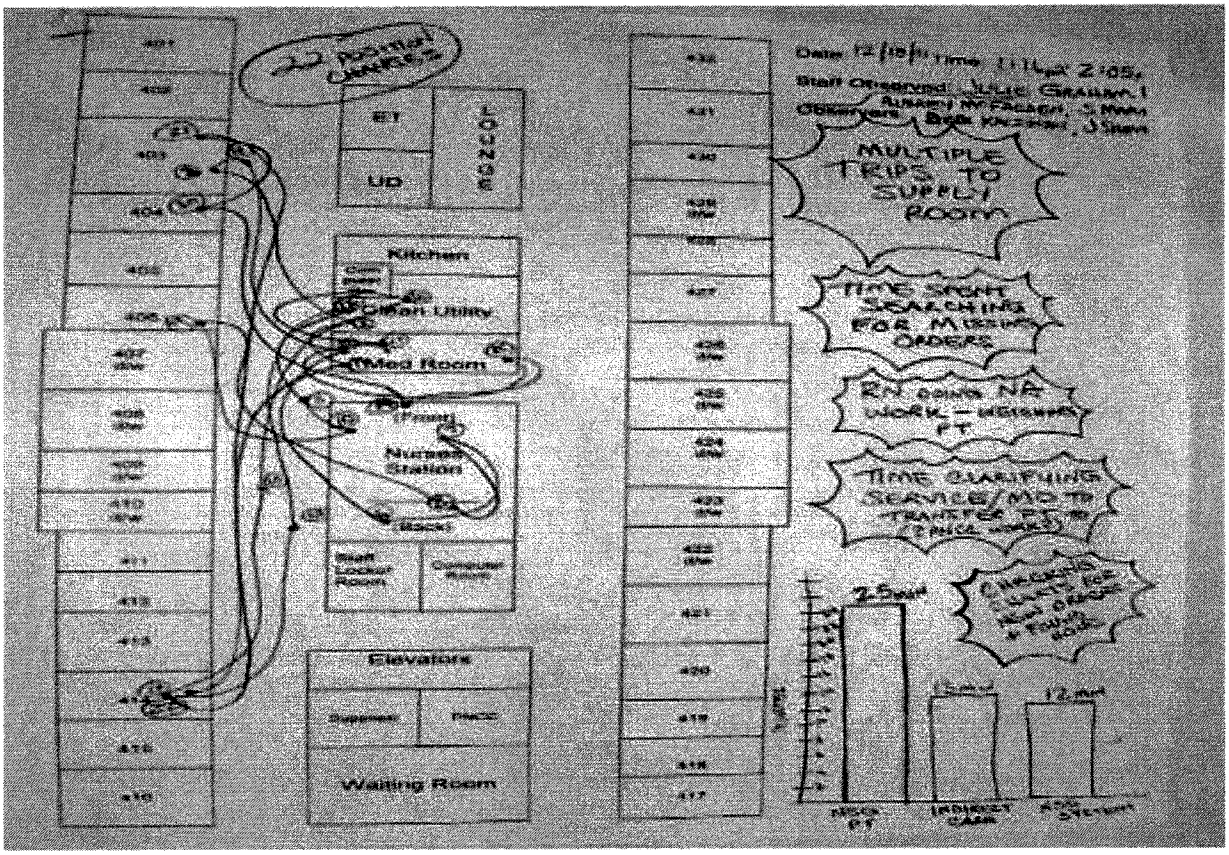


Figure 1. The fundamentals of care framework: Relational, integrative and contextual dimensions (Source: Kitson, Conroy, Kuluski, Locock, & Lyons (2013), reprinted with permission).

Exhibit 2: Diagram of one nurse's movements through 50 minutes of a single shift



Source: Institute for Healthcare Improvement, TCAB How-to Manual on Nurse Time in Direct Patient Care, 2008

Exhibit 3: Table from Kane, et al, Medical Care, 2007 meta-analysis of association of increases in resgistered nurses and reductions in adverse events and length of stay

TABLE 1. Pooled Odds Ratios of Patient Outcomes Corresponding to an Increase of 1 Registered Nurse Full Time Equivalent per Patient Day*

Outcome	Studies	Odds Ratio (95% CI)	Attributable to Nurse Staffing Fraction of Events (%)	No. Avoided Events/1000 Hospitalized (95% CI)
All patients				
Mortality, hospital level analysis, all patients	5	0.96 (0.94; 0.98)	4.2	3 (2; 4)
Mortality, intensive care units	5	0.91 (0.86; 0.96)	9.2	5 (2; 8)
Mortality, surgical patients	8	0.84 (0.8; 0.89)	16	6 (4; 8)
Mortality, medical patients	6	0.94 (0.94; 0.95)	5.6	5 (4; 5)
Hospital-acquired pneumonia	4	0.81 (0.67; 0.98)	19.1	1 (0; 2)
Pulmonary failure	5	0.94 (0.94; 0.94)	6	1 (1; 1)
Cardiopulmonary resuscitation	5	0.72 (0.62; 0.84)	27.6	2 (1; 2)
Intensive care units				
Hospital-acquired pneumonia	3	0.7 (0.56; 0.88)	30.2	7 (3; 10)
Pulmonary failure	4	0.4 (0.27; 0.59)	60.3	7 (5; 9)
Unplanned extubation	5	0.49 (0.36; 0.67)	50.9	6 (4; 8)
Cardiopulmonary resuscitation	3	0.72 (0.62; 0.84)	27.6	2 (1; 2)
Relative change in length of stay	4	0.76 (0.62; 0.94)	24	7 (2; 11)
Surgical patients				
Failure to rescue	5	0.84 (0.79; 0.9)	16	26 (17; 35)
Surgical wound infection	1	0.15 (0.03; 0.82)	84.5	7 (1; 8)
Cardiopulmonary resuscitation	1	0.72 (0.62; 0.84)	27.6	1 (1; 2)
Nosocomial bloodstream infection	5	0.64 (0.46; 0.89)	36	4 (2;5)
Relative change in length of stay	3	0.69 (0.55; 0.86)	31	14 (6; 21)

*An increase of 1 registered nurse full time equivalent per patient day would result in 8 additional registered nurse hours per patient day and an increased cost of $24.57/h × 8 h or $196.56/patient day.[122] Attributable to nurse staffing fraction of events and number of avoided events per 1000 hospitalized patients were estimated assuming causality in the association.

Exhibit 4: Domains of missed care from Basil Extent of Rationing of Nursing Care instrument

Items questionnaire abbreviated

1. Activity of Daily Livings (ADLs)
   - (1a) Bathing/skin care
   - (1b) Perform oral or dental hygiene for patients
   - (1c) Eating
   - (1d) Mobilization/changing positions
   - (1e) Managing body waste (urine, stool, vomit)
   - (1f) Changing bed linen
2. Caring–Support
   - (2a) Emotional or psychosocial support
   - (2b) Conversations with patients or their families
3. Rehabilitation–Instruction–Education
   - (3a) Toilet training
   - (3b) Activating/rehabilitating care
   - (3c) Education of patients/their families about self-care
   - (3d) Preparation for hospital discharge
4. Monitoring–Safety
   - (4a) Adequate monitoring of patients vital signs
   - (4b) Adequate monitoring of confused/impaired patients
   - (4c) Coping with the delayed response of a physician
   - (4d) Respond promptly to patient calls
   - (4e) Adequate hand hygiene
5. Documentation
   - (5a) Review patient documentation at the beginning of the shift
   - (5b) Formulate/update patient care plans
   - (5c) Documentation of performed nursing care

Source: Schubert, M., T. R. Glass, S. P. Clarke, B. Schaffert-Witvliet, and S. De Geest. 2007. "Validation of the Basel Extent of Rationing of Nursing Care instrument." *Nursing Research* 56(6): 416-24.

Exhibit 5: Rates of missed car reported by Kalisch using MISSCARE instrument

Table 3. Study 1 (n = 459) and Study 2 (n = 639); Part A Missed Nursing Care Percentages

Item A	Study 1 Missed Care, %[a]	Study 2 Missed Care, %[a]
Ambulation 3 times per day or as ordered	83.6	88.7
Assess effectiveness of medications	83.1	65.4
Turning patient every 2 h	82.4	68.8
Mouth care	81.9	82.6
Patient teaching about procedures, tests, and other diagnostic studies	80.4	68.7
PRN medication requests acted on within 15 min	80.3	54.0
Full documentation of all necessary data	79.3	73.9
Feeding patient when the food is still warm	76.4	78.5
Medications administered within 30 min before or after scheduled time	74.6	66.0
Assist with toileting needs within 5 min of request	69.5	65.1
Response to call light is initiated within 5 min	65.5	69.6
Emotional support to patient and/or family	65.4	58.3
Patient bathing/skin care	63.1	57.7
IV/central line site care and assessments according to hospital policy	61.9	54.0
Teach patient about plans for their care after discharge and when to call after discharge	57.6	28.4
Monitoring intake/output	57.0	54.6
Setting up meals for patient who feed themselves	50.3	50.8
Vital signs assessed as ordered	40.0	28.3
Focused reassessments according to patient condition	36.9	30.9
Hand washing	30.2	48.4
Bedside glucose monitoring as ordered	26.1	25.0
Patient assessments performed each shift	17.0	13.0

[a]Percentage of missed care used categories of occasionally, frequently, and always.

Source: Kalisch, B. J. and R. A. Williams. 2009. "Development and psychometric testing of a tool to measure missed nursing care." *Journal of Nursing Administration* 39(5): 211-9.

Exhibit 6: Estimates of avoided adverse outcomes, days and deaths associated with increased nurse staffing and costs of increased staffing and cost offsets from Needleman et al., Health Affairs, 2006 [20]

Avoided Adverse Outcomes, Hospital Days, Costs, And Deaths If Proportion Of Registered Nurses (RNs) Or Number Of Licensed Nursing Hours Were Increased To The 75th Percentile Of Hospitals Studied, National Estimates Updated To 2002

	Option 1: Raise proportion of RNs from 75th percentile without changing number of licensed hours	Option 2: Raise number of licensed hours to 75th percentile without changing proportion of RNs	Option 3: Raise both proportion of RNs and number of licensed hours to 75th percentile
Number of avoided adverse outcomes			
Failure to rescue (major surgery pool)	354	597	942
Urinary tract infection	40,770	4,174	44,773
Hospital-acquired pneumonia	11,761	1,372	13,093
Upper GI bleeding	4,145	4,129	8,182
Shock or cardiac arrest	2,908	540	3,426
Total avoided outcomes	59,938	10,813	70,416
Hospital days avoided	1,507,493	2,598,339	4,106,315
Cost impacts (in millions)			
Cost savings assuming that 40% of hospital costs are variable			
Cost savings of avoided outcomes	$ 73	$ 17	$ 89
Cost savings of avoided days	980	1,702	2,683
Total avoided costs	1,053	1,719	2,772
Net cost of increasing nursing	-242	5,819	5,716
Net cost as percent of hospital expenses	-0.1%	1.5%	1.4%
Cost savings assuming that fixed hospital costs are recovered (in millions)			
Cost savings of avoided outcomes	$ 183	$ 42	$ 224
Cost savings of avoided days	2,450	4,256	6,707
Total avoided costs	2,633	4,298	6,930
Net cost of increasing nursing	-1,821	3,240	1,558
Net cost as percent of hospital expenses	-0.5%	0.8%	0.4%
Avoided deaths	4,997	1,801	6,754

SOURCE: Authors' estimates using data from J. Needleman et al., "Nurse-Staffing Levels and Quality of Care in Hospitals," *New England Journal of Medicine* 346, no. 22 (2002): 1415–1422, updated to 2002 based on 1997 and 2002 American Hospital Association annual survey data and on wage data for nurses employed in hospitals from the Current Population Survey.

NOTES: Urinary tract infection, hospital-acquired pneumonia, upper gastrointestinal (GI) bleeding, and shock or cardiac arrest and change in length-of-stay were analyzed for medical patients only. Failure to rescue was analyzed for surgical patients only. Cost savings of avoided outcomes and days are initially reduced by 60 percent based on research that only 40 percent of hospital costs are variable in the short run. Over time, fixed costs should be reduced to reflect changed volume. Estimates based on recovery of 40 percent of average costs and all average costs are presented. Net cost of increasing nurse staffing was calculated by subtracting total estimated cost savings due to avoided outcomes and days from cost of increasing nurse staffing reported in Exhibit 3.

Exhibit 7: Table 2 from Martolf, 2014, presenting regression results of cost per admission on nurse staffing and other variables.

TABLE 2. Fixed Effect Model Results for Nurse Staffing, Length of Stay, and Total Cost Measures

	Nurse Staffing Measures	Models 1	Models 2
	% with any nursing-sensitive adverse event		
A	Total no. discharges	11,754,487	11,754,487
A	Total no. licensed nurses (RN+LPN) per 1000 inpatient days	−0.252* (−0.444, −0.059)	—
A	All nursing staff (including aides) per 1000 inpatient days	—	−0.191* (−0.364, 0.019)
A	Percentage of licensed nurses (RN+LPN) that are RNs	0.094 (−0.019, 0.206)	—
A	Percentage of nursing staff (including aides) that are licensed nurses (RN+LPN)	—	−0.007 (−0.036, 0.021)
	Length of stay		
B	Total no. discharges	18,466,880	18,466,880
B	Total no. licensed nurses (RN+LPN) per 1000 inpatient days	−0.033* (−0.059, −0.007)	—
B	All nursing staff (including aides) per 1000 inpatient days	—	−0.031** (−0.051, −0.011)
B	Percentage of licensed nurses (RN+LPN) that are RNs	−0.009 (−0.021, 0.003)	—
B	Percentage of nursing staff (including aides) that are licensed nurses (RN+LPN)	—	−0.001 (−0.004, 0.006)
	Total cost ($)		
C	Total no. discharges	16,971,758	16,971,758
C	Total no. licensed nurses (RN+LPN) per 1000 inpatient days	166.5 (−35.0, 368.1)	—
C	All nursing staff (including aides) per 1000 inpatient days	—	63.1 (−70.5, 196.7)
C	Percentage of licensed nurses (RN+LPN) that are RNs	−87.0* (−153.6, −20.4)	—
C	Percentage of nursing staff (including aides) that are licensed nurses (RN+LPN)	—	41.2 (−25.6, 108.0)

*$0.01 \le P < 0.05$.
**$0.001 \le P < 0.01$.
LPN indicates licensed practical nurses; RN, registered nurses.

Note: This table presents regression results for three outcomes: the percent of patients with any nursing-sensitive adverse event (Block A), length of stay (Block B) and total cost (Block C). Two different models are run. Model 1 measures nurse staffing with only RNs and licensed practical nurses counted. Model 2 measures staffing including nurses' aides. The results are similar and I focus on model 1 and the total cost regression block C. For reference, the average cost per admission in the sample is $11,141.

If one looks at the line in Block C "total no. licensed nurses (RN+LPN) per 1000 patient days," the estimated increase in cost per admission associated with an increase of 1 (the mean is 6.31), a 16% increase in nurse staffing, is $166.50, or 1.5%. But there is a wide range of uncertainty in this estimate, with the 95% confidence interval ranging from a cost reductionof $35.00 to an increase of $368.10. Given this broad confidence interval, the researchers conclude there is no statistically significant increase in the per admission costs. The 1.5% increase in net costs is consistent with the estimates from Needleman 2006 and Dall 2009.

Similarly, if one looks at the line in Block C "Percentage of licensed nurses (RN+LPN) that are RN's", the estimate is that the cost per admission would decrease by $87.00. The 95% confidence interval ranges from savings of $153.60 to $20.40, and the decrease is statistically significant. The researchers conclude there is a statistically significant decrease in costs per admission associated with a richer RN mix.

The other controls in the model, not shown in the regression table, are extensive. They include at the patient level: the patient's sex, age, and the urban-rural classification of the patient's county of residence, primary payer, emergency department admission source, and multiple diagnostic codes. A hospital fixed effect was also included in the regression, accounting for variations in outcomes and costs across hospitals.

References

1. Cipriano PF, Bowles K, Dailey M, Dykes P, Lamb G, Naylor M. The importance of health information technology in care coordination and transitional care. Nursing outlook 2013;61:475-89.

2. Kitson AL, Muntlin Athlin A, Conroy T. Anything but basic: Nursing's challenge in meeting patients' fundamental care needs. J Nurs Scholarsh 2014;46:331-9.

3. Ebright PR, Patterson ES, Chalko BA, Render ML. Understanding the complexity of registered nurse work in acute care settings. J Nurs Adm 2003;33:630-8.

4. Needleman J. Nurse Staffing: The Knowns and Unknowns. Nursing economic$ 2015;33:5-7.

5. Institute of Medicine Committee on the Adequacy of Nursing Staff in H, Nursing H. Washington (DC): National Academies Press (US)

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6. Kane RL, Shamliyan T, Mueller C, Duval S, Wilt TJ. Nurse staffing and quality of patient care. Evidence report/technology assessment 2007:1-115.

7. Kane RL, Shamliyan TA, Mueller C, Duval S, Wilt TJ. The association of registered nurse staffing levels and patient outcomes: systematic review and meta-analysis. Med Care 2007;45:1195-204.

8. 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;383:1824-30.

9. Needleman J, Buerhaus P, Pankratz VS, Leibson CL, Stevens SR, Harris M. Nurse staffing and inpatient hospital mortality. The New England journal of medicine 2011;364:1037-45.

10. Kalisch BJ, McLaughlin M, Dabney BW. Patient perceptions of missed nursing care. Jt Comm J Qual Patient Saf 2012;38:161-7.

11. Kalisch BJ, Williams RA. Development and psychometric testing of a tool to measure missed nursing care. J Nurs Adm 2009;39:211-9.

12. Schubert M, Glass TR, Clarke SP, Schaffert-Witvliet B, De Geest S. Validation of the Basel Extent of Rationing of Nursing Care instrument. Nurs Res 2007;56:416-24.

13. Dabney BW, Kalisch BJ. Nurse Staffing Levels and Patient-Reported Missed Nursing Care. J Nurs Care Qual 2015.

14. Jha AK, Orav EJ, Zheng J, Epstein AM. Patients' Perception of Hospital Care in the United States. New England Journal of Medicine 2008;359:1921-31.

15. Schubert M, Clarke SP, Aiken LH, De Geest S. Associations between rationing of nursing care and inpatient mortality in Swiss hospitals. International Journal for Quality in Health Care 2012;24:220-38.

16. Ball JE, Murrells T, Rafferty AM, Morrow E, Griffiths P. 'Care left undone' during nursing shifts: associations with workload and perceived quality of care. BMJ Qual Saf 2014;23:116-25.

17. Bruyneel L, Li B, Ausserhofer D, et al. Organization of Hospital Nursing, Provision of Nursing Care, and Patient Experiences With Care in Europe. Med Care Res Rev 2015.

18. Kalisch BJ, Tschannen D, Lee KH. Missed Nursing Care, Staffing, and Patient Falls. Journal of Nursing Care Quality 2012;27:6-12.

19. Kalisch BJ, Xie B, Dabney BW. Patient-Reported Missed Nursing Care Correlated With Adverse Events. American Journal of Medical Quality 2014;29:415-22.

20. Needleman J, Buerhaus PI, Stewart M, Zelevinsky K, Mattke S. Nurse staffing in hospitals: is there a business case for quality? Health affairs (Project Hope) 2006;25:204-11.

21. Needleman J. Is what's good for the patient good for the hospital? Aligning incentives and the business case for nursing. Policy, politics & nursing practice 2008;9:80-7.

22. Dall TM, Chen YJ, Seifert RF, Maddox PJ, Hogan PF. The economic value of professional nursing. Med Care 2009;47:97-104.

23. Shamliyan TA, Kane RL, Mueller C, Duval S, Wilt TJ. Cost savings associated with increased RN staffing in acute care hospitals: simulation exercise. Nursing economic$ 2009;27:302-14, 31.

24. Martsolf GR, Auerbach D, Benevent R, et al. Examining the value of inpatient nurse staffing: an assessment of quality and patient care costs. Med Care 2014;52:982-8.